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WILLIAM R. MERRIAM, DIRECTOR

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 209. WASHINGTON, D. C. JUNE 25, 1902.

MANUFACTURES.

FRUITS AND VEGETABLES, FISH, AND OYSTERS, CANNING AND PRESERVING.

Hon. William R. Merriam,
Director of the Census.

Sir: I transmit herewith, for publication in bulletin form, a report on the canning and preserving of fruits and vegetables, fish, and oysters during the census year, prepared under my direction by Mr. Arthur L. Hunt, of the Census Office.

The canning and preserving of fruits and vegetables, fish, and oysters are now for the first time made the subject of a special report by the Census Office, although these industries have been of commercial importance in the United States for nearly half a century. The statistics included in the report were collected, as in previous censuses, upon the schedule for the general statistics of manufactures; but in view of the notable growth of these industries it was decided to supplement the canvass made by the enumerators and local special agents, and to give them more detailed treatment than is given to manufacturing industries in general, or than they have received heretofore.

The report is presented in three parts, pertaining respectively to the canning and preserving of fruits and vegetables, fish, and oysters, the totals being combined in the first table, which is a summary for the three branches of the industry. These industries are closely allied with "food preparations," and with "pickles, preserves, and sauces," and considerable quantities of fruits and vegetables, and fish were canned and preserved by establishments engaged in these latter industries. It was attempted to segregate these quantities of fruits and vegetables and fish so included, but in many cases it was found impossible to do so. Therefore the totals given in this report do not represent the entire quantity of the different varieties canned and preserved during the census year, but they may be fairly inferred from the figures given.

Acknowledgment is due Mr. E. S. Judge, of the "Baltimore Trade;" Mr. F. N. Barrett, of the "American Grocer;" Mr. B. N. Rowley, of the "California Fruit Grower," and Mr. William Fait, president of the William Fait Company, of Baltimore, for valuable assistance and suggestions in the preparation of this report.

The statistics are presented in 34 tables. Tables 1 to 4, inclusive, relate to the combined industries, as follows: Table 1 is a summary of the three industries for 1900; Table 2 shows the value of imports for each year, 1891 to 1900, inclusive; Table 3 shows the value of exports for each year, 1891 to 1900, inclusive; Table 4 shows the per cent of the value of imports and exports to the value of products for 1900.

Tables 5 to 14, inclusive, relate to the canning and preserving of fruits and vegetables, as follows: Table 5 is a comparative summary for the several censuses; Table 6 shows, by states and territories, the number of establishments, 1890 and 1900, and the increase during the decade; Table 7 is a comparative summary of the statistics for the industry by states and territories, 1890 and 1900; Table 8 shows, by states and territories, the establishments classified by the number of wage-earners employed, 1900; Table 9 is a comparative summary of the statistics of capital, 1890 and 1900; Table 10 shows the cost of materials used, 1900; Table 11 shows, by states and territories, the value of products for 1900; Table 12 shows, by states and territories, the quantity and value of fruits and vegetables, canned and preserved, for 1900; Table 13 shows the statistics of cities of over 20,000 population for 1900; Table 14 shows the detailed statistics for the industries for 1900.

Tables 15 to 24, inclusive, relate to the canning and preserving of fish, as follows: Table 15 shows comparative figures for the industry for 1890 and 1900; Table 16 shows, by states and territories, the number of establishments, 1890 and 1900, and the increase during the decade; Table 17 is a comparative summary of the statistics for the industry, by states and territories, 1890 and 1900; Table 18 shows, by states and territories, the number of establishments classified by the number of wage-earners employed, 1900; Table 19 is a comparative summary of the statistics of capital, 1890 and 1900; Table 20 shows the cost of materials used, 1900; Table 21 shows, by states and territories, the value of products for 1900; Table 22 shows, by states and territories, the quantity and value of fish, canned and preserved, for 1900; Table 23 shows the statistics of cities of over 20,000 population for 1900; Table 24 shows the detailed statistics for the industry for 1900.

Tables 25 to 34, inclusive, relate to the canning and preserving of oysters, as follows: Table 25 shows comparative figures for the industry for 1890 and 1900; Table 26 shows, by states and territories, the number of establishments, 1890 and 1900, and the increase during the decade; Table 27 is a comparative summary of the statistics for the industry by states and territories, 1890 and 1900; Table 28 shows, by states and territories, the establishments classified by the number of wage-earners employed, 1900; Table 29 is a comparative summary of the statistics of capital, 1890 and 1900; Table 30 shows the cost of materials used, 1900; Table 31 shows, by states and territories, the value of products for 1900; Table 32 shows, by states and territories, the quantity and value of oysters, canned and preserved, for 1900; Table 33 shows the statistics of cities of over 20,000 population for 1900; Table 34 shows the detailed statistics for the industry for 1900.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

In some instances, the number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations or cooperative establishments.

The reports show a capital of $48,497,978 invested in the canning and preserving of fruits and vegetables, fish, and oysters in the 2,195 establishments reporting for the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations engaged in this industry. The value of the products is returned as $82,592,196, to produce which involved an outlay of $1,975,067 for salaries of officials, clerks, etc.; $12,910,399 for wages; $3,400,743 for miscellaneous expenses, including rent, taxes, etc.; and $53,365,055 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the product is in any sense indicative of the profits in these industries during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the factory. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

Chief Statistician for Manufactures.

FRUITS AND VEGETABLES, FISH, AND OYSTERS, CANNING AND PRESERVING.

By Arthur L. Hunt.

The hermetic sealing of food, usually referred to under the generic title of "canning," is an industry which has grown to be an important factor in the commercial and industrial development of the United States. It has long since passed the experimental stage and has taken its place among the leading industries of the country.

From earliest times man's thoughts have been occupied in devising ways and means to prevent articles of food from deterioration or putrefaction. In their natural state most foods are seasonable only during limited periods of the year, and their consumption is restricted to certain localities. Their preservation in such a manner as to make them palatable during the entire year, in all localities, has been the subject of much research.

Independent experiments by such well-known scientists as Cagnaird de la Tour, Schwann, Helmholtz, Pasteur, Schultz, and others established beyond a doubt that the decomposition of food is due to the presence of a living organism known as "ferment." It was reasoned that anything that would kill this organism or preclude its presence would preserve the article treated. The known processes that will accomplish this result, and at the same time preserve the food, are desiccation, use of antiseptics, refrigeration, and canning. Desiccation, or drying, was undoubtedly the first method used, but food preserved by this means loses much of its natural flavor and becomes tough in texture. The same objections arise in the use of antiseptics. Refrigerated foods, unless great care is exercised in the thawing, are not palatable.

Prior to 1795, drying and the use of salt and sugar were the only methods used to any extent in the preservation of foods. At this time Nicholas Appert, a Frenchman, who had spent most of his life in the preparation and preservation of articles of food, being stimulated in his work by the offer of a reward by the French navy department for a method of preservation of foods for sea service, submitted to his Government an exhaustive treatise bearing upon the hermetic sealing of all kinds of food. His method was to inclose fruit in a glass jar, which was then corked, and subjected to the action of boiling water for a time, varying according to the nature of the article treated. A description of his process can be best summed up in his own words, as follows: "It is obvious that this new method of preserving animal and vegetable substances proceeds from the simple principle of applying heat in a due degree to the several substances after having deprived them as much as possible of all contact with the external air. It might, on the first view of the subject, be thought that a substance, either raw or previously acted upon by fire, and afterwards put into hot bottles, might, if a vacuum were made in those bottles and they were completely corked, be preserved equally well with the application of heat in the water bath. This would be an error, for all trials I have made convince me that the absolute privation of the contact of external air (the internal air being rendered of no effect by the action of heat) and the application of heat by means of the water bath, are both indispensable to the complete preservation of alimentary substances." Time has proved his method to be the most satisfactory for preserving food in its natural state. France purchased his process and gave it to manufacturing firms in France and England for the production of the goods. By this means the industry gradually spread over England, Ireland, and France.

In the year 1810 Peter Durant secured a patent from the English Government for the preservation of fruits, vegetables, and fish in hermetically sealed tin and glass cans. He did not claim to be the discoverer of the process, but said that it had been communicated to him by a "foreigner residing abroad." The secret of the process was jealously guarded, but the employees of the different establishments became more or less familiar with its essentials, and in this manner the industry found its way to America.

One of the first men to come to America with a knowledge of the process gained in its actual use was Ezra Daggett, who arrived in New York some time between the years 1815 and 1818. In the year 1819 he and his son-in-law, Thomas Kensett, were engaged in the manufacture of hermetically sealed goods, the principal foods packed being salmon, lobsters, and oysters. In the following year the industry was launched in Boston by William Underwood and Charles Mitchell, emigrants from England, where they had been employed in canning establishments. Their principal business, however, during the early days of their establishment, was the preparation of pickles, sauces, jellies, jams, and mustard; but they also canned damsons, quinces, cranberries, and currants. The industry also owes much to Allen Taylor, an Englishman, and M. Gallagher, an Irishman, both of whom learned their trade at Sligo, Ireland, the latter having in his possession a copy of Appert's treatise on the subject of canning. These men came to America at about the same time as those mentioned above, and were for a time employed in New York. Prior to 1840 the industry was established in Baltimore, and Kensett, Taylor, and Gallagher did much to place it upon a permanent basis.

Glass jars were gradually abandoned, as it was found that they could not withstand the extremes of temperature and were expensive, bulky, and costly in transportation. In 1825, Thomas Kensett secured a patent on the use of tin cans in preserving food, and in the same year began using the patented process in his factory. Tin has been the favorite material for the construction of cans. Their early manufacture was by hand and very crude, the bodies being cut with shears and the side seam made with a plumb joint (that is, meeting, but not overlapping) and then soldered together. Heads were made to set into the body, and were soldered in place in a very crude manner. The construction of the cans was slow and costly, the making of 100 being considered a good day's work. In 1847 Allen Taylor invented the stamp can, which proved a decided improvement over the plumb-joint can just described, and about two years later Henry Evans, jr., of New Jersey, invented the "pendulum" press for making can tops. The latest important improvement in can manufacture was the invention of the key-opening can, which by the genius of a Mr. Zimmerman has been so reduced in cost that it has come into general use.

Can making is now a distinct industry, and not usually carried on, as formerly, in connection with the actual canning of the foods. It is estimated, however, that about 10 per cent of the cans are still made by the canning establishments. For the past fifteen years labor-saving machines have been introduced in can manufacture until now all the parts are made and put together by mechanical devices. The tin cans are made from Bessemer steel plates cut into sheets 14 by 20 inches and weighing about one pound. They are then subjected to an acid to remove all dirt, grease, scales, etc., and coated with pure tin by the acid process or the palm-oil process, the latter being the safer and better of the two methods. The objection having been urged against the use of tin cans that the natural acids of fruits, vegetables, meats, and fish act upon the tin and solder in such a way as to form metallic salts or metallic compounds that are injurious to the health; the matter was carefully investigated by expert chemists, who reported that the objection is groundless if good tin is used. In the poorer grades of tin injurious substances were found, but in such small quantities that they were of no consequence.

By the Appert process the goods were cooked in open kettles, the highest temperature obtainable by this method being 212° F., or the temperature of boiling water. The process was necessarily slow, but gradually improvements were made in the methods and a higher degree of temperature was obtained by the addition of common salt to the water. This innovation was followed by the use of chloride of calcium, which made possible a temperature of 240° F. The cans, however, under this process become discolored, involving considerable expense in cleaning them to make the goods merchantable. In 1874 Mr. A. K. Shriver, of Baltimore, invented a closed-process kettle to cook the goods by superheating water with steam. About the same time Mr. John Fisher, of the same city, invented a patent-process kettle which secured the same results by the use of dry steam. By these methods, which are used at the present time, any desired temperature can be obtained and the heat regulated to meet requirements.

The canning and preserving of food products is an industry which lies on the border line both between manufacture and agriculture and between manufacture and fishing, and for this reason the several branches of the industry have not always been regarded in census reports as manufacturing. In theory, all industries which expend manufacturing forces upon raw materials, came under the scope of manufacturing. They are distinguished from mining, fishing, and agriculture in that the latter either withdraw raw materials from nature or aid her in their production, but do not themselves make use of raw materials. Therefore, although the preparation of food products from fruits and vegetables and fish was an established industry prior to 1850, no reliable statistics are available previous to 1870. For instance, in the census of 1850, the fishing industry was classed with manufactures and reports were received from 1,407 establishments with products valued at $10,056,163. Fisheries were again reported in 1860, and returns were received from 1,970 establishments, with a product of $14,284,405. Presumably the reports from establishments engaged in fish canning for the two periods were included in these statistics, as there was no separate classification for fish canning and preserving. In the census reports of 1850 and 1860 no mention is made of fruit and vegetable canning, but in the latter year the classification "provisions" appears and returns were secured from 352 establishments reporting the value of products as $31,986,433. It is not known just what was included under this caption, but in all probability it contained the statistics for fruit and vegetable canning, if at that time the industry was considered manufacturing. From 1870 the several branches of the food products were differentiated and separate classifications appear for each branch with the exception of oyster canning and preserving. The statistics for the latter in 1870 were probably included under the head of "fish, cured and packed".

In the earlier stages of the industry the canning of fruits and vegetables, fish, and oysters was not only frequently but generally carried on by the same individual, firm, or corporation, and it was impossible to ascertain the amount of capital invested in each branch or to segregate the labor employed and the cost of materials according to the several classifications. The various branches of the industry are still closely correlated and overlap to a certain extent, many establishments being engaged in the canning of fruits and vegetables during the summer months, and in the canning of fish and oysters during the winter months. For this reason the three branches of the industry have been grouped together and the statistics included in this report are presented under the following heads: Fruits and vegetables, fish, and oysters, canning and preserving, as returned by the establishments engaged in these several industries during the census year ending May 31, 1900.

In the tabulation of the reports the office adopted the rule of classifying establishments as engaged in the canning of fruits and vegetables, of fish, or of oysters in accordance with the predominating product. Thus fruits and vegetables may appear under the products of establishments engaged in the canning and preserving of fish and oysters, or visa versa. Furthermore, some establishments classified under the heads of "food preparations" and "pickles, preserves, and sauces," the statistics for which are not included herein, reported the canning of fruits and vegetables. It has therefore been attempted in subsequent tables to present the total quantities and values of fruits and vegetables, fish, and oysters irrespective of the general classification under which they were reported.

Although the canning industry was established in three great commercial centers in the United States as early as 1825, it did not become of much importance until within the past quarter of a century. The tardy introduction of machinery, the secrecy observed in the method of canning, the skepticism of the public regarding the healthfulness of the articles canned, the general prejudice against canned foods, the cost of production, and the high price of the goods may be given as reasons for the slow growth of this industry. Gradually these obstacles in its progress were overcome, and by 1883 machines were used for practically all operations in canned goods' manufacture, and to-day even the labeling, trimming of labels, and the boxing of goods are done by mechanical devices run by steam or electric power. After the invention of the patent-process kettles, the secret of the process was no longer guarded, and the industry spread over the country with remarkable rapidity, so that at the present time there are canneries in most every fruit and vegetable raising locality in the United States and in states in close proximity to the fish and oyster supply. The several branches of the industry have collectively assumed large proportions.

Table 1 shows the statistics for each of the industries according to the several subdivisions, with the percentages of each to the total.

TABLE 1.—FRUITS AND VEGETABLES, FISH AND OYSTERS, CANNING AND PRESERVING: SUMMARY FOR THE UNITED STATES, 1900.

	Total.	Fruits and vegetables.	Per cent of total.	Fish.	Per cent of total.	Oysters.	Per cent of total.
Number of establishments	2,195	1,808	82.4	348	15.8	39	1.8
Capital	$48,497,978	$27,743,067	57.2	$19,514,215	40.2	$1,240,696	2.6
Land	$3,554,980	$2,702,470	76.0	$757,510	21.3	$95,000	2.7
Buildings	$8,670,574	$4,517,008	52.1	$3,914,853	45.1	$238,713	2.8
Machinery, tools, and implements	$10,113,482	$4,797,719	47.4	$5,164,046	51.1	$151,717	1.5
Cash and sundries	$26,158,942	$15,725,870	60.1	$9,677,806	37.0	$755,266	2.9
Salaried officials, clerks, etc., number	2,478	1,741	70.3	618	24.9	119	4.8
Salaries	$1,975,067	$1,277,028	64.7	$585,160	29.6	$112,879	5.7
Wage-earners, average number	52,590	36,401	69.2	13,410	25.5	2,779	5.3
Total wages	$12,910,447	$8,050,793	62.3	$4,229,638	32.8	$630,016	4.9
Miscellaneous expenses	$3,400,743	$2,423,673	71.3	$883,363	26.0	$93,707	2.7
Cost of materials used	$53,365,055	$37,524,297	70.3	$13,232,001	24.8	$2,608,757	4.9
Value of products	$82,592,196	$56,668,313	68.6	$22,253,749	26.9	$3,670,134	4.5

The totals for the three industries show 2,195 establishments with a capital of $48,497,978; 52,581 wage-earners; $12,910,399 paid for wages; $53,365,055 for materials; and products valued at $82,592,196.

As indicated by Table 1, the canning and preserving of fruits and vegetables is by far the largest of the three branches of the industry. There were 1,808 establishments, or 82.4 per cent of the total number, reporting nearly 60 per cent of the total capital, nearly 70 per cent of the total wage-earners, over 60 per cent of the total wages, and nearly 70 per cent of the total value of the products. The canning and preserving of fish ranked second and reported over 15 per cent of the total number of establishments, 40.2 per cent of the total capital, 25.5 per cent of the total wage-earners, nearly 33 per cent of the total wages, and over 25 per cent of the value of products. The canning and preserving of oysters is a small industry in comparison with the other two branches of the industry. Most of the items enumerated for this branch in Table 1 formed less than 5 per cent of the total for the combined industry.

In this connection it is interesting to note the imports and exports of fruits and vegetables and fish during the past decade. Table 2 shows the imports of fish and fruits and vegetables, canned or preserved, for each year from 1891 to 1900, inclusive, and Table 3 shows the exports for the same period as reported by the Bureau of Statistics, Treasury Department. Although their classifications are not strictly comparable with those adopted by the Census Office, the figures may nevertheless be studied to advantage in their relation to the statistics given in the other tables of this report.

Table 2.—IMPORTS OF FISH, FRUITS, AND VEGETABLES, CANNED OR PRESERVED, FOR EACH YEAR, 1891 TO 1900, INCLUSIVE.

ARTICLES.	1900	1899	1898	1897	1896	1896	1894	1893	1892	1891
Total	$8,023,763	$6,546,682	$6,121,294	$6,010,447	$6,217,626	$5,348,145	$5,666,216	$6,719,269	$6,854,557	$7,570,468
Fish, total	5,771,863	4,619,714	4,455,624	4,352,329	4,566,524	3,638,256	4,293,010	4,761,189	4,443,629	5,101,649
Lobsters, canned or uncanned[1]	931,219	730,460	699,577	791,602	788,638	241,778	549,049	589,109	604,052	966,782
Cured or preserved:										
Anchovies and sardines packed in oil or otherwise	1,483,768	1,152,981	1,110,674	902,742	970,347	767,857	976,952	1,366,966	1,201,149	1,089,975
Cod, haddock, hake, and pollock, smoked, salted, or pickled	543,172	425,414	525,968	451,654	467,059	499,245	509,395	553,113	449,567	527,113
Herring—										
Dried or smoked	127,555	87,279	107,840	88,085	74,460	58,597	77,079	66,485	66,456	101,493
Pickled or salted	1,355,013	1,077,138	1,053,050	886,647	1,138,693	1,030,669	962,311	1,164,942	1,178,514	922,099
Mackerel, pickled or salted	1,276,900	1,105,027	992,822	1,164,424	1,063,476	995,231	1,133,509	967,352	883,473	1,413,875
Salmon, pickled or salted	54,236	41,415	65,693	67,175	63,851	44,879	84,716	63,222	60,418	80,312
Fruits, total	[1] 1,243,479	1,020,644	922,357	605,053	598,928	570,568	526,561	864,166	1,234,828	1,289,137
Prepared or preserved	1,243,479	1,020,644	922,357	605,053	598,928	570,568	526,561	864,166	1,234,828	1,289,137
Vegetables, total	1,008,421	906,324	743,313	1,053,065	1,052,174	1,139,321	846,645	1,093,904	1,176,100	1,179,682
Pickles and sauces	306,223	352,022	243,354	332,243	324,377	321,632	341,135	454,099	421,292	511,163
Prepared or preserved	702,198	554,302	499,969	720,822	727,797	817,689	505,510	639,805	754,808	668,519

[1] Includes values of uncanned lobster. Impossible to separate.

Table 3.—EXPORTS OF FISH, FRUITS, AND VEGETABLES, CANNED OR PRESERVED, FOR EACH YEAR, 1891 TO 1900, INCLUSIVE.

ARTICLES.	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891
Total	$10,557,857	$8,501,453	$7,898,188	$8,091,629	$7,530,999	$5,343,532	$3,786,271	$5,822,891	$6,707,826	$5,267,497
Fish, total	4,019,460	3,913,507	3,557,022	4,369,089	4,153,547	3,313,901	2,300,174	3,587,314	3,113,287	3,593,522
Dried, smoked, or cured:										
Cod, haddock, hake, and pollock	404,212	370,150	300,953	396,422	448,286	514,370	704,652	728,475	765,199	890,277
Herring	82,407	66,032	74,844	105,770	96,462	97,719	123,882	93,412	82,772	105,260
All other	56,684	40,308	48,442	38,571	37,654	61,082	50,966	88,258	85,353	80,844
Pickled:										
Mackerel	14,352	12,771	14,830	28,990	16,692	35,725	43,082	33,480	47,108	37,128
All other	99,627	61,660	76,403	84,978	104,374	108,178	149,316	147,932	169,643	159,671
Salmon:										
Canned	2,693,648	2,906,475	2,564,017	3,215,798	3,084,889	2,266,727	1,026,215	2,279,625	1,738,465	2,096,957
All other, fresh or cured[1]	535,276	331,601	332,023	284,891	167,991	88,789	58,659	49,230	78,680	83,993
Canned fish, other than salmon or shellfish	133,244	124,520	146,510	213,669	198,199	141,311	143,402	166,902	146,067	139,392
Fruits, total	5,438,577	3,643,347	3,604,970	3,070,158	2,787,141	1,380,099	1,039,992	1,844,126	3,061,660	1,207,481
Apples, dried	2,247,851	1,245,733	1,897,725	1,340,159	1,340,507	461,214	168,054	482,085	1,288,102	409,605
Fruits, preserved:										
Canned	3,127,278	2,330,715	1,624,741	1,686,723	1,376,281	871,465	660,723	1,137,660	1,558,820	703,880
All other	63,448	66,899	82,504	43,276	70,353	47,420	211,215	224,381	214,738	93,996
Vegetables, total	1,099,830	944,599	736,196	652,382	590,311	649,532	446,106	391,451	532,879	466,494
Canned	603,288	555,691	386,039	408,840	407,506	441,388	255,857	242,284	373,068	286,321
All other, including pickles and sauces[2]	496,542	388,908	350,157	243,542	182,805	208,144	190,248	149,167	159,811	180,173

[1] Includes small amounts of fresh fish.
[2] Includes fresh vegetables other than heaus, pease, onions, and potatoes. Impossible to separate values of pickles, etc., from other vegetables.

Table 2 indicates that the imports of fish and fruits and vegetables have slightly increased during the decade. From 1891 to 1895, inclusive, there was a steady decrease each year, but from 1895 to 1900, inclusive, with the exception of 1896 and 1897, there has been a substantial increase. This is evidently due to the increase in the imports of fish, especially sardines and pickled or salted herring, as there has been a decrease in the total imports of both fruits and vegetables. It appears that the exports have fluctuated considerably during the decade, but on the whole there has been an increase of over 100 per cent since 1890. The total exports of fish show a gain for the decade of 11.9 per cent, but the gain is solely due to the marked increase in the exports of salmon, whereas the exports in all other fish have decreased. The greatest growth and development in exports has been in the direction of fruits and vegetables, the exports in the former having increased from $1,207,481 to $5,438,577, an absolute increase of $4,231,096, or 350.4 per cent. There has been a most marked increase in the exports of dried apples, and also of canned fruits. The exports of vegetables increased from $466,494 to $1,099,830, an increase of $633,336, or 135.8 per cent. Thus the principal points brought out by Tables 2 and 3 are the following: The total exports for 1900 were $10,557,857, or 31.6 per cent larger than the imports; the imports of fish have increased faster than the exports; the imports of fruits and vegetables since 1891 have decreased 3.5 and 14.5 per cent, respectively, while the exports of fruits and vegetables have shown most marked increases.

As stated above, the difference between the classifications used by the Treasury Department and those adopted by the Census Office precludes accurate comparisons, but in a general way the figures are comparable. The value of products, the exports and imports of fruits and vegetables and fish, with the per cent of exports and imports to the value of the domestic product of each, are shown in Table 4.

TABLE 4.—FRUITS AND VEGETABLES AND FISH, CANNING AND PRESERVING: VALUE OF PRODUCTS IMPORTS AND EXPORTS, AND PER CENT OF IMPORTS AND EXPORTS TO PRODUCTS, 1900.

FRUITS AND VEGETABLES.					FISH.				
Value of products.	Value of imports.	Per cent of imports to products.	Value of exports.	Per cent of exports to products.	Value of products.	Value of imports.	Per cent of imports to products.	Value of exports.	Per cent of exports to products.
$56,668,313	$2,251,900	4.0	$6,538,407	11.5	$22,253,749	$5,771,863	26.9	$4,019,460	18.0

Table 4 indicates that the value of imports of fruits and vegetables was but 4 per cent of the value of those canned and preserved in the country, while the value of exports was 11.5 per cent of the total value of the domestic product. The value of imports of fish formed 25.9 per cent of the total value of domestic fish products, and the value of exports formed 18 per cent. The comparatively insignificant percentage of exports of each shows the extent of the home consumption of these varieties of canned goods.

FRUITS AND VEGETABLES, CANNING AND PRESERVING.

Table 5 is a comparative summary of the statistics for the establishments engaged in the canning and preserving of fruits and vegetables as returned at the censuses of 1870 to 1900, inclusive, with the percentages of increase for each decade.

TABLE 5.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: COMPARATIVE SUMMARY, 1870 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.				PER CENT OF INCREASE.		
	1900	1890	1880	1870	1890 to 1900	1880 to 1890	1870 to 1880
Number of establishments	1,808	886	411	97	104.1	115.6	323.7
Capital	$27,743,067	$15,315,185	$8,247,488	$2,335,925	81.1	85.7	263.1
Salaried officials, clerks, etc., number	1,741	[1] 1,119	(2)	(2)	55.6	....	....
Salaries	$1,277,028	[1] $592,390	(2)	(2)	115.6	....	....
Wage-earners, average number	36,401	49,762	31,905	5,869	[3] 26.8	56.0	443.6
Wages	$8,050,793	$4,651,317	$2,679,960	$771,643	73.1	73.6	247.3
Men, 16 years and over	13,542	18,469	10,638	1,658	[3] 27.4	75.3	541.6
Wages	$4,122,104	$2,488,328	(2)	(2)	65.7	....	....
Women, 16 years and over	19,699	25,714	15,463	3,434	[3] 23.4	66.3	350.3
Wages	$3,600,243	$2,000,848	(2)	(2)	79.9	....	....
Children, under 16 years	3,160	5,579	5,804	777	[3] 43.4	[3] 3.9	647
Wages	$328,446	$162,141	(2)	(2)	102.6	....	....
Miscellaneous expenses	$2,423,673	$1,289,681	(4)	(4)	87.9	....	....
Cost of materials used	$37,527,297	$18,665,163	$12,051,293	$3,094,846	101.1	54.9	289.4
Value of products	$56,668,313	$29,862,416	$17,599,576	$5,425,677	89.8	69.7	224.4

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 14.)
[2] Not reported separately.
[3] Decrease.
[4] Not reported.

The canning and preserving of fruits and vegetables had its inception in this country prior to 1850, but the census of 1870 was the first which contained the statistics of the industry. At that time the number of establishments engaged primarily in this industry was 97, and the capital $2,335,925. They reported 5,869 wage-earners, $771,643 for wages, $3,094,846 for materials, and $5,425,677 as the value of products. The development in this industry during the past thirty years has been most marked, especially during the past decade. The number of establishments from 1890 to 1900 increased 922; the capital, $12,427,882; and the value of products, $26,805,897. Notwithstanding these increases, the average capital per establishment has decreased from $24,082 to $15,345, a decrease of $8,737, or 36.3 per cent. This is presumably accounted for by the great number of establishments employing small capital which have become engaged in the industry since 1870. Nevertheless there were in 1900 several establishments employing more capital than the combined capital of the 97 establishments reporting for 1870. The average value of product per establishment has also shown a decrease from $55,935 to $31,343; that is, the average value of product in 1900 was only slightly over one-half that reported for 1870. This decrease is primarily due to the great decrease in the cost of production brought about by the introduction of machinery in every detail of the business, both in the making of cans and in the preparation of the product. From 1890 to 1900 every item, with the exception of wage-earners, has shown a substantial increase. The decrease in the average number of wage-earners was 26.8 per cent. This is only apparent, however, the decrease being due to the difference in the methods employed at the two censuses. The method adopted in the present census gives the average number for the entire year, 12 (the number of calendar months) being used as a divisor to obtain the sum of the average numbers reported for each month. In 1890 the average number was computed for the actual time that the establishments were reported as being in operation. The greatest number employed at any one time during the last census year was 133,106. This number was undoubtedly much larger than at any one time in 1890.

A careful investigation of the schedules for various states discloses the fact that establishments engaged in the canning and preserving of fruits and vegetables employ a large number of wage-earners during four months of the year, and that during the remaining months they employ a relatively small number of operatives, usually before the opening of the canning season, in making cans, and later, after the season, in labeling, packing, and preparing the product for market.

The length of the "canning season" varies considerably in the several states, owing to climatic influences and the character of the goods canned. In the Northern states, for instance, the season is much shorter than in states with a milder climate, where a greater variety of fruits and vegetables are grown for the market.

In the United States as a whole, the four months which constituted the "busy season" were July, August, September, and October. If this be regarded as the industrial year and if the computation be made according to the method used in 1890, the total average number of wage-earners in 1900 was 81,659. The total average number of wage-earners (men, women, and children) for each month during 1900 is given in the following statement:

AVERAGE NUMBER OF WAGE-EARNERS FOR EACH MONTH: 1900.

July	45,577	November	27,718	March	7,321
August	97,372	December	11,039	April	8,620
September	116,550	January	6,205	May	13,246
October	67,143	February	5,643	June	30,430

Thus it will be seen that the number of wage-earners has in reality shown an increase commensurate with the increase in the other items, and the apparent decrease is due solely to the difference in the methods of computation employed at the two censuses.

From 1890 to 1900 the wages increased from $4,651,317 to $8,050,793, an increase of $3,399,476, or 73.1 per cent. This is in accord with the gradual increase in the rate of wages paid employees in this industry. Increased competition has compelled the various factories to adopt modern machinery, necessitating the employment of a higher class of labor. In the infancy of the industry all work was done by hand, and the female labor employed was of the cheapest possible character. The introduction of machinery, however, has resulted in an increase in the number of men employed and a corresponding decrease in the number of women. This has inured to the benefit of the wage-earner by making employment for men at an increased rate of wages, and the females employed are not obliged to do the burdensome work formerly required of them. During the past decade the wages paid children increased from $162,141 to $328,446, an increase of $166,305, or 102.6 per cent. This striking increase is primarily due to the fact that children under 12 years of age are no longer employed, and accordingly the children over this age are able to command higher wages than the younger children formerly employed. Further, the wage rate per day has also materially increased owing to competition for labor of this character.

From 1890 to 1900 the cost of materials increased from $18,665,163 to $37,524,297, an increase of $18,859,134, or 101.1 per cent. As fully 65 per cent of the cost of materials used is for farm products, it demonstrates what a vast advantage this industry is to the farming interests of this country, in that it stimulates the culture of every variety of fruits and vegetables.

The individual form of organization predominates in this industry. Of the total number of establishments, 919, or 50.8 per cent, were conducted by individuals. Of the remaining number, 505, or 27.9 per cent, were operated by firms or limited partnerships; 365, or 20.2 per cent, by incorporated companies; and the remaining 19, or 1.1 per cent, were cooperative or miscellaneous in character.

Table 6 shows, by states and territories arranged geographically, the number of establishments from which returns were received in 1900, with the increase during the decade.

TABLE 6.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: COMPARATIVE SUMMARY, NUMBER OF ACTIVE ESTABLISHMENTS, 1890 AND 1900, AND THE INCREASE DURING THE DECADE, BY STATES AND TERRITORIES ARRANGED GEOGRAPHICALLY.

	1900	1890	Increase.
United States	1,808	886	922
New England states	80	62	18
Maine	59	44	15
New Hampshire	3	6	[1] 3
Vermont	3		3
Massachusetts	9	10	[1] 1
Rhode Island	1	1	
Connecticut	5	1	4
Middle states	945	445	500
New York	511	159	352
New Jersey	73	34	39
Pennsylvania	39	27	12
Delaware	51	28	23
Maryland	271	197	74
Southern states	204	95	109
West Virginia	9	3	6
Virginia	88	54	34
North Carolina	19	5	14
South Carolina	12	2	10
Georgia	8	4	4
Florida	2		2
Kentucky	8	2	6
Tennessee	11	4	7
Alabama	3		3
Mississippi		2	[1] 2
Arkansas	34	8	26
Louisiana		1	[1] 1
Texas	10	10	
Central states	380	196	184
Ohio	70	38	32
Michigan	98	90	8
Indiana	60	11	49
Illinois	61	23	38
Wisconsin	16	1	15
Minnesota	4	3	1
Iowa	26	17	9
Missouri	45	13	32
Western states	28	25	3
Idaho	2		2
South Dakota		1	[1] 1
Nebraska	5	7	[1] 2
Utah	8	2	6
Colorado	7	3	4
Kansas	5	12	[1] 7
New Mexico	1		1
Pacific states	171	63	108
Washington	18		18
Oregon	17	2	15
California	136	61	75

[1] Decrease.

TABLE 6.—FRUITS AND VEGETABLES, CANNING AND PRESERVING, COMPARATIVE SUMMARY: NUMBER OF ACTIVE ESTABLISHMENTS, 1890 AND 1900, ETC.—Cont'd.

The remarkable increase in the number of establishments from 1890 to 1900 in nearly every state, with the exceptions hereafter noted, shows that the industry is not localized and controlled by a few large establishments, but is well distributed throughout the country.

Table 6 shows that, in general, the states showing the large increases in the number of establishments were those which produce the different varieties of fruits and vegetables in large quantities. It appears that the greatest increase occurred in the Middle states, which group reported 445 establishments in 1890 and 945 in 1900, an increase of 500, or 112.4 per cent. The Central states followed, with an increase of 184, or 93.9 per cent; the Southern states reported an increase of 109, or 114.7 per cent; and the Pacific states followed, with an increase of 108, or 171.4 per cent. There was an increase of but 3 establishments in the Western states.

The greatest absolute increase was shown in New York, which reported an increase of 352. California followed with an increase of 75 and Maryland came third with an increase of 74. The leading 10 states, with the number of establishments reported for 1900, were as follows: New York, 511; Maryland, 271; California, 136; Michigan, 98; Virginia, 88; New Jersey, 73; Ohio, 70; Illinois, 61; Indiana, 60; Maine, 59.

The above table should be considered in connection with Table 7, which is a summary of the totals for the canning and preserving of fruits and vegetables as returned at the censuses of 1890 and 1900.

TABLE 7.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: COMPARATIVE SUMMARY, BY STATES AND TERRITORIES, 1890 AND 1900.

	Year.	United States.	Alabama.	Arkansas.	California.	Colorado.	Connecticut.	Delaware.	Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.
Number of establishments	1900	1,808	3	34	136	7	5	51	8	61	60	26	5	8
	1890	886	(1)	8	61	3	(2)	28	4	23	11	17	12	(2)
Capital: Total	1900	$27,743,067	$7,585	$33,038	$4,397,935	$277,325	$91,463	$966,660	$24,801	$1,551,977	$1,205,494	$1,027,321	$30,300	$95,600
	1890	$15,315,185	(1)	$63,530	$2,622,890	$158,000	(2)	$391,038	$29,217	$638,871	$419,253	$445,258	$261,433	(2)
Land	1900	$2,702,470	$4,110	$2,580	$1,132,110	$28,500	$2,450	$31,080	$1,851	$72,077	$104,151	$37,900	$4,200	$6,000
	1890	$1,338,584	(1)	$5,345	$255,285	$55,000	(2)	$16,400	$1,750	$20,075	$22,066	$24,975	$13,140	(2)
Buildings	1900	$4,517,008	$1,125	$13,123	$728,891	$79,500	$21,232	$148,338	$5,700	$221,647	$284,009	$190,900	$10,702	$18,150
	1890	$2,387,232	(1)	$16,110	$278,768	$16,500	(2)	$51,650	$1,200	$80,931	$80,600	$129,230	$44,117	(2)
Machinery, tools, and implements.	1900	$4,797,719	$850	$7,835	$554,086	$62,700	$29,496	$141,164	$5,500	$369,810	$225,005	$311,869	$8,766	$34,400
	1890	$2,480,027	(1)	$23,400	$292,556	$17,500	(2)	$73,466	$8,250	$110,870	$65,700	$133,409	$39,667	(2)
Cash and sundries	1900	$15,725,870	$1,500	$9,500	$1,982,848	$106,625	$38,285	$646,078	$11,750	$888,443	$592,329	$486,652	$6,632	$37,050
	1890	$9,109,342	(1)	$18,675	$1,796,281	$69,000	(2)	$249,522	$18,017	$426,995	$250,887	$157,644	$164,509	(2)

[1] None reported in 1890.

[2] Reported under head of other States in 1890.

TABLE 7.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: COMPARATIVE SUMMARY BY STATES AND TERRITORIES, 1890 AND 1900—Continued.

	Year.	United States.	Alabama.	Arkansas.	California.	Colorado.	Connecticut.	Delaware.	Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.
Salaried officials, clerks, etc.: Number	1900	1,741	1	2	259	18	7	29	4	99	165	46	11	12
	1890	[1]1,119	(2)	7	122	11	(3)	35	3	24	31	55	18	(3)
Salaries	1900	$1,277,028	$300	$350	$242,388	$23,700	$3,260	$14,278	$3,650	$101,515	$112,174	$27,305	$3,254	$5,840
	1890	[5]$592,390	(2)	$1,730	$81,058	$14,800	(3)	$13,482	$1,737	$14,497	$10,765	$7,573	$8,700	(3)
Wage-earners, average number.	1900	36,401	16	136	7,486	206	100	1,437	81	1,444	2,002	699	116	231
	1890	49,762	(2)	320	5,670	99	(3)	2,463	49	2,182	1,989	1,581	1,153	(3)
Total wages	1900	$8,050,793	$2,380	$21,942	$1,987,649	$62,661	$24,967	$226,149	$10,545	$392,636	$386,457	$184,710	$17,148	$36,903
	1890	$4,651,317	(2)	$23,904	$756,797	$45,930	(3)	$192,476	$4,088	$135,967	$170,933	$83,924	$60,828	(3)
Men, 16 years and over	1900	13,542	9	50	1,819	66	35	527	26	815	824	321	51	89
	1890	18,469	(2)	91	2,131	41	(3)	600	18	826	453	356	194	(3)
Wages	1900	$4,122,104	$1,760	$10,079	$702,428	$37,855	$12,203	$113,751	$5,260	$278,626	$219,239	$114,630	$10,124	$19,248
	1890	$2,488,328	(2)	$10,033	$377,165	$30,562	(3)	$89,510	$2,402	$80,781	$83,247	$41,609	$31,560	(3)
Women, 16 years and over.	1900	19,699	4	72	5,252	116	64	750	38	582	1,068	266	51	105
	1890	25,714	(2)	150	3,156	50	(3)	1,416	28	883	1,327	986	609	(3)
Wages	1900	$3,600,243	$400	$10,495	$1,233,861	$19,456	$12,614	$100,119	$4,410	$108,182	$156,473	$54,575	$5,564	$14,094
	1890	$2,000,848	(2)	$10,979	$357,199	$14,120	(3)	$83,201	$1,614	$40,972	$78,531	$35,076	$23,560	(3)
Children, under 16 years.	1900	3,160	3	14	415	24	1	160	17	47	110	112	14	37
	1890	5,579	(2)	79	383	8	(3)	447	3	474	209	239	350	(3)
Wages	1900	$328,446	$220	$1,368	$51,360	$5,250	$150	$12,279	$875	$5,828	$10,745	$15,505	$1,460	$3,561
	1890	$162,141	(2)	$2,892	$22,433	$1,248	(3)	$19,765	$72	$14,214	$9,155	$7,239	$5,708	(3)
Miscellaneous expenses	1900	$2,423,673	$135	$952	$412,737	$14,598	$1,985	$27,169	$4,262	$295,558	$165,755	$63,185	$11,722	$10,100
	1890	$1,289,681	(2)	$7,946	$351,334	$7,467	(3)	$26,519	$1,417	$60,005	$29,811	$51,943	$17,614	(3)
Cost of materials used	1900	$37,524,297	$3,418	$50,954	$9,102,400	$223,454	$81,887	$1,083,142	$67,192	$2,447,194	$1,526,088	$767,231	$68,465	$75,346
	1890	$18,665,163	(2)	$54,465	$3,888,323	$90,420	(3)	$432,317	$12,460	$768,556	$581,015	$294,817	$147,801	(3)
Value of products	1900	$56,668,313	$7,947	$100,503	$13,081,829	$343,394	$124,280	$1,570,790	$120,022	$3,730,030	$2,589,908	$1,359,958	$113,675	$192,787
	1890	$29,862,416	(2)	$93,101	$6,211,440	$207,424	(3)	$740,090	$28,770	$1,106,181	$885,145	$521,711	$292,505	(3)

	Year.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Missouri.	Nebraska.	New Hampshire.	New Jersey.	New York.	North Carolina.	Ohio.
Number of establishments	1900	59	271	9	98	4	45	5	3	73	511	19	70
	1890	44	197	10	90	3	13	7	6	34	169	5	38
Capital: Total	1900	$865,825	$4,459,660	$48,375	$898,668	$43,650	$345,360	$123,623	$21,642	$1,429,221	$6,649,059	$30,340	$910,670
	1890	$1,014,980	$2,739,008	$182,924	$420,265	$28,350	$419,130	$211,347	$18,690	$957,683	$2,211,715	$5,940	$505,654
Land	1900	$42,845	$378,143	$625	$91,603	$1,800	$22,117	$6,800	$150	$111,805	$355,910	$3,035	$65,490
	1890	$7,226	$376,675	$2,500	$42,852	$2,750	$4,875	$19,100	$690	$106,675	$223,211	$200	$33,505
Buildings	1900	$132,493	$430,586	$900	$204,315	$10,000	$71,255	$35,000	$1,600	$334,279	$1,025,624	$4,575	$150,973
	1890	$61,210	$381,900	$13,150	$109,506	$5,100	$16,550	$50,927	$3,960	$204,750	$588,262	$905	$110,100
Machinery, tools, and implements.	1900	$230,928	$633,234	$19,900	$146,649	$11,300	$128,736	$41,325	$9,542	$250,618	$906,809	$7,480	$200,057
	1890	$198,514	$360,311	$36,008	$103,863	$7,700	$95,600	$53,303	$6,800	$131,279	$391,163	$1,150	$83,075
Cash and sundries	1900	$459,559	$3,017,697	$26,950	$456,101	$20,550	$123,252	$40,498	$10,350	$732,519	$4,360,716	$15,250	$494,150
	1890	$748,031	$1,620,122	$131,266	$164,044	$12,800	$303,105	$88,017	$7,140	$514,879	$1,009,079	$3,686	$278,974
Salaried officials, clerks, etc.: Number.	1900	102	231	9	70	2	74	9	1	63	261	2	103
	1890	46	165	17	83	....	35	4	3	57	161	2	60
Salaries	1900	$50,854	$213,080	$7,600	$45,279	$1,600	$23,007	$6,400	$600	$33,830	$201,025	$300	$58,975
	1890	$19,538	$124,878	$15,170	$14,424	....	$33,291	$542	$305	$36,886	$82,380	$110	$26,271
Wage-earners, average number.	1900	904	7,505	139	1,165	45	650	161	19	1,992	5,518	78	1,608
	1890	2,087	13,048	286	1,831	111	610	600	68	3,608	5,936	87	2,177
Total wages	1900	$203,509	$1,379,131	$39,945	$240,102	$8,523	$116,467	$21,686	$5,957	$422,092	$1,462,820	$10,736	$305,398
	1890	$196,082	$1,416,386	$50,032	$114,544	$2,700	$102,798	$37,850	$4,695	$262,723	$516,643	$1,392	$176,516
Men, 16 years and over	1900	487	2,980	57	378	17	170	81	11	818	2,292	29	681
	1890	1,484	4,629	140	724	16	237	299	47	1,326	2,463	15	1,011
Wages	1900	$144,508	$744,516	$21,660	$121,412	$6,670	$49,803	$13,200	$4,700	$232,316	$811,564	$6,506	$158,919
	1890	$169,650	$634,986	$32,920	$64,625	$10,000	$76,250	$27,076	$3,655	$156,938	$307,502	$535	$91,191
Women, 16 years and over	1900	316	3,712	79	565	26	377	50	8	1,088	3,007	41	841
	1890	422	7,141	143	1,053	20	217	181	21	2,189	3,178	49	938
Wages	1900	$49,385	$559,310	$17,760	$95,054	$10,590	$56,883	$6,000	$1,257	$180,952	$623,168	$3,805	$123,826
	1890	$22,581	$762,980	$16,835	$48,018	$700	$21,559	$8,714	$1,040	$108,223	$201,066	$619	$76,219
Children, under 16 years.	1900	101	813	3	222	2	103	30	....	86	219	8	186
	1890	181	1,278	3	54	75	166	120	....	93	295	23	228
Wages	1900	$9,616	$75,305	$525	$23,636	$263	$9,781	$2,486	....	$8,824	$28,088	$425	$22,648
	1890	$3,851	$28,420	$277	$1,901	$1,000	$4,989	$2,060	....	$2,562	$8,075	$238	$9,106
Miscellaneous expenses	1900	$43,119	$371,108	$7,392	$123,514	$1,452	$23,399	$10,325	$270	$83,418	$495,478	$414	$73,781
	1890	$43,067	$151,496	$28,106	$35,884	$4,182	$79,721	$13,960	$972	$83,798	$143,241	$155	$36,771
Cost of materials	1900	$762,102	$8,786,518	$384,600	$1,154,698	$17,929	$559,651	$130,573	$21,111	$1,401,101	$5,592,462	$44,494	$1,197,269
	1890	$700,719	$4,416,352	$245,130	$304,464	$24,650	$1,107,691	$120,720	$6,709	$1,159,340	$1,747,798	$2,997	$506,809
Value of products	1900	$1,335,671	$11,996,245	$531,545	$1,760,875	$49,200	$869,977	$210,688	$29,964	$2,199,176	$8,975,321	$64,440	$1,941,398
	1890	$1,192,682	$7,196,109	$412,005	$591,546	$38,375	$1,480,469	$201,549	$17,165	$1,843,675	$2,918,671	$5,506	$928,213

1 Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 14.)

2 None reported in 1890.

3 Reported under head of other states in 1890.

TABLE 7.—FRUITS AND VEGETABLES. CANNING AND PRESERVING: COMPARATIVE SUMMARY BY STATES AND TERRITORIES, 1890 AND 1900—Continued.

	Year.	Oregon.	Pennsylvania.	South Carolina.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin	All other states.
Number of establishments	1900	17	39	12	11	10	8	3	88	18	9	16	[1] 6
	1890	(2)	27	(2)	4	10	(2)	(3)	54	(3)	3	(2)	[4] 15
Capital: Total	1900	$121,855	$520,206	$23,862	$35,824	$53,852	$304,258	$68,528	$218,533	$78,627	$95,260	$650,115	$37,055
	1890	(2)	$736,604	(2)	$16,910	$85,347	(2)	(3)	$416,476	(3)	$16,511	(2)	$298,361
Land	1900	$16,030	$38,216	$1,525	$880	$1,575	$33,645	....	$22,500	$1,394	$11,670	$58,103	$9,600
	1890	(2)	$35,465	(2)	$200	$9,890	(2)	(3)	$26,785	(3)	$250	(2)	$31,700
Buildings	1900	$29,945	$77,355	$2,075	$5,880	$14,310	$66,173	$13,500	$32,260	$11,000	$22,390	$112,453	$4,760
	1890	(2)	$30,676	(2)	$600	$19,880	(2)	(3)	$47,150	(3)	$2,000	(2)	$42,500
Machinery, tools, and implements.	1900	$26,650	$101,658	$6,718	$9,825	$23,100	$57,707	$20,316	$47,790	$10,177	$28,230	$120,634	$6,855
	1890	(2)	$83,670	(2)	$7,100	$30,100	(2)	(3)	$60,550	(3)	$2,961	(2)	$62,062
Cash and sundries	1900	$48,730	$302,977	$13,544	$19,239	$14,867	$146,733	$34,712	$115,983	$56,056	$32,970	$358,925	$15,850
	1890	(2)	$586,793	(2)	$9,010	$25,477	(2)	(3)	$281,991	(3)	$11,300	(2)	$162,099
Salaried officials, clerks, etc.: Number.	1900	9	35	6	16	5	20	4	25	4	4	42	1
	1890	(2)	88	(2)	4	12	(2)	(3)	59	(3)	1	(2)	16
Salaries	1900	$10,350	$25,309	$1,030	$2,043	$3,430	$8,068	$4,100	$3,477	$4,260	$1,475	$32,732	$200
	1890	(2)	$56,453	(2)	$1,257	$2,215	(2)	(3)	$17,561	(3)	$500	(2)	$6,267
Wage-earners, average number.	1900	129	468	64	116	111	141	111	637	44	128	676	38
	1890	(2)	830	(2)	111	703	(2)	(3)	1,470	(3)	57	(2)	636
Total wages	1900	$18,070	$123,179	$7,410	$15,216	$26,828	$37,565	$21,762	$77,576	$12,484	$13,108	$117,090	$10,097
	1890	(2)	$88,446	(2)	$3,283	$32,660	(2)	(3)	$89,516	(3)	$4,621	(2)	$76,583
Men, 16 years and over	1900	32	211	15	24	22	62	64	196	15	55	303	10
	1890	(2)	326	(2)	26	248	(2)	(3)	512	(3)	18	(2)	239
Wages	1900	$8,995	$81,346	$2,625	$4,992	$9,157	$26,037	$15,140	$33,915	$5,839	$7,858	$80,160	$5,064
	1890	(2)	$69,275	(2)	$1,850	$16,324	(2)	(3)	$42,488	(3)	$3,145	(2)	$42,049
Women, 16 years and over	1900	60	206	27	56	63	73	45	312	24	59	271	25
	1890	(2)	243	(2)	55	249	(2)	(3)	640	(3)	22	(2)	348
Wages	1900	$6,075	$35,833	$2,835	$6,539	$14,832	$10,172	$6,362	$33,577	$5,675	$4,220	$30,235	$4,655
	1890	(2)	$15,813	(2)	$1,155	$10,714	(2)	(3)	$41,342	(3)	$1,109	(2)	$31,909
Children, under 16 years.	1900	37	51	22	36	26	6	2	129	5	14	102	3
	1890	(2)	261	(2)	30	206	(2)	(3)	318	(3)	17	(2)	49
Wages	1900	$3,000	$6,001	$1,950	$3,685	$2,839	$1,356	$260	$10,084	$970	$1,030	$6,695	$378
	1890	(2)	$3,358	(2)	$278	$5,622	(2)	(3)	$5,686	(3)	$367	(2)	$1,625
Miscellaneous expenses	1900	$4,543	$58,788	$503	$207	$1,245	$6,024	$3,390	$7,289	$2,677	$2,983	$91,887	$2,309
	1890	(2)	$46,264	(2)	$1,332	$6,559	(2)	(3)	$45,482	(3)	$3,098	(2)	$11,537
Cost of materials	1900	$79,290	$499,353	$15,169	$37,598	$85,275	$211,279	$83,361	$342,689	$24,781	$39,328	$543,496	$13,399
	1890	(2)	$615,294	(2)	$19,307	$59,650	(2)	(3)	$1,131,868	(3)	$20,862	(2)	$204,639
Value of products	1900	$141,498	$801,250	$28,565	$72,007	$151,104	$300,349	$166,184	$535,900	$63,141	$66,886	$1,007,765	$34,041
	1890	(2)	$931,008	(2)	$29,030	$141,787	(2)	(3)	$1,403,216	(3)	$36,750	(2)	$408,293

[1] Includes establishments distributed as follows: Florida, 2; Idaho, 2; New Mexico, 1; Rhode Island, 1.
[2] Reported under head of other states in 1890.
[3] None reported in 1890.
[4] Includes establishments distributed as follows: Connecticut, 1; Kentucky, 2; Louisiana, 1; Mississippi, 2; Oregon, 2; Rhode Island, 1; South Carolina, 2; South Dakota, 1; Utah, 2; Wisconsin, 1.

Table 7 gives the totals for the principal items of the industry for the two periods and indicates the marked growth and expansion which has occurred during the decade in each state. In 1890 the canning and preserving of fruits and vegetables was reported by 886 establishments located in 36 states and territories, and in 1900 the number had increased to 1,808, distributed among 39 states and territories. In order to avoid disclosing the operations of individual establishments, states having less than 3 establishments were grouped under "all other states." Nearly every state and territory has shown a most gratifying increase in the number of establishments, capital, and value of products. The exceptions are as follows: Kansas reported a decrease in all three items; Massachusetts, a decrease of 1 establishment, but a notable increase in capital and value of products; Maine, Missouri, Pennsylvania, and Virginia, a decrease in capital, but an increase in the other two items; Nebraska, a decrease in establishments and in capital, but an increase in value of products; Texas, the same number of establishments, but an increase in the other two items.

Climatic conditions largely regulate the locality where each particular fruit or vegetable is canned. In general each state puts up the varieties of fruits and vegetables which are grown extensively therein. The leading 10 states, ranked according to the value of products for the census year, were as follows: California, $13,081,829; Maryland, $11,996,245; New York, $8,975,321; Illinois, $3,730,030; Indiana, $2,589,908; New Jersey, $2,199,176; Ohio, $1,941,398; Delaware, $1,570,790; Iowa, $1,359,958, and Maine, $1,335,671. The total value of products of these 10 states was $48,780,326, or 86.1 per cent of the total value of products for the industry. The number of establishments reported by these 10 states was 1,318, or 72.9 per cent of the total number, and the capital was $23,463,822, as compared with $27,743,067 for the entire country, or

84.6 per cent of the total capital reported. Alabama, Vermont, and Washington have become engaged in the industry during the decade.

The summary of establishments engaged in the canning and preserving of fruits and vegetables, classified according to the number of wage-earners employed, is shown in Table 8. In this connection, attention is here directed to the fact that the data contained in this table were computed from the greatest number of wage-earners employed at any time during the year. This should be taken into consideration in making deductions.

TABLE 8.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: ESTABLISHMENTS CLASSIFIED BY NUMBER OF WAGE-EARNERS EMPLOYED, BY STATES AND TERRITORIES ARRANGED GEOGRAPHICALLY, 1900.

STATES AND TERRITORIES.	Total number of establishments.	NUMBER OF ESTABLISHMENTS EMPLOYING—								
		No wage-earners.	Under 5	5 to 20	21 to 50	51 to 100	101 to 250	251 to 500	501 to 1,000	Over 1,000
United States	1,808	8	154	521	424	308	282	76	31	4
New England states	80	1	1	16	12	31	17		2	
Maine	59	1	1	8	10	25	12		2	
New Hampshire	3			2		1				
Vermont	3						3			
Massachusetts	9			6	1	1	1			
Rhode Island	1				1					
Connecticut	5					4	1			
Middle states	945	1	124	290	225	134	130	32	7	2
New York	511		118	241	72	27	37	13	2	1
New Jersey	73			9	5	22	33	4		
Pennsylvania	39		3	11	15	6	4			
Delaware	51		1		11	15	21	3		
Maryland	271	1	2	29	122	64	35	12	5	1
Southern states	204	3	4	79	76	33	7	2		
West Virginia	9		1		6	1	1			
Virginia	88			23	44	19	2			
North Carolina	19	2	1	12	1	3				
South Carolina	12	1	1	8	1	1				
Georgia	8		1	3	2	1		1		
Florida	2			2						
Kentucky	8				4	1	2	1		
Tennessee	11			2	5	4				
Alabama	3			1	2					
Arkansas	34			25	8		1			
Texas	10			3	3	3	1			
Central states	380	1	3	84	84	82	102	18	4	2
Ohio	70			12	18	23	14	1	2	
Michigan	98			55	25	7	9	1	1	
Indiana	60			7	8	13	25	5		2
Illinois	61	1	2	8	18	14	13	5		
Wisconsin	16				1	3	9	2	1	
Minnesota	4				1	2	1			
Iowa	26			1	2	5	14	4		
Missouri	45		1	1	11	15	17			
Western states	28		1	3	6	6	11	1		
Idaho	2		1	1						
Nebraska	5			1			4			
Utah	8				2	3	2	1		
Colorado	7			1	4		2			
Kansas	5					2	3			
New Mexico	1					1				
Pacific states	171	2	21	49	21	22	15	23	18	
Washington	18		6	10	2					
Oregon	17		4	7	3	1	1	1		
California	136	2	11	32	16	21	14	22	18	

Table 8 indicates that the largest number of establishments employed from 5 to 20 wage-earners. Four establishments, 2 in Indiana and 1 each in Maryland and New York, employed over 1,000 wage-earners, and 31 establishments, 18 of which were located in California, gave employment to from 501 to 1,000 wage-earners. Maryland, New York and California, in the order named, reported the largest number of establishments employing more than 50 wage-earners. The largest number of establishments in Maryland were reported for the class "21 to 50," and the largest number in New York and California from "5 to 20."

According to Table 8 it appears that the Middle states employed the greatest number of wage-earners, while the Central states ranked second, and the Pacific states third. There were 8 small establishments employing no wage-earners, presumably all the work being done by the owner.

Table 9 presents a comparative summary of the statistics of capital for 1890 and 1900, with the percentages of the total and the increase for the several items.

TABLE 9.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: STATISTICS OF CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$27,743,067	100.0	$15,315,185	100.0	81.15
Land	2,702,470	9.7	1,338,584	8.7	101.9
Buildings	4,517,008	16.3	2,387,232	15.6	89.2
Machinery, tools, and implements	4,797,719	17.3	2,480,027	16.2	93.5
Cash and sundries	15,725,870	56.7	9,109,342	59.5	72.6

Every item of capital showed a decided increase and relatively constituted nearly the same percentage of the total for both years. The item cash and sundries, including cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, formed the principal item of capital in both years. This is accounted for by the fact that the industry has a tendency to be suburban, as is indicated by the small per cent of the value of land to the total value. In consequence of this expensive buildings are unnecessary. Further, intricate machinery and mechanical appliances are not required in the preparation of the product. For these reasons comment upon the remaining items of capital is not called for.

As the several items of miscellaneous expenses for 1890 can not be shown separately, the usual detailed comparison with the figures reported for 1900 is impossible. The expenses of this nature in this industry do not call for special comment, but the several subdivisions for 1900 are shown in Table 14.

The cost of materials used, with the proportion each formed of the total for 1900, is given in Table 10.

TABLE 10.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: COST OF MATERIALS USED, 1900.

	Amount.	Per cent of total.
Total	$37,524,297	100.0
Principal materials	[1]36,428,791	97.1
Fuel	480,858	1.3
Rent of power and heat	10,388	(2)
Freight	604,260	1.6

[1] Includes mill supplies and all other materials, which are shown separately in Table 14.
[2] Less than one-tenth of 1 per cent.

Of the total cost the amount reported for principal materials formed 97.1 per cent. The principal materials are made up of those purchased in the raw state and those purchased in partially manufactured form, the latter comprising those materials upon which some manufacturing force has been expended. Included in this item are mill supplies and all other materials, such as cans, solder, etc., which were required in the preparation of the product for the market. That the cost of fuel formed only 1.3 per cent of the total cost of materials is but natural in this industry.

Table 11 shows the value of products, by states, for 1900.

TABLE 11.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: VALUE OF PRODUCTS, BY STATES AND TERRITORIES, ARRANGED GEOGRAPHICALLY, 1900.

	VALUE.		
	Total product.	Fruits and vegetables.	All other products.
United States	$56,668,313	$44,460,665	$12,207,648
New England states	2,194,644	1,511,416	683,228
Maine	1,335,671	1,129,415	206,256
New Hampshire	29,964	28,988	976
Vermont	166,184	166,184	....
Massachusetts	531,545	58,259	473,286
Other states[1]	131,280	128,570	2,710
Middle states	25,542,782	18,808,605	6,734,177
New York	8,975,321	7,032,750	1,942,571
New Jersey	2,199,176	1,965,502	233,674
Pennsylvania	801,250	584,293	216,957
Delaware	1,570,790	1,542,401	28,389
Maryland	11,996,245	7,683,659	4,312,586
Southern states	1,344,342	1,280,784	63,558
West Virginia	66,886	54,694	12,192
Virginia	535,900	533,542	2,358
North Carolina	64,440	60,590	3,850
South Carolina	28,565	11,715	16,850
Georgia	120,022	119,397	625
Kentucky	192,787	192,787	....
Tennessee	72,007	71,116	891
Arkansas	100,503	95,861	4,642
Texas	151,104	131,954	19,150
Other states[2]	12,128	9,128	3,000
Central states	13,309,111	9,638,385	3,670,726
Ohio	1,941,398	1,856,900	84,498
Michigan	1,760,875	720,572	1,040,303
Indiana	2,589,908	2,196,080	393,828
Illinois	3,730,030	1,942,938	1,787,092
Wisconsin	1,007,765	973,954	33,811
Minnesota	49,200	49,200	....
Iowa	1,359,958	1,330,807	29,151
Missouri	869,977	567,934	302,043
Western states	990,966	882,903	108,063
Nebraska	210,688	207,286	3,402
Utah	300,349	294,769	5,580
Colorado	343,394	250,833	92,561
Kansas	113,675	113,675	....
Other states[3]	22,860	16,340	6,520
Pacific states	13,286,468	12,338,572	947,896
Washington	63,141	14,645	48,496
Oregon	141,498	140,311	1,187
California	13,081,829	12,183,616	898,212

[1] Includes establishments distributed as follows: Rhode Island, 1; Connecticut, 5.
[2] Includes establishments distributed as follows: Florida, 2; Alabama, 3.
[3] Includes establishments distributed as follows: Idaho, 2; New Mexico, 1.

Table 11 shows that of the total value of products, $44,460,665, or 78.5 per cent, was reported as the value of canned and preserved fruits and vegetables, and $12,207,648, or 21.5 per cent, was returned as the value of "all other products." This latter item includes such articles as pineapples, figs, jams, jellies, condiments, catsup, apple butter, soups, and numerous other varieties of canned or preserved food not included in the above, the quantities and values of which it was impossible to show separately. It will be noticed that in Massachusetts, Michigan, South Carolina, and Washington the value of other products exceeded the value of fruits and vegetables, and in Maryland and Illinois the value of other products formed a goodly proportion of the value of the total product—nearly equal to that of the fruits and vegetables.

The tables which have thus far been shown give an incomplete statistical photograph of the fruit and vegetable canning and preserving industry for the reason given above, that establishments were classified according to the predominating product, and in many instances the canning and preserving of fruits and vegetables is carried on in connection with some other branch of the canning industry, and the totals have not been included in the above tables. It is possible, however, to show the quantity and value of the principal varieties of fruits and vegetables canned and preserved during the census year as reported by establishments of any character. This is done in Table 12.

TABLE 12.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: BY STATES AND TERRITORIES, 1900.

	United States.	NEW ENGLAND STATES.					
		Total.	Maine.	New Hampshire.	Vermont.	Massachusetts.	All other states.[1]
Canning and preserving:							
Aggregate value	$45,379,548	$1,520,722	$1,137,765	$28,988	$166,184	$58,259	$129,526
Canned vegetables—							
Total pounds	1,172,467,073	49,700,208	36,024,288	744,144	5,745,120	3,246,864	3,939,792
Total value	$29,368,158	$1,452,730	$1,107,286	$18,603	$164,584	$57,504	$104,753
Tomatoes—							
Pounds	641,219,993	5,093,640	299,304			953,424	3,840,912
Value	$13,926,749	$128,962	$5,405			$21,638	$101,919
Corn—							
Pounds	305,566,439	40,932,612	34,330,112	652,512	5,649,120	206,688	94,080
Value	$8,230,975	$1,233,843	$1,046,316	$16,313	$162,084	$6,466	$2,664
Pease—							
Pounds	131,436,061	140,352	98,400			41,952	
Value	$4,679,426	$4,325	$3,325			$1,000	
Beans—							
Pounds	75,729,160	2,866,312	720,712		96,000	2,044,800	4,800
Value	$2,124,808	$65,055	$33,985		$2,500	$28,400	$170
Pumpkins—							
Pounds	9,988,416	294,336	294,336				
Value	$203,260	$7,185	$7,185				
Sweet potatoes—							
Pounds	6,205,488						
Value	$127,667						
Gumbo or okra—							
Pounds	524,924						
Value	$20,531						
Succotash—							
Pounds	1,796,592	373,056	281,424	91,632			
Value	$54,742	$13,360	$11,070	$2,290			
Canned fruits—							
Total pounds	302,127,819	2,393,208	1,211,256	213,120	57,600	9,408	901,824
Total value	$11,589,885	$64,267	$30,479	$6,660	$1,600	$755	$24,773
Pears—							
Pounds	49,906,216	8,160				2,160	6,000
Value	$2,233,166	$907				$157	$750
Peaches—							
Pounds	107,609,194	4,080				1,680	2,400
Value	$4,414,277	$490				$140	$350
Apples—							
Pounds	48,104,074	2,355,240	1,211,256	213,120	57,600	1,920	871,344
Value	$1,160,728	$61,446	$30,479	$6,660	$1,600	$40	$22,667
Blackberries—							
Pounds	9,957,160	480					480
Value	$319,323	$50					$50
Strawberries—							
Pounds	11,766,300	21,888				288	21,600
Value	$470,379	$974				$18	$956
Raspberries—							
Pounds	8,826,137	3,360				3,360	
Value	$355,603	$400				$400	
Apricots—							
Pounds	38,525,300						
Value	$1,691,567						
Cherries—							
Pounds	5,549,368						
Value	$310,114						
Plums—							
Pounds	21,894,070						
Value	$736,728						
Dried fruits—							
Total pounds	81,314,406	63,750		53,750			
Total value	$4,421,505	$3,726		$3,725			
Apples—							
Pounds	33,337,309	53,750		53,750			
Value	$1,913,142	$3,725		$3,725			
Apricots—							
Pounds	5,465,217						
Value	$455,394						
Pears—							
Pounds	701,506						
Value	$49,279						
Peaches—							
Pounds	5,662,390						
Value	$312,495						
Prunes—							
Pounds	25,413,763						
Value	$970,927						
Raisins—							
Pounds	10,734,221						
Value	$720,268						

[1] Includes establishments distributed as follows: Connecticut, 5; Rhode Island, 1.

TABLE 12.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: BY STATES AND TERRITORIES, 1900—Continued.

	MIDDLE STATES.					
	Total.	New York.	New Jersey.	Pennsylvania.	Delaware.	Maryland.
Canning and preserving:						
Aggregate value	$19,550,313	$7,032,750	$1,965,502	$584,293	$1,542,401	$8,425,367
Canned vegetables—						
Total pounds	611,802,706	85,432,524	84,423,137	20,390,240	64,309,512	307,247,293
Total value	$15,019,673	$4,410,251	$1,858,489	$516,468	$' 14,308	$6,820,157
Tomatoes—						
Pounds	361,776,261	18,332,340	77,764,232	9,549,896	54,996,168	201,133,625
Value	$7,374,134	$483,112	$1,668,855	$201,304	$1,121,546	$3,899,317
Corn—						
Pounds	114,940,656	64,384,896		7,063,008	2,556,520	40,937,232
Value	$3,255,446	$1,925,496		$187,834	$65,950	$1,076,166
Pease—						
Pounds	83,162,137	36,073,696	3,840,273	1,998,632	4,849,824	36,404,712
Value	$2,997,232	$1,473,912	$96,255	$82,776	$176,578	$1,167,711
Beans—						
Pounds	41,648,176	13,196,752	1,596,960	1,596,864	1,836,000	23,421,600
Value	$1,172,261	$448,314	$64,768	$41,740	$49,244	$568,195
Pumpkins—						
Pounds	2,617,848	1,783,368	182,520	186,840	72,000	393,120
Value	$50,247	$36,370	$3,902	$2,814	$990	$7,171
Sweet potatoes—						
Pounds	6,194,832	720,000	1,009,152			4,465,680
Value	$127,271	$15,000	$23,829			$88,442
Gumbo or okra—						
Pounds	163,196	53,856	30,000			79,340
Value	$4,551	$1,541	$880			$2,130
Succotash—						
Pounds	1,299,600	887,616				411,984
Value	$38,531	$27,506				$11,025
Canned fruits—						
Total pounds	107,861,324	41,241,240	3,224,512	1,476,312	5,486,704	56,432,556
Total value	$3,227,427	$1,347,390	$107,013	$39,721	$128,093	$1,605,210
Pears—						
Pounds	15,516,976	4,178,592	1,760,496	45,000	2,621,464	6,911,424
Value	$535,607	$226,082	$63,356	$2,450	$62,361	$181,358
Peaches—						
Pounds	32,558,770	2,096,112	62,400		1,791,240	28,609,018
Value	$963,097	$72,591	$2,500		$41,282	$846,724
Apples—						
Pounds	32,312,376	23,088,792	1,137,528	1,172,112	162,000	6,751,944
Value	$764,129	$560,048	$26,945	$22,371	$3,065	$151,700
Blackberries—						
Pounds	5,406,792	313,488	18,816	48,000	828,000	4,198,488
Value	$144,834	$17,216	$873	$2,760	$17,960	$106,025
Strawberries—						
Pounds	9,472,388	2,953,728	106,504	86,400	54,000	6,271,756
Value	$351,320	$141,049	$8,554	$5,040	$1,925	$194,752
Raspberries—						
Pounds	6,893,096	4,191,776	138,768	124,800	30,000	2,407,752
Value	$256,674	$163,494	$4,785	$7,100	$1,500	$79,795
Apricots—						
Pounds	2,400	2,400				
Value	$150	$150				
Cherries—						
Pounds	2,279,296	1,017,952				1,261,344
Value	$116,303	$71,881				$44,422
Plums—						
Pounds	3,419,230	3,398,400				20,830
Value	$95,313	$94,879				$434
Dried fruits—						
Total pounds	22,113,387	21,542,897		570,490		
Total value	$1,303,213	$1,275,109		$28,104		
Apples—						
Pounds	22,113,387	21,542,897		570,490		
Value	$1,303,213	$1,275,109		$28,104		
Apricots—						
Pounds						
Value						
Pears—						
Pounds						
Value						
Peaches—						
Pounds						
Value						
Prunes—						
Pounds						
Value						
Raisins—						
Pounds						
Value						

TABLE 12.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: BY STATES AND TERRITORIES, 1900—Continued.

	Total.	SOUTHERN STATES. West Virginia.	Virginia.	North Carolina.	South Carolina.	Georgia.	Kentucky.	Tennessee.	Alabama.	Arkansas.	Texas.	All other states.[1]
Canning and preserving:												
Aggregate value	$1,301,231	$54,694	$533,542	$60,590	$11,715	$124,563	$192,787	$71,116	$7,947	$95,861	$131,954	$16,462
Canned vegetables—												
Total pounds	45,948,227	1,882,152	27,332,771	1,797,840	401,064	488,616	7,979,688	2,682,480	227,880	576,000	2,211,312	368,424
Total value	$931,528	$36,355	$499,355	$49,709	$8,785	$12,663	$180,187	$51,216	$4,248	$15,000	$57,713	$16,297
Tomatoes—												
Pounds	40,148,904	1,805,640	26,434,344	893,160	369,696	359,544	5,157,864	2,617,200	227,880	576,000	1,662,576	45,000
Value	$759,734	$34,133	$474,305	$19,292	$8,090	$7,814	$106,227	$49,996	$4,248	$15,000	$39,629	$1,000
Corn—												
Pounds	2,555,811	20,832	520,467	67,120		14,016	1,584,000				359,376	
Value	$57,169	$648	$13,160	$1,485		$526	$30,600				$10,750	
Peas—												
Pounds	1,535,472		136,800	528,000		66,672	768,000				36,000	
Value	$61,658		$6,080	$22,000		$2,778	$29,000				$1,800	
Beans—												
Pounds	1,274,312	55,680	205,160	319,560	31,368	45,504	397,824	66,280			153,360	576
Value	$35,587	$1,574	$5,195	$6,932	$695	$1,461	$12,960	$1,220			$5,534	$16
Pumpkins—												
Pounds	72,000						72,000					
Value	$1,400						$1,400					
Gumbo or okra—												
Pounds												
Value												
Sweet potatoes—												
Pounds	361,728		36,000			2,880						322,848
Value	$15,980		$615			$84						$15,281
Succotash—												
Pounds												
Value												

	Total.	West Virginia.	Virginia.	North Carolina.	South Carolina.	Georgia.	Kentucky.	Tennessee.	Alabama.	Arkansas.	Texas.	All other states.[1]
Canned fruits—												
Total pounds	9,872,344	639,240	1,524,792	475,536	139,248	4,155,664	288,000	621,600	168,360		1,855,440	4,464
Total value	$279,357	$18,339	$30,752	$10,881	$2,930	$111,900	$7,200	$19,250	$3,699		$74,241	$165
Pears—												
Pounds	1,041,552		108,000		1,152	724,800		96,000			111,600	
Value	$29,021		$1,650		$25	$20,200		$3,500			$3,646	
Peaches—												
Pounds	6,027,912	24,120	349,440	328,536	83,952	3,012,000	288,000	252,000	136,720		1,549,680	4,464
Value	$181,916	$500	$7,300	$7,996	$1,655	$83,475	$7,200	$10,000	$2,850		$60,775	$165
Apples—												
Pounds	2,068,176	613,584	657,816	28,440	50,976	369,600		273,600			74,160	
Value	$46,250	$17,775	$11,663	$692	$1,150	$7,200		$5,750			$2,020	
Blackberries—												
Pounds	525,904	1,536	284,736	118,560	3,168	1,264			32,640		84,000	
Value	$16,500	$64	$7,019	$2,193	$100	$25			$849		$5,250	
Strawberries—												
Pounds	36,000										36,000	
Value	$2,550										$2,550	
Raspberries—												
Pounds	48,000					48,000						
Value	$1,000					$1,000						
Apricots—												
Pounds												
Value												
Cherries—												
Pounds	124,800		124,800									
Value	$3,120		$3,120									
Plums—												
Pounds												
Value												
Dried fruits—												
Total pounds	1,558,000		53,000				90,000	13,000		1,402,000		
Total value	$90,346		$3,435				$5,400	$650		$80,861		
Apples—												
Pounds	1,658,000		63,000				90,000	13,000		1,402,000		
Value	$90,346		$3,435				$5,400	$650		$80,861		
Apricots—												
Pounds												
Value												
Pears—												
Pounds												
Value												
Peaches—												
Pounds												
Value												
Prunes—												
Pounds												
Value												
Raisins—												
Pounds												
Value												

[1]Includes establishments distributed as follows: Florida, 2; Louisiana, 1; Mississippi, 1.

TABLE 12.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: BY STATES AND TERRITORIES, 1900—Continued.

	CENTRAL STATES.								
	Total.	Ohio.	Michigan.	Indiana.	Illinois.	Wisconsin.	Minnesota.	Iowa.	Missouri.
Canning and preserving:									
Aggregate value	$9,715,994	$1,856,900	$762,985	$2,196,080	$1,976,834	$973,954	$49,200	$1,330,807	$569,234
Canned vegetables—									
Total pounds	369,470,692	76,362,754	8,573,568	91,566,684	80,214,384	30,338,424	2,101,992	53,612,790	26,700,096
Total value	$8,834,552	$1,769,432	$211,425	$2,169,003	$1,802,309	$973,954	$49,200	$1,822,622	$536,607
Tomatoes—									
Pounds	155,958,988	40,968,068	5,827,968	63,272,984	13,533,120	2,526,696	358,776	6,124,680	23,346,696
Value	$3,121,866	$814,044	$114,005	$1,286,027	$260,907	$52,383	$7,140	$125,796	$461,564
Corn—									
Pounds	139,349,460	24,354,854	....	9,943,440	51,945,408	3,589,920	1,649,616	45,394,222	2,472,000
Value	$3,463,910	$642,161	....	$270,265	$1,214,696	$90,163	$40,500	$1,146,075	$60,050
Pease—									
Pounds	41,404,020	2,127,792	2,656,800	10,039,380	1,965,840	23,534,208	....	1,080,000	....
Value	$1,379,594	$76,564	$92,700	$310,172	$60,500	$807,408	....	$32,250	....
Beans—									
Pounds	26,953,224	7,987,776	88,800	6,533,584	11,656,376	615,600	....	71,088	....
Value	$751,339	$199,615	$4,720	$270,670	$251,483	$23,000	....	$1,851	....
Pumpkins—									
Pounds	5,681,064	924,264	....	1,746,336	1,113,640	72,000	93,600	849,824	881,400
Value	$114,992	$37,048	....	$31,439	$14,723	$1,000	$1,560	$14,229	$14,993
Sweet potatoes—									
Pounds	....	....	....	....	....	....	....	....	....
Value	....	....	....	....	....	....	....	....	....
Gumbo or okra—									
Pounds	....	....	....	....	....	....	....	....	....
Value	....	....	....	....	....	....	....	....	....
Succotash—									
Pounds	123,936	....	....	30,960	....	....	....	92,976	....
Value	$2,851	....	....	$430	....	....	....	$2,421	....
Canned fruits—									
Total pounds	15,913,393	2,691,821	9,603,980	1,130,040	796,920	....	....	257,280	1,433,352
Total value	$462,587	$74,253	$308,275	$21,397	$23,775	....	....	$7,060	$27,827
Pears—									
Pounds	297,120	648	282,144	10,008	4,320	....	....	....	....
Value	$14,718	$27	$14,236	$255	$200	....	....	....	....
Peaches—									
Pounds	3,217,464	399,960	2,716,944	....	100,560	....	....	....	....
Value	$120,730	$10,940	$107,490	....	$2,300	....	....	....	....
Apples—									
Pounds	8,249,616	1,171,416	4,019,088	1,072,800	295,680	....	....	257,280	1,433,352
Value	$177,639	$27,892	$88,053	$20,132	$6,675	....	....	$7,060	$27,827
Blackberries—									
Pounds	1,119,024	607,728	322,272	17,424	171,600	....	....	....	....
Value	$36,147	$17,801	$12,008	$338	$6,000	....	....	....	....
Strawberries—									
Pounds	834,480	340,992	417,048	....	76,440	....	....	....	....
Value	$35,513	$11,245	$21,068	....	$3,200	....	....	....	....
Raspberries—									
Pounds	1,228,065	171,077	880,660	28,008	148,320	....	....	....	....
Value	$46,853	$6,348	$34,483	$622	$5,400	....	....	....	....
Apricots—									
Pounds	....	....	....	....	....	....	....	....	....
Value	....	....	....	....	....	....	....	....	....
Cherries—									
Pounds	68,016	....	68,016	....	....	....	....	....	....
Value	$4,166	....	$4,166	....	....	....	....	....	....
Plums—									
Pounds	899,608	....	897,808	1,800	....	....	....	....	....
Value	$26,821	....	$26,771	$50	....	....	....	....	....
Dried fruits—									
Total pounds	7,501,102	269,500	4,418,453	101,000	2,569,149	....	....	26,100	116,900
Total value	$418,855	$13,215	$243,285	$5,680	$150,750	....	....	$1,125	$4,800
Apples—									
Pounds	6,481,102	269,500	4,418,453	101,000	1,549,149	....	....	26,100	116,900
Value	$357,755	$13,215	$243,285	$5,680	$89,650	....	....	$1,125	$4,800
Apricots—									
Pounds	155,000	....	....	....	155,000	....	....	....	....
Value	$12,850	....	....	....	$12,850	....	....	....	....
Pears—									
Pounds	100,000	....	....	....	100,000	....	....	....	....
Value	$7,000	....	....	....	$7,000	....	....	....	....
Peaches—									
Pounds	160,000	....	....	....	160,000	....	....	....	....
Value	$11,000	....	....	....	$11,000	....	....	....	....
Prunes—									
Pounds	605,000	....	....	....	605,000	....	....	....	....
Value	$30,250	....	....	....	$30,250	....	....	....	....
Raisins—									
Pounds	....	....	....	....	....	....	....	....	....
Value	....	....	....	....	....	....	....	....	....

TABLE 12.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: BY STATES AND TERRITORIES, 1900—Continued.

	WESTERN STATES.						PACIFIC STATES.			
	Total.	Nebraska.	Utah.	Colorado.	Kansas.	All other states.[1]	Total.	Washington.	Oregon.	California.
Canning and preserving:										
Aggregate value	$882,903	$207,286	$294,769	$250,833	$113,675	$16,340	$12,408,385	$14,645	$140,311	$12,253,429
Canned vegetables—										
Total pounds	32,667,480	7,429,488	12,552,336	7,092,216	5,089,440	504,000	62,877,760		324,000	62,553,760
Total value	$837,382	$193,286	$271,488	$247,083	$110,825	$14,700	$2,292,293		$14,300	$2,277,993
Tomatoes—										
Pounds	20,814,024	1,512,000	12,300,048	3,393,336	3,104,640	504,000	57,428,176		110,400	57,317,776
Value	$466,948	$31,800	$263,363	$94,105	$62,980	$14,700	$2,075,105		$2,700	$2,072,405
Corn—										
Pounds	7,773,600	5,740,800		720,000	1,312,800		14,400		14,400	
Value	$220,202	$157,890		$27,000	$35,312		$405		$405	
Peas—										
Pounds	1,560,000			1,440,000	120,000		3,634,080		141,600	3,492,480
Value	$82,000			$78,000	$4,000		$154,617		$8,630	$145,987
Beans—										
Pounds	1,271,088	162,288		1,060,800	48,000		1,716,048		67,600	1,658,448
Value	$40,656	$3,396		$36,160	$1,100		$59,910		$2,565	$57,345
Pumpkins—										
Pounds	1,248,768	14,400	252,288	478,080	504,000		74,400			74,400
Value	$27,576	$200	$8,125	$11,818	$7,433		$1,860			$1,860
Sweet potatoes—										
Pounds							10,656			10,656
Value							$396			$396
Gumbo or okra—										
Pounds										
Value										
Succotash—										
Pounds										
Value										
Canned fruits—										
Total pounds	1,311,408	451,200	631,248	108,000	120,960		164,776,142		2,585,760	162,190,382
Total value	$43,781	$13,900	$23,281	$3,750	$2,850		$7,512,466		$106,550	$7,405,916
Pears—										
Pounds	182,880		182,880				32,859,528		530,400	32,329,128
Value	$6,994		$6,994				$1,645,919		$22,000	$1,623,919
Peaches—										
Pounds	91,488		91,488				65,709,480		72,000	65,637,480
Value	$3,362		$3,362				$3,144,682		$2,550	$3,142,132
Apples—										
Pounds	892,800	451,200	212,640	108,000	120,960		2,225,866		405,600	1,820,266
Value	$26,037	$13,900	$5,637	$3,750	$2,850		$85,227		$13,800	$71,427
Blackberries—										
Pounds	20,880		20,880				2,884,080		422,400	2,461,680
Value	$1,087		$1,087				$121,705		$15,000	$106,705
Strawberries—										
Pounds	4,800		4,800				1,386,744		168,000	1,218,744
Value	$250		$250				$79,772		$9,500	$70,272
Raspberries—										
Pounds	6,144		6,144				647,472		124,800	522,672
Value	$320		$320				$48,356		$6,600	$41,756
Apricots—										
Pounds	3,360		3,360				38,519,540			38,519,540
Value	$175		$175				$1,591,242			$1,591,242
Cherries—										
Pounds	7,920		7,920				3,069,336		699,360	2,369,976
Value	$412		$412				$186,113		$30,300	$155,813
Plums—										
Pounds	101,136		101,136				17,474,096		163,200	17,310,896
Value	$5,144		$5,144				$609,450		$6,800	$602,650
Dried fruits—										
Total pounds	66,934	6,600				60,334	50,021,233	286,000	397,350	49,337,883
Total value	$1,740	$100				$1,640	$2,603,626	$14,645	$19,461	$2,569,520
Apples—										
Pounds	6,600	6,600					3,124,470		37,250	3,087,220
Value	$100	$100					$158,003		$2,110	$155,893
Apricots—										
Pounds							5,310,217			5,310,217
Value							$442,544			$442,544
Pears—										
Pounds							601,506			601,506
Value							$42,279			$42,279
Peaches—										
Pounds							5,602,390			5,502,390
Value							$301,495			$301,495
Prunes—										
Pounds	60,334					60,334	24,748,429	286,000	360,100	24,102,329
Value	$1,640					$1,640	$939,037	$14,645	$17,351	$907,041
Raisins—										
Pounds							10,734,221			10,734,221
Value							$720,268			$720,268

[1] Includes establishments distributed as follows: Idaho, 2; New Mexico, 1.

Table 12 shows the quantity and value of fruits and vegetables prepared by fruit and vegetable canning factories as such, and also the quantity and value reported as a subsidiary product in establishments engaged primarily in the canning and preserving of fish and oysters. The values reported do not include the amounts returned for all other products, and therefore, the totals given in Table 12 do not agree with the total products elsewhere given in this report, or with those of the general report, on this industry as presented in Manufactures, Parts I and II. Further, many establishments classified under "food preparations" and "pickles, preserves, and sauces" are engaged in the canning and preserving of fruits and vegetables, and it was impossible to ascertain the total quantity and value of fruits and vegetables canned by such establishments. It will be observed that the quantity and value of some varities of fruits and vegetables do not appear in Table 12. This is due to the fact that it was impossible to secure the quantity and value of each, as they were not separately reported. They are therefore, as heretofore explained, included under "all other products" in Table 11. Nevertheless, the totals given in Table 12 may be taken as fairly representing the quantities and value of fruits and vegetables canned during the census year.

Table 12 shows that the value of canned and preserved fruits and vegetables was $45,379,548. The total number of pounds of canned vegetables was 1,172,467,073, valued at $29,368,158; canned fruit, 302,127,819 pounds, valued at $11,589,885; and dried fruit, 81,314,406 pounds, valued at $4,421,505. It appears that the Middle states led in this industry and reported $19,550,313 as the value of canned and preserved fruits and vegetables, or 43.1 per cent of the total value. The Pacific states ranked second, with $12,408,385 as the value of products, or 27.3 per cent of the total value. The Central states ranked third, with a product of $9,715,994, or 21.4 per cent of the total value. The New England, Southern, and Western states followed in the order named.

In the total number of pounds of canned vegetables Maryland easily led, reporting 307,247,293 pounds, or 26.2 per cent of the total number. The other 4 leading states in the order named, with the number of pounds reported by each, were: New York, 135,432,524; Indiana, 91,566,684; Illinois, 80,214,384; and California, 62,553,760. The total number of pounds of canned and preserved vegetables reported by these 5 states was 677,014,645, or over 50 per cent of the total number of pounds reported for the entire country.

In the canning of the different varieties of fruits California ranked first with 162,190,382 pounds, or 53.7 per cent of the total. The other 5 leading states, ranked according to the number of pounds, were: Maryland, 56,432,556; New York, 41,241,240; Michigan, 9,603,980; Delaware, 5,486,704, and New Jersey, 3,224,512. The total number of pounds of canned fruits returned by these 6 states was 278,179,375, or 92.1 per cent of the entire number of pounds reported for the country.

Naturally climatic and other physiographic conditions cause a tendency to sectionalism in this industry. The states which stood preeminent in the several varieties of canned and preserved foods as shown by Table 12, in the order of their importance, were as follows: tomatoes, Maryland, New Jersey, Indiana, California, Delaware, and Ohio; corn, New York, Illinois, Iowa, Maryland, and Maine; pease, New York, Maryland, Wisconsin, Indiana, and Delaware; beans, Maryland, New York, Illinois, Ohio, and Indiana; pumpkins, New York, Indiana, and Illinois; pears, California, New York, and Delaware; peaches, California, Maryland, Michigan, and Delaware; apples, New York, Maryland, Michigan, California, Maine, and Ohio; small fruits, as blackberries, strawberries, and raspberries, California, Maryland, and New York.

The drying of fruit seems to be confined principally to California and New York, those 2 states reporting 70,880,780 pounds, or 87.2 per cent of the total number reported.

The principal details of the statistics for the canning and preserving of fruits and vegetables as carried on in cities of over 20,000 population are shown in Table 13.

TABLE 13.—FRUITS AND VEGETABLES, CANNING AND PRESERVING: STATISTICS OF CITIES OF 20,000 POPULATION OR OVER, 1900.

CITIES.	Rank by value of products.	Number of establishments.	Capital.	Salaried officials, clerks, etc.		Wage-earners.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Wages.			
Total	....	107	$9,529,513	$508	$611,554	10,189	$2,569,859	$1,170,459	$15,422,289	$21,788,123
Baltimore, Md	1	23	2,862,467	148	172,326	4,360	905,397	309,985	6,432,415	8,477,178
San Francisco, Cal	2	10	856,900	51	70,656	1,538	433,107	102,137	2,131,175	2,992,802
Chicago, Ill	3	6	366,100	36	56,661	311	105,972	181,907	1,236,981	1,766,129
New York, N. Y	4	6	1,732,932	27	46,880	379	118,693	31,448	545,957	880,865
Indianapolis, Ind	5	3	241,260	70	69,520	300	65,331	56,360	435,556	724,968
Boston, Mass	6	4	32,700	8	7,100	110	31,796	6,925	350,329	466,110
Los Angeles, Cal	7	3	148,000	5	6,600	322	76,500	14,706	297,623	423,000
Portland, Me	8	3	122,935	3	3,681	55	20,544	6,850	72,996	128,219
All other cities[1]	....	49	3,166,219	160	178,130	2,814	812,519	460,141	3,919,257	5,928,852

[1] Includes establishments distributed as follows: Atlanta, Ga., 1; Auburn, N. Y., 1; Austin, Tex., 1; Birmingham, Ala., 1; Buffalo, N. Y., 1; Burlington, Iowa, 1; Canton, Ohio, 2; Cedar Rapids, Iowa, 1; Cincinnati, Ohio, 1; Columbus, Ohio, 1; Davenport, Iowa, 1; Dayton, Ohio, 1; Denver, Colo., 1; Detroit, Mich., 1; Elgin, Ill., 1; Evansville, Ind., 1; Grand Rapids, Mich., 1; Hamilton, Ohio, 1; Jersey City, N. J., 1; Kalamazoo, Mich., 1; Leavenworth, Kans., 1; Muncie, Ind., 1; Oakland, Cal., 1; Oshkosh, Wis., 1; Peoria, Ill., 1; Philadelphia, Pa., 1; Pittsburg, Pa., 1; Portland, Oreg., 2; Providence, R. I., 1; Pueblo, Colo., 1; Quincy, Ill., 1; Rochester, N. Y., 1; Rockford, Ill., 1; Sacramento, Cal., 1; St. Joseph, Mo., 2; St. Louis, Mo., 1; St. Paul, Minn., 1; San Jose, Cal., 2; Seattle, Wash., 2; Syracuse, N. Y., 1; Topeka, Kans., 1; West Hoboken, N. J., 1; Zanesville, Ohio, 1.

Table 13 indicates that of the total value of products, $21,788,123, or 38.4 per cent, was reported for the cities named, and of this amount, $8,477,178, or 15 per cent of the total for the United States, was returned for Baltimore, which, since the inception of the industry, has always been the principal city in the fruit and vegetable canning and preserving industry. On the whole, the industry can hardly be said to be carried on chiefly in cities, as there seems to be a natural inclination toward the rural districts nearest the source of supply of the different varieties of fruits and vegetables.

Fruits and vegetables were the first goods canned successfully, the early processes being especially applicable to this class of goods, as they require a less degree of heat to preserve them than do fish and oysters. The method first used was to fill glass bottles to the necks with fruits, which in some cases were partly worked, and then loosely cork the bottle and place in tepid water. The temperature was then gradually increased to from 170° to 190° F. and maintained at that point for a period of from thirty to sixty minutes, when the bottles were sealed and cooled in a bath. This method was improved upon by Pierre Atoine Angilbert in the year 1823 in the following manner: The fruit having been placed in a tin can containing water, a lid with an aperture was fastened on and heat was applied. After the liquid had boiled a while the aperture was closed with a drop of solder. This method does not differ materially from that in use in American canneries at the present time.

Although fruits and vegetables were among the first articles canned in the United States, the industry was largely confined, during the period between 1820 and 1845, to the cities where fish and oyster canning was carried on. Little information is available regarding the canning of fruits and vegetables during this time, and it is to be presumed that it was not very extensive. Tomatoes and corn, the two vegetables which are most extensively canned to-day, were not put up during the period mentioned.

The art of hermetically sealing tomatoes in tin cans was first used by Harrison W. Crosby when he was acting as steward of Lafayette College, Eaton, Pa., in 1847. The first methods used in putting up this article were crude and imperfect, but labor-saving machinery and economical methods have wrought great changes from time to time in this branch of the industry.

The canning of corn was begun simultaneously in 1839 by two canneries in Baltimore, Md., and Portland, Me., the latter being under the management of Mr. Isaac Winslow. Little information is available concerning the progress of the canning of this article in Baltimore, but the history of its progress in Maine appears to be more complete. Mr. Winslow met with little success until 1852, in which year he applied for a patent, which, however, was not granted until 1862. His method was substantially as follows:[1] The kernels of a superior quality of fresh green corn were removed from the cob by a knife and placed in hermetically sealed tin cans, which were then subjected to steam or boiling heat for about one and one-half hours, when the cans were punctured and again sealed and boiled for two and one-half hours longer. A much greater degree of success followed the invention of steam retorts in 1874, by which a higher degree of temperature could be secured. The first cooking under the old system was done away with by the introduction of "cookers," which are steam retorts used to cook the corn before placing it in the cans. This method is in use at the present time.

[1] Origin and Progress of the Canning Industry in Maine, F. O. Conant.

Prior to 1846, canneries were in operation in New York, Boston, and Baltimore, and in Portland and Eastport, Me., and in Newark, N. J., the canneries in the latter place having prepared the fruits and vegetables for Dr. Kane's Arctic Expedition. After 1850 canneries began to develop rapidly under the stimulus of an increasing demand for the goods. By 1866 factories were in operation in most fruit and vegetable raising sections of the country. Canneries were established in the Middle West at Circleville, Ohio, in 1873, and at Indianapolis, Ind., a few years previously. The rapid development of fruit and vegetable culture in California and elsewhere on the Pacific coast led to the introduction of canning establishments as early as 1856.[2] At present this section takes the lead in the canning and preserving of small fruits. The fruits most extensively canned on the Pacific coast are plums, apricots, pears, peaches, and cherries, and the leading vegetables are tomatoes, asparagus, and pease.

Baltimore has been aptly called the "cradle of the canning industry." The state of Maryland not only leads in oyster canning, but is also among the first in the canning of tomatoes, corn, peaches, peas, lima beans, apples, pears, and pineapples.

Maine, in addition to being the leading state in sardine canning, is one of the leading corn-canning states, while New York leads in canning corn, apples, and pears, and also puts up peas and beans in large quantities. As stated elsewhere, climatic conditions largely determine the locality in which each variety of fruits or vegetables is canned.

The canning of fruits and vegetables has increased with greater rapidity during the past thirty years than have the other branches of the canning industry included in this report. This is in a measure due to the fact that it differs from oyster and fish canning in that it is not confined to as narrow limits as these latter, but may be carried on in the numerous fruit and vegetable raising sections of the country.

Table 14 shows the detailed statistics for the industry by states and territories as returned for 1900.

[2] San Francisco Trade Journal, December 20, 1901.

TABLE 14.—FRUITS AND VEGETABLES, CANNING AND

		United States.	Alabama.	Arkansas.	California.	Colorado.	Connecticut.
1	Number of establishments	1,808	3	34	136	7	5
	Character of organization:						
2	Individual	919	3	18	52	2	....
3	Firm and limited partnership	505	....	14	27	....	1
4	Incorporated companies	365	....	2	50	5	4
5	Miscellaneous	19	....	....	7	....	....
	Capital:						
6	Total	$27,743,067	$7,585	$33,038	$4,397,935	$277,325	$91,463
7	Land	$2,702,470	$4,110	$2,580	$1,132,110	$28,500	$2,450
8	Buildings	$4,517,008	$1,125	$13,123	$728,891	$79,500	$21,232
9	Machinery, tools, and implements	$4,797,719	$850	$7,836	$554,086	$62,700	$29,496
10	Cash and sundries	$15,725,870	$1,500	$9,500	$1,982,848	$106,625	$38,285
11	Proprietors and firm members	2,060	3	44	128	2	2
	Salaried officials, clerks, etc.:						
12	Total number	1,741	1	2	259	18	7
13	Total salaries	$1,277,028	$300	$350	$242,388	$23,700	$3,260
	Officers of corporations—						
14	Number	338	....	1	39	8	4
15	Salaries	$350,301	....	$300	$58,675	$13,150	$1,610
	General superintendents, managers, clerks, etc.—						
16	Total number	1,403	1	1	220	10	3
17	Total salaries	$926,727	$300	$50	$183,713	$10,550	$1,650
	Men—						
18	Number	1,253	1	1	182	10	3
19	Salaries	$881,739	$300	$50	$172,163	$10,550	$1,650
	Women—						
20	Number	160	....	....	38	....	....
21	Salaries	$44,988	....	....	$11,550	....	....
	Wage-earners, including pieceworkers, and total wages:						
22	Greatest number employed at any one time during the year	133,106	84	601	24,935	613	429
23	Least number employed at any one time during the year	45,106	45	504	6,952	266	51
24	Average number	36,401	16	136	7,486	206	100
25	Wages	$8,050,793	$2,380	$21,942	$1,987,649	$62,561	$24,967
	Men, 16 years and over—						
26	Average number	13,542	9	50	1,819	66	35
27	Wages	$4,122,104	$1,760	$10,079	$702,428	$37,855	$12,203
	Women, 16 years and over—						
28	Average number	19,699	4	72	6,262	116	64
29	Wages	$3,600,243	$400	$10,495	$1,233,861	$19,456	$12,614
	Children, under 16 years—						
30	Average number	3,160	3	14	415	24	1
31	Wages	$328,446	$220	$1,368	$51,360	$5,250	$150
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
32	January	3,384	....	....	326	24	2
33	February	3,348	....	....	285	26	2
34	March	4,350	....	....	419	26	1
35	April	5,242	....	....	885	26	2
36	May	6,464	....	....	1,188	26	3
37	June	11,474	18	....	2,048	101	3
38	July	14,182	29	37	3,252	101	5
39	August	31,958	38	160	4,217	108	90
40	September	41,108	25	208	4,125	159	141
41	October	23,714	....	154	2,938	119	94
42	November	11,934	....	44	1,498	49	67
43	December	5,346	....	....	641	32	16
	Women, 16 years and over—						
44	January	2,451	....	....	177	28	....
45	February	1,958	....	....	106	28	2
46	March	2,536	....	....	106	28	....
47	April	2,885	....	....	428	28	....
48	May	5,981	....	....	1,473	28	....
49	June	16,589	6	....	6,227	128	....
50	July	26,835	16	61	13,496	128	....
51	August	54,533	21	246	16,157	140	175
52	September	64,111	6	280	14,947	385	276
53	October	38,667	1	224	7,788	335	185
54	November	14,625	1	59	1,595	97	86
55	December	5,217	....	....	524	37	38
	Children, under 16 years—						
56	January	370	....	....	....	1	....
57	February	337	....	....	....	1	....
58	March	435	....	....	....	1	....
59	April	493	5	....	6	1	....
60	May	801	....		22	1	....
61	June	2,367	5	....	295	51	3
62	July	4,560	8	14	1,257	51	3
63	August	10,831	12	57	1,649	50	....
64	September	11,331	10	56	1,281	69	3
65	October	4,762	....	46	406	44	3
66	November	1,159	....	....	55	14	....
67	December	476	....	....	12	1	....
	Miscellaneous expenses:						
68	Total	$2,423,673	$135	$952	$412,737	$14,598	$1,985
69	Rent of works	$164,169	....	$35	$26,708	$530	....
70	Taxes, not including internal revenue	$110,139	$45	$213	$18,311	$1,694	$200
71	Rent of offices, interest, insurance, and all sundry expenses not hitherto included.	$2,112,800	$60	$704	$366,412	$12,374	$1,785
72	Contract work	$36,565	$30	....	$1,306	....	....
	Materials used:						
73	Aggregate cost	$37,524,297	$3,418	$50,954	$9,102,400	$223,454	$81,887
	Principal materials—						
74	Total cost	$20,704,783	$1,060	$43,633	$5,449,382	$117,954	$29,330
75	Purchased in raw state	$16,429,113	$1,050	$43,533	$3,797,656	$115,200	$29,330
76	Purchased in partially manufactured form	$4,275,670	....	....	$1,651,726	$2,754	....
77	Fuel	$480,858	$120	$4,306	$96,103	$3,761	$1,168
78	Rent of power and heat	$10,388	$3	....	$610	$120	....
79	Mill supplies	$96,651	$50	....	$5,189	$692	$300
80	All other materials	$15,627,357	$2,185	$2,512	$3,425,006	$100,860	$48,639
81	Freight	$604,260	$10	$503	$126,110	$67	$2,450

PRESERVING: BY STATES AND TERRITORIES, 1900.

Delaware.	Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
51	8	61	60	26	5	8	59	271	9	98	4	1
27	2	20	15	2	...	4	16	175	6	62	1	2
18	2	16	15	6	2	1	22	78	3	34	1	3
6	4	25	30	18	2	3	19	18	...	12	2	4
...	...	1	...	...	1	...	2	...	...	...	...	5
$966,660	$24,801	$1,551,977	$1,205,494	$1,027,321	$30,300	$95,600	$865,825	$4,459,660	$48,375	$898,668	$43,650	6
$31,080	$1,851	$72,077	$104,151	$37,900	$4,200	$6,000	$12,846	$378,143	$625	$91,603	$1,800	7
$148,338	$5,700	$221,647	$284,009	$190,900	$10,702	$18,150	$132,493	$430,586	$900	$204,315	$10,000	8
$141,164	$5,500	$369,810	$225,005	$311,869	$8,766	$34,400	$230,928	$633,234	$19,900	$146,649	$11,300	9
$646,078	$11,750	$888,443	$592,329	$486,652	$6,632	$37,050	$459,559	$3,017,697	$26,950	$456,101	$20,650	10
72	5	51	46	15	2	7	99	344	12	122	3	11
29	4	99	155	46	11	12	102	231	9	70	2	12
$14,278	$3,650	$101,515	$112,174	$27,305	$3,264	$5,842	$50,850	$213,080	$7,600	$45,279	$1,600	13
1	2	20	37	14	1	7	14	23	...	16	...	14
$150	$3,000	$23,120	$20,930	$12,000	$100	$3,750	$11,600	$52,850	...	$7,685	...	15
28	2	79	118	32	10	5	88	208	9	55	2	16
$14,128	$650	$78,395	$91,244	$15,305	$3,154	$2,090	$39,354	$160,230	$7,600	$37,594	$1,600	17
28	2	77	86	29	10	4	83	198	9	47	2	18
$14,128	$650	$77,845	$84,906	$14,610	$3,154	$2,010	$37,493	$166,274	$7,600	$34,445	$1,600	19
...	...	2	32	3	...	1	5	10	...	8	...	20
...	...	$550	$6,338	$695	...	$80	$1,861	$3,956	...	$3,149	...	21
5,909	468	5,573	8,718	3,867	512	874	5,050	22,907	261	4,014	285	22
2,257	187	1,986	2,187	1,609	131	358	1,885	12,341	135	1,908	139	23
1,437	81	1,444	2,002	699	116	231	904	7,505	139	1,165	45	24
$226,149	$10,545	$392,636	$386,457	$184,710	$17,148	$36,903	$203,509	$1,379,131	$39,945	$240,102	$8,523	25
527	26	815	824	321	51	89	487	2,980	57	378	17	26
$113,751	$5,260	$278,626	$219,239	$114,630	$10,124	$19,248	$144,508	$744,516	$21,660	$121,412	$6,670	27
750	38	582	1,068	266	51	105	316	3,712	79	665	26	28
$100,119	$4,410	$108,182	$156,473	$54,575	$5,564	$14,094	$49,385	$559,310	$17,760	$95,054	$1,590	29
160	17	47	110	112	14	37	101	813	3	222	2	30
$12,279	$875	$5,828	$10,745	$15,605	$1,460	$3,561	$9,616	$75,305	$525	$23,636	$263	31
50	14	248	109	43	1	15	137	1,310	49	93	...	32
72	14	259	116	39	...	10	158	1,201	47	93	...	33
120	14	273	197	129	...	10	180	1,698	51	95	4	34
137	14	363	287	77	11	15	226	1,731	58	94	4	35
246	2	416	384	99	20	20	217	2,020	57	97	4	36
494	19	407	916	164	42	90	138	2,586	52	316	4	37
323	70	502	915	215	35	138	192	2,378	62	273	10	38
1,667	80	2,691	2,313	606	183	274	934	7,121	60	447	63	39
1,774	45	2,857	2,810	1,722	170	280	2,739	7,678	59	1,000	100	40
1,161	14	994	1,347	395	126	189	560	4,459	63	1,075	10	41
219	12	433	342	259	27	23	273	2,236	64	693	6	42
62	12	331	156	103	2	10	89	1,343	69	257	2	43
17	3	199	87	7	...	...	91	962	68	112	...	44
17	3	194	84	7	...	...	94	619	66	112	...	45
29	3	190	88	39	...	...	111	1,132	60	114	...	46
23	3	206	84	...	...	...	92	1,094	74	114	...	47
57	...	197	109	...	...	...	85	2,485	75	112	...	48
318	20	202	615	43	10	75	39	3,756	84	483	...	49
112	154	495	626	65	3	208	64	3,976	82	438	...	50
2,769	178	1,710	4,010	1,153	230	358	594	9,754	100	694	111	51
3,211	80	1,848	4,747	1,263	225	348	1,385	10,788	91	1,633	171	52
2,204	3	1,069	1,958	361	110	258	704	6,689	79	1,655	18	53
207	3	412	269	212	34	18	412	2,237	85	1,020	18	54
37	3	267	134	36	...	...	122	1,054	83	297	...	55
...	...	...	...	3	...	...	12	123	...	160	...	56
...	...	...	...	3	...	...	12	87	...	160	...	57
9	...	...	...	3	...	...	12	132	...	160	...	58
9	...	...	...	3	...	...	10	142	...	160	...	59
24	...	2	2	3	...	...	10	344	...	160	...	60
87	34	10	73	3	25	35	...	601	...	306	...	61
67	78	57	89	18	6	75	3	660	2	253	...	62
602	76	214	413	576	65	126	417	2,847	3	250	6	63
650	16	226	463	597	46	123	618	2,931	6	286	21	64
443	...	49	236	114	21	80	77	1,526	5	310	...	65
30	...	4	37	24	1	...	30	268	14	265	...	66
3	...	...	5	3	...	...	10	95	2	188	...	67
$27,169	$4,262	$295,558	$165,755	$63,185	$11,722	$10,100	$43,119	$371,108	$7,392	$123,514	$1,452	68
$1,722	$600	$32,313	$2,835	$225	$596	...	$4,936	$33,560	$4,724	$7,381	75	69
$1,501	$221	$8,413	$6,619	$3,852	$363	$254	$5,444	$20,139	$463	$3,731	$166	70
$23,946	$3,441	$253,332	$154,493	$57,508	$10,763	$9,846	$32,239	$316,949	$2,205	$112,368	$1,211	71
...	...	$1,600	$1,808	$1,600	...	...	$500	$460	...	$34	...	72
$1,083,142	$67,192	$2,447,194	$1,526,088	$767,231	$68,465	$75,346	$762,102	$8,786,518	$384,600	$1,154,698	$17,929	73
$478,586	$17,406	$1,367,171	$608,358	$294,244	$20,681	$25,110	$389,984	$5,019,365	$325,137	$630,078	$9,310	74
$429,948	$14,606	$1,075,569	$534,854	$266,424	$20,681	$25,110	$342,208	$4,028,376	$281,324	$440,052	$8,785	75
$48,638	$2,800	$291,602	$73,504	$37,820	...	...	$47,776	$990,989	$43,813	$190,026	$525	76
$12,859	$493	$18,295	$20,782	$11,357	$1,599	$1,565	$10,578	$50,894	$3,394	$22,642	$549	77
$35	...	$5,800	$25	...	...	...	$70	$475	...	...	$40	78
$3,496	$130	$4,371	$2,892	$6,195	$444	$55	$2,351	$20,138	$212	$1,595	$119	79
$567,527	$41,130	$1,022,060	$857,677	$447,504	$45,172	$47,466	$350,524	$3,593,237	$53,325	$462,470	$5,786	80
$20,639	$8,033	$29,497	$36,354	$7,931	$569	$1,150	$8,595	$102,409	$2,532	$37,913	$2,125	81

TABLE 14.—FRUITS AND VEGETABLES, CANNING AND

		United States.	Alabama.	Arkansas.	California.	Colorado.	Connecticut.
	Products:						
82	Aggregate value	$56,668,313	$7,947	$100,503	$13,081,829	$343,394	$124,280
	Canned vegetables—						
83	Total pounds	1,142,327,265	227,880	576,000	62,428,288	7,092,216	3,800,592
84	Total value	$28,734,598	$4,248	$15,000	$2,274,037	$247,083	$101,048
	Tomatoes—						
85	Pounds	626,438,753	227,880	576,000	57,208,720	3,393,336	3,783,312
86	Value	$13,666,560	$4,248	$15,000	$2,068,997	$94,105	$100,544
	Corn—						
87	Pounds	304,175,223				720,000	17,280
88	Value	$8,191,383				$27,000	$504
	Pease—						
89	Pounds	122,098,669			3,492,480	1,440,000	
90	Value	$4,465,673			$145,987	$78,000	
	Beans—						
91	Pounds	71,688,808			1,642,032	1,060,800	
92	Value	$2,025,123			$56,797	$36,160	
	Pumpkins—						
93	Pounds	9,941,616			74,400	478,080	
94	Value	$202,404			$1,860	$11,818	
	Sweet potatoes—						
95	Pounds	6,013,896			10,656		
96	Value	$124,245			$396		
	Succotash—						
97	Pounds	1,768,224					
98	Value	$53,960					
	Okra—						
99	Pounds	202,076					
100	Value	$5,250					
	Canned fruits—						
101	Total pounds	293,637,273	168,360		160,921,862	108,000	867,744
102	Total value	$11,311,062	$3,699		$7,340,059	$3,750	$22,217
	Peaches—						
103	Pounds	104,353,640	135,720		65,064,696		
104	Value	$4,283,165	$2,850		$3,103,775		
	Pears—						
105	Pounds	48,418,936			31,992,672		
106	Value	$2,188,201			$1,610,900		
	Apricots—						
107	Pounds	38,278,628			38,272,868		
108	Value	$1,583,252			$1,582,927		
	Apples—						
109	Pounds	46,494,898			1,820,266	108,000	867,744
110	Value	$1,125,119			$71,427	$3,750	$22,217
	Plums—						
111	Pounds	21,781,462			17,198,288		
112	Value	$730,562			$596,484		
	Strawberries—						
113	Pounds	11,059,628			1,218,744		
114	Value	$446,679			$70,272		
	Raspberries—						
115	Pounds	8,542,889			522,672		
116	Value	$344,598			$41,756		
	Cherries—						
117	Pounds	5,489,608			2,369,976		
118	Value	$307,788			$155,813		
	Blackberries—						
119	Pounds	9,217,584	32,640		2,461,680		
120	Value	$301,698	$849		$106,705		
	Dried fruits—						
121	Total pounds	81,189,406		1,402,000	49,337,883		
122	Total value	$4,415,005		$80,861	$2,569,520		
	Apples—						
223	Pounds	33,212,309		1,402,000	3,087,220		
124	Value	$1,906,642		$80,861	$155,893		
	Prunes—						
125	Pounds	25,413,763			24,102,329		
126	Value	$970,927			$907,041		
	Raisins—						
127	Pounds	10,734,221			10,734,221		
128	Value	$720,268			$720,268		
	Apricots—						
129	Pounds	5,465,217			5,310,217		
130	Value	$455,394			$442,544		
	Peaches—						
131	Pounds	5,662,390			5,502,390		
132	Value	$312,495			$301,495		
	Pears—						
133	Pounds	701,506			601,506		
134	Value	$49,279			$42,279		
135	Value of all other products	$12,207,648		$4,642	$898,213	$92,561	$1,015
	Comparison of products:						
136	Number of establishments reporting for both years	1,036	1	6	73	6	4
137	Value for census year	$39,974,339	$1,800	$13,820	$5,879,608	$335,719	$96,180
138	Value for preceding business year	$33,286,939	$1,800	$15,250	$4,639,734	$315,845	$49,000
	Power:						
139	Number of establishments reporting	822	1	1	33	6	5
140	Total horsepower	27,172	15	40	953	253	161
	Owned—						
	Engines—						
	Steam—						
141	Number	1,030	1	1	35	8	6
142	Horsepower	25,336	15	40	838	208	161
	Gas or gasoline—						
143	Number	46			5		
144	Horsepower	405			48		
	Water wheels—						
145	Number	9					
146	Horsepower	132					
	Electric motors—						
147	Number	14			4		
148	Horsepower	266			35		
	Other power—						
149	Number	4				1	
150	Horsepower	110				40	
	Rented—						
151	Total horsepower	928			32	5	
152	Electric horsepower	244			17	5	
153	All other horsepower	679			15		
154	Furnished to other establishments, horsepower	17					

PRESERVING: BY STATES AND TERRITORIES, 1900—Continued.

Delaware.	Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
$1,570,790	$120,022	$3,730,030	$2,589,908	$1,359,958	$113,676	$192,787	$1,335,671	$11,996,245	$531,545	$1,760,875	$49,200	82
64,309,512	313,320	79,182,384	91,566,684	53,612,790	5,089,440	7,979,688	36,784,688	279,588,301	3,246,864	8,059,968	2,101,992	83
$1,414,308	$7,522	$1,774,913	$2,169,003	$1,322,622	$110,825	$180,187	$1,098,936	$6,260,691	$57,504	$198,755	$49,200	84
64,996,168	272,280	13,461,120	63,272,984	6,124,680	3,104,640	5,157,864	299,304	187,160,705	953,424	5,359,968	358,776	85
$1,121,546	$6,163	$258,607	$1,286,027	$125,796	$62,980	$106,227	$5,405	$3,659,137	$21,638	$102,755	$7,140	86
2,555,520		50,985,408	9,943,440	45,394,222	1,312,800	1,584,000	34,100,112	40,750,032	206,688		1,649,616	87
$65,950		$1,189,700	$270,265	$1,146,075	$35,312	$30,600	$1,038,316	$1,070,096	$6,466		$40,500	88
4,849,824		1,965,840	10,039,380	1,080,000	120,000	768,000	98,400	27,150,792	41,952	2,640,000		89
$176,578		$60,500	$310,172	$32,250	$4,000	$29,000	$3,325	$957,436	$1,000	$92,000		90
1,836,000	38,160	11,656,376	6,533,584	71,088	48,000	397,824	711,112	19,443,408	2,044,800	60,000		91
$49,244	$1,275	$251,483	$270,670	$1,851	$1,100	$12,960	$33,635	$470,314	$28,400	$4,000		92
72,000		1,113,640	1,746,336	849,824	504,000	72,000	294,336	346,320			93,600	93
$990		$14,723	$31,439	$14,229	$7,433	$1,400	$7,185	$6,315			$1,560	94
								4,274,088				95
								$85,020				96
			30,960	92,976			281,424	383,616				97
			$430	$2,421			$11,070	$10,243				98
	2,880							79,340				99
	$84							$2,130				100
5,486,704	4,154,400	796,920	1,130,040	257,280	120,960	288,000	1,211,256	50,484,850	9,408	8,352,524		101
$128,093	$111,875	$23,775	$21,397	$7,060	$2,860	$7,200	$30,479	$1,422,968	$755	$278,532		102
1,791,240	3,012,000	100,560				288,000		26,070,248	1,680	2,572,944		103
$41,282	$83,475	$2,300				$7,200		$758,919	$140	$102,540		104
2,621,464	724,800	4,320	10,008					5,798,904	2,160	243,840		105
$62,361	$20,200	$200	$255					$151,012	$157	$12,636		106
												107
												108
162,000	369,600	295,680	1,072,800	257,280	120,960		1,211,256	6,186,720	1,920	2,975,136		109
$3,065	$7,200	$6,675	$20,132	$7,060	$2,850		$30,479	$137,884	$40	$66,260		110
			1,800					20,830		897,808		111
			$50					$434		$26,771		112
54,000		76,440						5,614,684	288	399,048		113
$1,925		$3,200						$173,008	$18	$20,068		114
30,000	48,000	148,320	28,008					2,131,704	3,360	873,460		115
$1,500	$1,000	$5,400	$622					$71,190	$400	$34,083		116
								1,201,584		68,016		117
								$42,096		$4,166		118
828,000		171,600	17,424					3,460,176		322,272		119
$17,960		$6,000	$338					$88,425		$12,008		120
		2,444,149	101,000	26,100		90,000				4,418,453		121
		$144,250	$5,680	$1,125		$5,400				$243,285		122
		1,424,149	101,000	26,100		90,000				4,418,453		123
		$83,150	$5,680	$1,125		$5,400				$243,285		124
		605,000										125
		$30,250										126
												127
												128
		155,000										129
		$12,850										130
		160,000										131
		$11,000										132
		100,000										133
		$7,000										134
$28,389	$625	$1,787,092	$393,828	$29,151			$206,256	$4,312,686	$473,286	$1,040,303		135
37	4	35	37	19	5	5	46	120	7	62	2	136
$1,190,807	$65,582	$2,996,422	$2,258,826	$1,187,773	$113,675	$108,287	$1,146,309	$9,899,920	$505,945	$1,644,118	$39,880	137
$1,010,585	$11,000	$2,525,423	$1,941,254	$1,003,620	$75,121	$85,325	$1,062,747	$8,048,981	$348,975	$1,156,638	$34,000	138
48	5	30	42	23	5	6	43	117	7	25	4	139
1,736	93	1,082	1,899	1,428	178	193	681	4,551	96	750	60	140
69	5	33	48	33	6	8	47	175	8	29	4	141
1,470	93	881	1,818	1,422	178	193	673	4,257	96	713	60	142
3		2	3	1				6		2		143
6		4	81	6				24		7		144
								3		1		145
								30		22		146
								4		1		147
								160		8		148
												149
												150
260		197					8	80				151
		197					5					152
							3	80				153

Table 14.—FRUITS AND VEGETABLES, CANNING AND

		United States.	Alabama.	Arkansas.	California.	Colorado.	Connecticut.
	Establishments classified by number of persons employed, not including proprietors and firm members:						
155	Total number of establishments	1,808	3	34	136	7	5
156	No employees	8			2		
157	Under 5	154			11		
158	5 to 20	521	1	25	32	1	
159	21 to 50	424	2	8	16	4	
160	51 to 100	308			21		4
161	101 to 250	282		1	14	2	1
162	251 to 500	76			22		
163	501 to 1,000	31			18		
164	Over 1,000	4					

		Missouri.	Nebraska.	New Hampshire.	New Jersey.	New York.	North Carolina.
1	Number of establishments	45	5	3	73	511	19
	Character of organization:						
2	Individual	8		1	30	334	9
3	Firm and limited partnership	9	2	2	27	124	5
4	Incorporated companies	27	3		12	50	5
5	Miscellaneous	1			4	3	
	Capital:						
6	Total	$345,360	$123,623	$21,642	$1,429,221	$6,649,059	$30,340
7	Land	$22,117	$6,800	$150	$111,805	$355,910	$3,035
8	Buildings	$71,255	$35,000	$1,600	$334,279	$1,025,624	$4,575
9	Machinery, tools, and implements	$128,736	341,325	$9,542	$250,618	$906,809	$7,480
10	Cash and sundries	$123,252	$40,498	$10,350	$732,519	$4,360,716	$15,250
11	Proprietors and firm members	33	6	6	90	589	20
	Salaried officials, clerks, etc:						
12	Total number	74	9	1	63	261	2
13	otal salaries	$23,007	$6,400	$600	$33,830	$201,025	$300
	Officers of corporations—						
14	Number	29			14	45	
15	Salaries	$8,702			$10,525	$71,645	
	General superintendents, managers, clerks, etc.—						
16	Total number	45	9	1	49	216	2
17	Total salaries	$14,305	$6,400	$600	$23,305	$129,380	$300
	Men—						
18	Number	41	9	1	46	191	2
19	Salaries	$13,970	$6,400	$600	$22,760	$118,461	300
	Women—						
20	Number	4			3	25	
21	Salaries	$335			$545	$10,919	
	Wage-earners, including pieceworkers, and total wages:						
22	Greatest number employed at any one time during the year	3,598	733	91	8,355	16,421	372
23	Least number employed at any one time during the year	1,790	136	36	1,874	854	193
24	Average number	650	161	19	1,992	5,518	78
25	Wages	$116,467	$21,686	$5,957	$422,092	$1,462,820	$10,736
	Men, 16 years and over—						
26	Average number	170	81	11	818	2,292	29
27	Wages	$49,803	$13,200	$4,700	$232,316	$811,564	$6,506
	Women, 16 years and over—						
28	Average number	377	50	8	1,088	3,007	41
29	Wages	$56,883	$6,000	$1,257	$180,952	$623,168	$3,805
	Children, under 16 years—						
30	Average number	103	30		86	219	8
31	Wages	$9,781	$2,486		$8,824	$28,088	$425
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
32	January	21	10	3	193	428	8
33	February	20	5	3	253	446	5
34	March	20	10	3	269	476	15
35	April	21	13	3	282	529	17
36	May	34	23	3	315	692	59
37	June	35	28	3	685	2,141	46
38	July	55	40	3	687	2,494	59
39	August	679	340	3	1,651	3,003	80
40	September	631	331	48	2,765	6,585	33
41	October	368	100	25	1,755	5,472	17
42	November	129	41	27	688	3,864	4
43	December	22	25	12	267	1,377	4
	Women, 16 years and over—						
44	January	8		5	19	480	3
45	February	9		5	18	407	3
46	March	6		5	25	436	
47	April	8		5	19	496	4
48	May	99	20	5	78	712	60
49	June	97	25	5	488	2,447	90
50	July	69	28	8	385	3,376	114
51	August	1,670	195		3,093	4,437	138
52	September	1,592	197	19	4,587	8,890	59
53	October	783	116	19	3,038	7,044	12
54	November	178	16	20	1,155	5,333	3
55	December	11	7	5	152	2,030	
	Children, under 16 years—						
56	January	1			2	19	
57	February	1			3	21	
58	March	1			3	23	
59	April	1			4	24	
60	May	1	10		4	34	10
61	June	1	35		46	188	10
62	July	80	42		44	410	30
63	August	473	165		186	409	33
64	September	459	85		404	946	15
65	October	186	20		244	290	2
66	November	31			81	183	
67	December	1			14	78	

PRESERVING: BY STATES AND TERRITORIES, 1900.

Delaware.	Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
51	8	61	60	26	5	8	59	271	9	98	4	155
....	....	1	....	....	....	....	1	1	....	....	....	156
1	1	2	....	....	....	....	1	2	....	....	....	157
....	3	8	7	1	....	....	8	29	6	55	....	158
11	2	18	8	2	....	4	10	122	1	25	1	159
15	1	14	13	5	2	1	25	64	1	7	2	160
21	....	13	25	14	3	2	12	35	1	9	1	161
3	1	5	5	4	....	1	....	12	....	1	....	162
....	....	....	....	....	....	....	2	5	....	1	....	163
....	....	....	2	....	....	....	....	1	....	....	....	164

Ohio.	Oregon.	Pennsylvania	South Carolina.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin.	All other states.[1]	
70	17	39	12	11	10	8	3	88	18	9	16	6	1
20	11	18	10	2	4	1	....	49	12	8	1	6	2
....	....	....	....	....	....	....	....	....	....	....	....	....	3
26	2	14	1	7	3	1	2	37	1	....	3	....	4
24	4	7	1	2	3	6	1	2	5	1	12	....	5
$910,670	$121,355	$520,206	$23,862	$35,824	$53,852	$304,258	$68,528	$218,533	$78,627	$95,260	$650,115	$37,055	6
$65,490	$16,030	$38,216	$1,525	$880	$1,575	$33,645	....	$22,500	$1,394	$11,670	$58,103	$9,600	7
$150,973	$29,945	$77,355	$2,075	$5,880	$14,310	$66,173	$13,500	$32,260	$11,000	$22,390	$112,453	$4,750	8
$200,057	$26,650	$101,658	$6,718	$9,825	$23,100	$57,707	$20,316	$47,790	$10,177	$28,230	$120,634	$6,855	9
$494,150	$48,730	$302,977	$13,544	$19,239	$14,867	$146,733	$34,712	$115,983	$56,056	$32,970	$358,925	$15,850	10
83	15	43	13	19	8	8	6	130	13	8	8	5	11
103	9	35	6	16	5	20	4	25	4	4	42	1	12
$58,975	$10,350	$25,309	$1,030	$2,043	$3,430	$8,068	$4,100	$3,477	$4,250	$1,475	$32,732	$200	13
18	6	10	....	6	....	6	2	1	....	2	13	....	14
$19,844	$9,500	$8,600	....	$275	....	$1,949	$2,500	$50	....	$1,200	$6,691	....	15
85	3	25	6	10	5	14	2	24	4	2	29	1	16
$39,131	$850	$16,709	$1,030	$1,768	$3,430	$6,119	$1,600	$3,427	$4,250	$275	$26,041	$200	17
76	2	25	4	10	5	14	2	24	4	1	23	1	18
$36,257	$400	$16,709	$950	$1,768	$3,430	$6,119	$1,600	$3,427	$4,250	$75	$24,635	$200	19
9	1	....	2	....	....	....	....	....	....	1	6	....	20
$2,874	$450	....	$80	....	....	....	....	....	....	$200	$1,406	....	21
6,980	734	1,609	229	485	548	816	487	3,204	167	458	2,575	154	22
2,941	239	827	139	295	242	386	40	1,952	109	281	776	55	23
1,608	129	468	64	116	111	141	111	637	44	128	676	38	24
$305,393	$18,070	$123,179	$7,410	$15,216	$26,828	$37,565	$21,762	$77,576	$12,484	$13,108	$117,090	$10,097	25
581	32	211	15	24	22	62	64	196	15	55	303	10	26
$158,919	$8,995	$81,345	$2,625	$4,992	$9,157	$26,037	$15,140	$33,915	$5,839	$7,858	$80,160	$5,064	27
841	60	206	27	56	63	73	45	312	24	59	271	25	28
$123,826	$6,076	$35,833	$2,835	$6,539	$14,832	$10,172	$6,362	$33,577	$5,675	$4,220	$30,235	$4,655	29
186	37	51	22	36	26	6	2	129	5	14	102	3	30
$22,648	$3,000	$6,001	$1,950	$3,685	$2,839	$1,356	$260	$10,084	$970	$1,030	$6,695	$378	31
87	....	100	3	....	....	....	21	12	16	12	38	11	32
88	....	96	3	....	....	....	21	12	16	12	36	11	33
103	3	122	3	....	....	....	21	12	8	12	45	11	34
121	3	128	3	....	5	....	21	16	4	8	127	11	35
135	18	128	13	....	15	....	21	33	6	8	151	11	36
310	46	193	5	11	29	17	21	49	7	8	430	12	37
662	26	204	39	50	74	24	21	193	6	14	984	10	38
2,286	17	395	64	82	74	82	215	798	9	95	1,021	12	39
2,013	135	494	24	109	30	303	240	823	61	158	412	21	40
766	86	309	12	29	26	242	78	319	35	142	237	8	41
267	34	228	6	10	11	37	68	61	5	120	94	5	42
146	18	130	3	....	....	35	24	19	8	75	66	....	43
77	....	11	10	....	....	....	2	....	46	....	40	....	44
78	....	9	10	....	....	....	2	....	45	....	40	....	46
112	....	11	20	....	....	....	2	....	15	....	4	....	46
112	....	20	30	....	10	....	2	....	11	....	22	....	47
157	60	19	40	....	32	....	6	18	20	1	28	6	48
517	155	253	24	20	103	21	5	43	20	1	257	12	49
1,061	80	285	29	139	218	33	5	307	15	23	718	8	50
2,823	51	518	66	199	235	136	150	1,298	16	·122	948	39	51
2,860	230	684	34	210	66	386	160	1,422	24	225	672	110	52
1,708	74	344	22	75	60	261	115	596	23	172	459	105	53
439	42	276	10	23	21	30	65	55	20	100	53	21	54
146	25	48	10	....	8	5	27	3	30	60	7	11	55
29	....	....	10	....	....	....	....	....	10	....	....	....	56
29	....	....	10	....	....	....	....	....	10	....	....	....	57
61	....	....	30	....	....	....	....	....	10	....	....	....	58
51	....	17	50	....	....	....	....	....	10	....	....	....	59
57	13	17	40	....	21	....	....	12	10	....	....	4	60
207	133	34	20	23	77	....	....	20	10	....	28	7	61
452	75	78	26	98	108	....	....	143	....	23	301	9	62
696	55	175	35	143	73	12	12	556	....	50	388	7	63
449	141	175	15	138	20	37	12	609	1	65	353	5	64
155	20	57	13	26	10	19	....	188	3	27	138	4	65
34	6	33	10	10	....	....	....	15	....	....	15	....	66
27	1	26	10	....	....	....	....	....	....	....	....	....	67

[1] Includes establishments distributed as follows: Florida, 2; Idaho, 2; New Mexieo, 1; Rhode Island, 1.

TABLE 14.—FRUITS AND VEGETABLES, CANNING AND

		Missouri.	Nebraska.	New Hampshire.	New Jersey.	New York.	North Carolina.
	Miscellaneous expenses:						
68	Total	$23,399	$10,325	$270	$83,418	$495,478	$414
69	Rent of works	$2,630	...	$250	$1,440	$15,910	$75
70	Taxes, not including internal revenue	$1,526	$500	$20	$6,493	$17,503	$146
71	Rent of offices, interest, insurance, and all sundry expenses not hitherto included.	$17,831	$9,825	...	$75,485	$461,302	$193
72	Contract work	$1,412	...	...	...	$763	...
	Materials used:						
73	Aggregate cost	$559,651	$130,573	$21,111	$1,401,101	$5,592,462	$44,494
	Principal materials—						
74	Total cost	$361,489	$48,789	$19,014	$649,720	$3,352,396	$21,985
75	Purchased in raw state	$130,739	$30,320	$11,802	$606,206	$2,986,579	$20,181
76	Purchased in partially manufactured form	$230,750	$18,469	$7,212	$43,514	$365,817	$1,804
77	Fuel	$7,117	$1,965	$1,167	$17,380	$138,468	$797
78	Rent of power and heat	$12	...	...	$50	$1,906	$282
79	Mill supplies	$1,624	$1,177	...	$5,715	$22,854	$190
80	All other materials	$185,279	$77,649	$921	$686,228	$1,989,626	$20,462
81	Freight	$4,130	$993	$9	$42,008	$87,212	$778
	Products:						
82	Aggregate value	$869,977	$210,688	$29,964	$2,199,176	$8,975,321	$64,440
	Canned vegetables—						
83	Total pounds	26,628,096	7,429,488	744,144	84,423,137	135,432,524	1,797,840
84	Total value	$535,307	$193,286	$18,603	$1,858,489	$4,410,251	$49,709
	Tomatoes—						
85	Pounds	23,274,696	1,512,000	...	77,764,232	18,332,340	893,160
86	Value	$460,264	$31,800	...	$1,668,855	$483,112	$19,292
	Corn—						
87	Pounds	2,472,000	5,740,800	652,512	...	64,384,896	57,120
88	Value	$60,050	$157,890	$16,313	...	$1,925,496	$1,485
	Peas—						
89	Pounds	...	...	...	3,840,273	36,073,696	528,000
90	Value	...	...	...	$96,255	$1,473,912	$22,000
	Beans—						
91	Pounds	...	162,288	...	1,596,960	13,196,752	319,560
92	Value	...	$3,396	...	$64,768	$448,314	$6,932
	Pumpkins—						
93	Pounds	881,400	14,400	...	182,520	1,783,368	...
94	Value	$14,993	$200	...	$3,902	$35,370	...
	Sweet potatoes—						
95	Pounds	...	...	...	1,009,152	720,000	...
96	Value	...	...	...	$23,829	$15,000	...
	Succotash—						
97	Pounds	...	...	91,632	...	887,616	...
98	Value	...	...	$2,290	...	$27,506	...
	Okra—						
99	Pounds	...	...	...	30,000	53,856	...
100	Value	...	...	...	$880	$1,541	...
	Canned fruit—						
101	Total pounds	1,433,352	451,200	213,120	3,224,512	41,241,240	475,536
102	Total value	$27,827	$13,900	$6,660	$107,013	$1,347,390	$10,881
	Peaches—						
103	Pounds	...	...	...	62,400	2,096,112	328,536
104	Value	...	...	...	$2,500	$72,591	$7,996
	Pears—						
105	Pounds	...	...	...	1,760,496	4,178,592	...
106	Value	...	...	...	$63,356	$226,082	...
	Apricots—						
107	Pounds	...	...	...	...	2,400	...
108	Value	...	...	...	...	$150	...
	Apples—						
109	Pounds	1,433,352	451,200	213,120	1,137,528	28,088,792	28,440
110	Value	$27,827	$13,900	$6,660	$26,945	$560,048	$692
	Plums—						
111	Pounds	...	...	...	...	3,398,400	...
112	Value	...	...	...	...	$94,879	...
	Strawberries—						
113	Pounds	...	...	...	106,504	2,953,728	...
114	Value	...	...	...	$8,554	$141,049	...
	Raspberries—						
115	Pounds	...	...	...	138,768	4,191,776	...
116	Value	...	...	...	$4,785	$163,494	...
	Cherries—						
117	Pounds	...	...	...	...	1,017,952	...
118	Value	...	...	...	...	$71,881	...
	Blackberries—						
119	Pounds	...	...	...	18,816	313,488	118,560
120	Value	...	...	...	$873	$17,216	$2,193
	Dried fruits—						
121	Total pounds	116,900	6,600	53,750	...	21,542,897	...
122	Total value	$4,800	$100	$3,725	...	$1,275,109	...
	Apples—						
123	Pounds	116,900	6,600	53,750	...	21,542,897	...
124	Value	$4,800	$100	$3,725	...	$1,275,109	...
	Prunes—						
125	Pounds	...	...	...	...	...	...
126	Value	...	...	...	...	...	...
	Raisins—						
127	Pounds	...	...	...	...	...	...
128	Value	...	...	...	...	...	...
	Apricots—						
129	Pounds	...	...	...	...	...	...
130	Value	...	...	...	...	...	...
	Peaches—						
131	Pounds	...	...	...	...	...	...
132	Value	...	...	...	...	...	...
	Pears—						
133	Pounds	...	...	...	...	...	...
134	Value	...	...	...	...	...	...
135	Value of all other products	$302,043	$3,402	$976	$233,674	$1,942,571	$3,850
	Comparison of products:						
136	Number of establishments reporting for both years	19	3	2	52	290	10
137	Value for census year	$590,203	$189,150	$26,664	$1,770,752	$6,118,082	$14,908
138	Value for preceding business year	$534,749	$117,000	$23,314	$1,511,680	$5,443,779	$9,376

PRESERVING: BY STATES AND TERRITORIES, 1900—Continued.

Ohio.	Oregon.	Pennsylvania.	South Carolina.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin.	All other states.[1]	
$73,781	$4,543	$58,788	$503	$207	$1,245	$6,024	$3,390	$7,289	$2,677	$2,983	$91,887	$2,309	68
$4,834	$310	$3,527	...	$2	$440	$58	$450	$1,173	$1,130	$50	$14,050	$1,600	69
$5,486	$318	$1,409	$185	$83	$124	$488	$210	$913	$302	$157	$2,324	$323	70
$63,461	$3,915	$53,700	$318	$122	$681	$5,478	$2,730	$5,203	$1,245	$2,776	$48,513	$386	71
...	...	$162	...	...	...	...	...	...	...	...	$27,000	...	72
$1,197,269	$79,290	$499,353	$15,169	$37,598	$86,275	$211,279	$83,361	$342,689	$24,781	$39,328	$543,496	$13,399	73
$502,614	$40,242	$277,840	$5,923	$13,559	$42,678	$81,485	$53,756	$134,118	$15,622	$12,526	$239,441	$4,807	74
$431,413	$33,481	$193,581	$5,433	$13,559	$38,614	$73,271	$36,465	$116,519	$13,822	$12,526	$225,489	$4,307	75
$71,201	$6,761	$81,259	$490	...	$4,064	$8,214	$17,291	$17,599	$1,800	...	$13,952	$500	76
$13,318	$1,888	$6,965	$290	$636	$1,007	$4,027	$1,200	$5,162	$1,464	$1,417	$15,645	$480	77
$670	$125	$50	...	...	...	...	...	$25	$90	...	...	...	78
$3,629	$206	$1,513	$30	$162	$110	$391	$240	$1,222	$55	$132	$9,157	$15	79
$655,596	$36,099	$207,082	$8,398	$22,716	$41,255	$124,992	$27,358	$194,116	$6,950	$22,319	$239,434	$7,797	80
$21,442	$730	$5,903	$528	$525	$225	$384	$807	$8,046	$600	$2,934	$39,819	$300	81
$1,941,398	$141,498	$801,250	$28,565	$72,007	$151,104	$300,349	$166,184	$535,900	$63,141	$66,886	$1,007,765	$34,041	82
76,362,754	324,000	20,390,240	401,064	2,682,480	2,211,312	12,552,336	5,745,120	27,332,771	...	1,882,152	30,338,424	688,776	83
$1,769,432	$14,300	$516,468	$8,785	$51,216	$57,713	$271,488	$164,584	$499,355	...	$36,355	$973,954	$19,421	84
40,968,068	110,400	9,549,896	369,696	2,617,200	1,662,576	12,300,048	...	26,484,344	...	1,805,640	2,526,696	606,600	85
$814,044	$2,700	$201,304	$8,090	$49,996	$39,629	$263,363	...	$474,305	...	$34,133	$52,383	$17,075	86
24,354,854	14,400	7,063,008	...	...	359,376	...	5,649,120	520,467	...	20,832	3,689,920	76,800	87
$642,161	$405	$187,834	...	...	$10,750	...	$162,084	$13,160	...	$648	$90,163	$2,160	88
2,127,792	141,600	1,993,632	...	...	36,000	...	...	136,800	...	...	23,534,208	...	89
$76,564	$8,630	$82,776	...	...	$1,800	...	...	$6,080	...	...	$807,408	...	90
7,987,776	57,600	1,596,864	31,368	65,280	153,360	...	96,000	205,160	...	55,680	615,600	5,376	91
$199,615	$2,665	$41,740	$695	$1,220	$5,534	...	$2,500	$5,195	...	$1,674	$23,000	$186	92
924,264	...	186,840	...	...	...	252,288	...	...	...	...	72,000	...	93
$37,048	...	$2,814	...	...	...	$8,126	...	...	...	...	$1,000	...	94
...	...	...	...	...	...	...	...	...	...	...	...	...	95
...	...	...	...	...	...	...	...	...	...	...	...	...	96
...	...	...	...	...	...	...	...	...	...	...	...	...	97
...	...	...	...	...	...	...	...	...	...	...	...	...	98
...	...	...	...	...	...	...	...	36,000	...	...	...	...	99
...	...	...	...	...	...	...	...	$615	...	...	...	...	100
2,691,821	2,585,760	1,476,312	139,248	621,600	1,855,440	631,248	57,600	1,524,792	...	639,240	...	16,944	101
$74,253	$106,550	$39,721	$2,930	$19,250	$74,241	$23,281	$1,600	$30,752	...	$18,339	...	$1,765	102
399,960	72,000	...	83,952	262,000	1,649,680	91,488	...	349,440	...	24,120	...	6,864	103
$10,940	$2,550	...	$1,656	$10,000	$60,775	$3,362	...	$7,300	...	$500	...	$515	104
648	530,400	45,000	1,152	96,000	111,600	182,880	...	108,000	...	...	...	6,000	105
$27	$22,000	$2,450	$25	$3,600	$3,646	$6,994	...	$1,650	...	...	...	$750	106
...	...	...	...	...	...	3,360	...	...	...	...	...	...	107
...	...	...	...	...	...	$175	...	...	...	...	...	...	108
1,171,416	405,600	1,172,112	50,976	273,600	74,160	212,640	57,600	657,816	...	613,584	...	3,600	109
$27,892	$13,800	$22,371	$1,150	$5,750	$2,020	$5,537	$1,600	$11,663	...	$17,775	...	$450	110
...	163,200	...	...	...	...	101,136	...	...	...	...	...	...	111
...	$6,800	...	...	...	...	$5,144	...	...	...	...	...	...	112
340,992	168,000	86,400	...	...	36,000	4,800	...	...	...	...	...	...	113
$11,245	$9,500	$5,040	...	...	$2,550	$250	...	...	...	...	...	...	114
171,077	124,800	124,800	...	...	...	6,144	...	...	...	...	...	...	115
$6,348	$6,600	$7,100	...	...	...	$320	...	...	...	...	...	...	116
...	699,360	...	...	...	...	7,920	...	124,800	...	...	...	...	117
...	$30,300	...	...	...	...	$412	...	$3,120	...	...	...	...	118
607,728	422,400	48,000	3,168	...	84,000	20,880	...	284,736	...	1,536	...	480	119
$17,801	$15,000	$2,760	$100	...	$5,250	$1,087	...	$7,019	...	$64	...	$50	120
269,500	397,350	570,490	...	13,000	...	...	...	53,000	286,000	...	...	60,334	121
$13,215	$19,461	$28,104	...	$650	...	...	...	$3,435	$14,645	...	...	$1,640	122
269,500	37,250	570,490	...	13,000	...	...	...	53,000	...	...	...	...	123
$13,215	$2,110	$28,104	...	$650	...	...	...	$3,436	...	...	...	...	124
...	360,100	...	...	...	...	...	...	...	286,000	...	...	60,334	125
...	$17,351	...	...	...	...	...	...	...	$14,645	...	...	$1,640	126
...	...	...	...	...	...	...	...	...	...	...	...	...	127
...	...	...	...	...	...	...	...	...	...	...	...	...	128
...	...	...	...	...	...	...	...	...	...	...	...	...	129
...	...	...	...	...	...	...	...	...	...	...	...	...	130
...	...	...	...	...	...	...	...	...	...	...	...	...	131
...	...	...	...	...	...	...	...	...	...	...	...	...	132
...	...	...	...	...	...	...	...	...	...	...	...	...	133
...	...	...	...	...	...	...	...	...	...	...	...	...	134
$84,498	$1,187	$216,957	$16,860	$891	$19,160	$5,580	...	$2,358	$48,496	$12,192	$33,811	$11,215	135
41	9	26	7	5	4	5	3	54	13	7	11	6	136
$1,505,991	$82,103	$612,265	$5,800	$33,071	$88,904	$175,530	$166,184	$329,471	$40,336	$29,929	$776,284	$34,041	137
$1,289,817	$103,130	$566,390	$5,290	$29,575	$75,875	$162,204	$115,133	$305,421	$51,855	$27,300	$559,158	$30,590	138

[1] Includes establishments distributed as follows: Florida, 2; Idaho, 2; New Mexico, 1; Rhode Island, 1.

TABLE 14.—FRUITS AND VEGETABLES, CANNING AND

		Missouri.	Nebraska.	New Hampshire.	New Jersey.	New York.	North Carolina.
	Power:						
139	Number of establishments reporting	30	4	1	64	124	7
140	Total horsepower	613	127	150	1,959	4,682	307
	Owned—						
	Engines—						
	Steam—						
141	Number	31	6	2	78	191	6
142	Horsepower	613	127	150	1,878	4,230	301
	Gas or gasoline—						
143	Number				8	5	
144	Horsepower				81	39	
	Water wheels—						
145	Number					5	
146	Horsepower					80	
	Electric motors—						
147	Number					4	
148	Horsepower					55	
	Other power—						
149	Number						
150	Horsepower						
	Rented—						
151	Total horsepower					278	6
152	Electric horsepower					18	
153	All other horsepower					260	6
154	Furnished to other establishments, horsepower						
	Establishments classified by number of persons employed, not including proprietors and firm members:						
155	Total number of establishments	45	5	3	73	511	19
156	No employees						2
157	Under 5	1				118	1
158	5 to 20	1	1	2	9	241	12
159	21 to 50	11			5	72	1
160	51 to 100	15		1	22	27	3
161	101 to 250	17	4		33	37	
162	251 to 500				4	13	
163	501 to 1,000					2	
164	Over 1,000					1	

PRESERVING: BY STATES AND TERRITORIES, 1900—Continued.

Ohio.	Oregon.	Pennsylvania.	South Carolina.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin.	All other states.[1]	
49	5	24	3	5	4	8	3	68	3	2	15	2	139
1,178	108	950	45	75	90	310	47	1,329	25	150	814	44	140
49	6	32	3	5	4	8	3	61	2	3	21	3	141
1,075	108	940	45	75	90	310	47	1,202	23	150	814	42	142
2		1						7				1	143
30		10						67				2	144
													145
													146
1													147
8													148
1								2					149
40								30					150
25								30	2				151
									2				152
25								30					153
		2											154
70	17	39	12	11	10	8	3	88	18	9	16	6	155
			1										156
	4	3	1						6	1		1	157
12	7	11	8	2	3			23	10			3	158
18	3	15	1	5	3	2		44	2	6	1	1	159
23	1	6	1	4	3	3		19		1	3	1	160
14	1	4			1	2	3	2		1	9		161
1	1					1					2		162
2											1		163
													164

[1] Includes establishments distributed as follows: Florida, 2; Idaho, 2; New Mexico, 1; Rhode Island, 1.

Table 15 is a comparative summary of the statistics for the establishments engaged in the canning and preserving of fish, as returned at the censuses of 1890 and 1900, with the percentages of increase for the decade.

TABLE 15.—FISH, CANNING AND PRESERVING: COMPARATIVE SUMMARY, 1890 AND 1900, WITH PER CENT OF INCREASE FOR THE DECADE.

	DATE OF CENSUS.		Per cent of increase.
	1900	1890	
Number of establishments	348	110	216.4
Capital	$19,514,215	$3,186,975	512.3
Salaried officials, clerks, etc., number	618	[1] 182	239.6
Salaries	$585,160	[1] $120,253	386.6
Wage-earners, average number	13,410	5,020	167.1
Total wages	$4,229,638	$1,128,143	274.9
Men, 16 years and over	9,731	3,787	157.0
Wages	$3,733,506	$986,689	278.4
Women, 16 years and over	2,533	841	201.2
Wages	$369,781	$121,059	205.5
Children, under 16 years	1,146	392	192.4
Wages	$126,351	$20,395	519.5
Miscellaneous expenses	$883,363	$280,660	214.7
Cost of materials used	$13,232,001	$4,710,709	180.9
Value of products	$22,253,749	$6,972,268	219.2

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 24.)

The canning and preserving of fish existed as an industry as early as 1850, but it was usually carried on in connection with the canning and preserving of fruits and vegetables and oysters, and statistics for the industry do not appear separately until the census of 1890. At that time the number of establishments reporting canned fish as the principal product had grown to 110, with a capital of $3,186,975, giving employment to 5,020 wage-earners, and paying for wages $1,128,143; for materials, $4,710,709. They reported $6,972,268 as the value of products. From 1890 to 1900 the increase in every item was most marked. The increase in the number of establishments was 238, or more than the total number reported for 1890. The capital showed a most notable increase of $16,327,240—that is, the capital in 1900 was more than six times that given for 1890. The average capital per establishment increased from $28,972 to $56,075—that is, the average capital in 1900 was nearly twice that reported in 1890. These figures indicate the internal growth and development of these establishments since 1890, as well as the expansion of the industry by the construction of new plants. In this last particular, the fish-canning industry differs from the other two industries included in this report. The total number of wage-earners increased 8,390—that is, there were nearly two and one-half times as many wage-earners in 1900 as in 1890. The wages have shown a comparatively larger increase. The relative proportion of wages and cost of materials to the value of products was about the same for the two periods.

In this branch of the canning industry, also, the individual form of organization appears to predominate. Of the total number of establishments 134, or 38.5 per cent, were conducted by individuals; 112, or 32.2 per cent, were operated by incorporated companies, and 102, or 29.3 per cent, by firms and limited partnerships.

Table 16 shows by states and territories, arranged geographically, the number of establishments from which returns were received in 1900, with the increase during the decade.

TABLE 16.—FISH, CANNING AND PRESERVING, COMPARATIVE SUMMARY: NUMBER OF ACTIVE ESTABLISHMENTS, 1890 AND 1900, AND THE INCREASE DURING THE DECADE, BY STATES AND TERRITORIES ARRANGED GEOGRAPHICALLY.

	1900	1890	Increase.
United States	348	110	238
New England states	179	64	115
Maine	117	35	82
New Hampshire	1		1
Massachusetts	61	29	32
Middle states	18	12	6
New York	9	2	7
New Jersey	1	2	[1] 1
Pennsylvania	1	5	[1] 4
Delaware	3		3
Maryland	3		3
District of Columbia	1	3	[1] 2
Southern states	18	1	17
Virginia	5	1	4
North Carolina	1		1
South Carolina	1		1
Mississippi	4		4
Louisiana	6		6
Texas	1		1
Central states	18	8	10
Ohio	3	5	[1] 2
Michigan	4	1	3
Illinois	4		4
Wisconsin	6		6
Minnesota		2	[1] 2
Missouri	1		1
Pacific states	79	25	54
Washington	36	7	29
Oregon	24	15	9
California	19	3	16
Outlying districts	36	(2)	36
Alaska	36	(2)	36

[1] Decrease.
[2] No statistics available for 1890.

Table 16 shows that the greatest development occurred in the New England states, where 64 establishments were reported in 1890 and 179 in 1900, an increase of 115, or 179.7 per cent. Of these states, Maine reported an increase of 234.3 per cent and Massachusetts 110.3 per cent.

The above table should be considered in connection with Table 17, which is a summary of the totals for the canning and preserving of fish as returned at the censuses of 1890 and 1900.

TABLE 17.—FISH, CANNING AND PRESERVING: COMPARATIVE SUMMARY, BY STATES AND TERRITORIES, 1890 AND 1900.

	Year.	United States.	Alaska.[1]	California.	Delaware.[1]	District of Columbia.[2]	Illinois.[1]	Louisiana.[1]	Maine.	Maryland.[1]	Massachusetts.
Number of establishments	1900	348	36	19	3	....	4	6	117	3	61
	1890	110	....	3	....	3	....	....	35	....	29
Capital: Total	1900	$19,514,215	$3,203,228	$691,285	$1,935	....	$2,655	$186,689	$8,481,056	$65,600	$1,734,227
	1890	$3,186,975	....	$47,070	....	$5,630	....	....	$527,420	....	$741,301
Land	1900	$757,510	$73,135	$51,000	$400	....	$475	$10,150	$137,355	$7,500	$194,557
	1890	$466,970	....	$3,250	....	$1,700	....	....	$23,550	....	$34,575
Buildings	1900	$3,914,853	$971,094	$70,100	$500	....	$750	$35,121	$740,315	$8,900	$206,659
	1890	$467,340	....	$4,250	....	$800	....	....	$110,300	....	$60,500
Machinery, tools, and implements	1900	$5,164,046	$1,849,264	$69,235	$185	....	$330	$33,538	$2,045,117	$7,400	$256,568
	1890	$487,420	....	$4,600	....	$230	....	....	$85,235	....	$27,755
Cash and sundries	1900	$9,677,806	$309,735	$500,950	$850	....	$1,100	$107,880	$5,558,269	$41,800	$1,076,543
	1890	$1,765,245	....	$34,970	....	$2,800	....	....	$308,335	....	$618,471
Salaried officials, clerks, etc., number	1900	618	64	33	....	....	....	8	177	6	122
	1890	[3]182	....	5	....	3	....	....	49	....	29
Salaries	1900	$585,160	$106,430	$49,710	....	....	....	$9,600	$139,497	$2,880	$103,131
	1890	$120,253	....	$2,815	....	$1,600	....	....	$23,837	....	$25,794
Wage-earners, average number	1900	13,410	2,092	376	....	....	5	236	5,567	442	1,328
	1890	5,020	....	74	....	5	....	....	2,342	....	603
Total wages	1900	$4,229,638	$1,242,642	$158,888	....	....	$2,642	$44,710	$1,184,850	$63,500	$475,123
	1890	$1,128,143	....	$12,439	....	$1,546	....	....	$447,806	....	$236,318
Men, 16 years and over	1900	9,731	2,091	279	....	....	5	45	2,895	207	1,194
	1890	3,787	....	58	....	5	....	....	1,351	....	448
Wages	1900	$3,733,506	$1,242,237	$136,422	....	....	$2,642	$22,450	$833,157	$36,900	$449,781
	1890	$986,689	....	$10,779	....	$1,546	....	....	$349,180	....	$204,250
Women, 16 years and over	1900	2,533	1	73	....	....	....	161	1,746	179	134
	1890	841	....	16	....	....	....	....	635	....	155
Wages	1900	$369,781	$405	$19,680	....	....	....	$21,260	$245,302	$22,600	$25,342
	1890	$121,059	....	$1,660	....	....	....	....	$80,951	....	$32,068
Children, under 16 years	1900	1,146	....	24	....	....	....	30	926	56	....
	1890	392	....	....	....	....	....	....	356	....	....
Wages	1900	$126,351	....	$2,786	....	....	....	$1,000	$106,391	$4,000	....
	1890	$20,395	....	....	....	....	....	....	$17,675	....	....
Miscellaneous expenses	1900	$883,363	$150,854	$23,370	$89	....	$526	$6,408	$97,859	$11,020	$118,058
	1890	$280,660	....	$1,906	....	$391	....	....	$94,712	....	$36,917
Cost of materials used	1900	$13,232,001	$1,587,883	$449,718	$6,238	....	$3,195	$67,583	$2,578,636	$154,605	$3,471,112
	1890	$4,710,709	....	$20,475	....	$7,006	....	....	$900,674	....	$2,031,863
Value of products	1900	$22,253,749	$3,821,136	$866,432	$8,473	....	$8,900	$144,379	$4,779,733	$248,100	$4,619,362
	1890	$6,972,268	....	$44,120	....	$11,302	....	....	$1,660,881	....	$2,537,088

	Year.	Michigan.[4]	Mississippi.[1]	New York.[4]	Ohio.	Oregon.	Pennsylvania.[2]	Virginia.[4]	Washington.	Wisconsin.[1]	All other states.
Number of establishments	1900	4	4	9	3	24	....	5	36	6	[5]8
	1890	....	....	....	5	15	6	....	7	....	[6]8
Capital: Total	1900	$6,800	$122,580	$100,564	$56,068	$2,558,642	....	$10,325	$2,222,726	$4,590	$65,245
	1890	....	....	....	$18,404	$1,365,800	$37,250	....	$320,790	....	$123,410
Land	1900	$700	$4,362	$17,021	$200	$127,522	....	$200	$118,288	$1,125	$13,520
	1890	....	....	....	$300	$372,000	$3,800	....	$14,945	....	$12,850
Buildings	1900	$1,850	$9,003	$25,553	$1,025	$1,539,129	....	$2,700	$284,804	$1,150	$16,300
	1890	....	....	....	$1,125	$220,000	$11,000	....	$53,615	....	$5,750
Machinery, tools, and implements	1900	$250	$12,628	$10,005	$42,943	$363,795	....	$1,825	$457,473	$815	$12,675
	1890	....	....	....	$3,000	$275,050	$5,300	....	$46,800	....	$39,450
Cash and sundries	1900	$4,000	$96,587	$47,985	$11,900	$528,196	....	$5,600	$1,362,161	$1,500	$22,750
	1890	....	....	....	$13,979	$498,750	$17,150	....	$205,430	....	$65,360
Salaried officials, clerks, etc., number	1900	....	9	7	5	58	....	6	116	....	7
	1890	....	....	....	6	51	8	....	15	....	16
Salaries	1900	....	$7,600	$6,520	$4,160	$56,125	....	$550	$93,117	....	$5,940
	1890	....	....	....	$3,910	$29,362	$5,570	....	$8,655	....	$18,710
Wage-earners, average number	1900	19	231	66	51	636	....	18	2,190	3	150
	1890	....	....	....	17	1,473	22	....	316	....	168
Total wages	1900	$7,961	$41,028	$20,842	$21,600	$219,744	....	$4,545	$711,214	$1,010	$29,339
	1890	....	....	....	$5,280	$300,824	$12,520	....	$63,820	....	$47,590
Men, 16 years and over	1900	18	71	39	51	620	....	11	2,086	2	117
	1890	....	....	....	6	1,467	22	....	306	....	124
Wages	1900	$7,886	$20,353	$18,424	$21,600	$217,750	....	$2,995	$693,480	$720	$26,709
	1890	....	....	....	$3,600	$300,624	$12,520	....	$62,820	....	$41,470

[1] None reported in 1890.
[2] Reported under head of other states in 1900.
[3] Includes proprietors and firm members, with their salaries, number only reported in 1900, but not included in this table. (See Table 24.)
[4] Includes establishments distributed as follows: District of Columbia, 1; Missouri, 1; New Hampshire, 1; New Jersey, 1; North Carolina, 1; Pennsylvania, 1; South Carolina, 1; Texas, 1.
[5] Includes establishments distributed as follows: Michigan, 1; Minnesota, 2; New Jersey, 2; New York, 2; Virginia, 1.

TABLE 17.—FISH, CANNING AND PRESERVING: COMPARATIVE SUMMARY, BY STATES AND TERRITORIES, 1890 AND 1900—Continued.

	Year.	Michigan.[3]	Mississippi.[1]	New York.[3]	Ohio.	Oregon.	Pennsylvania.[2]	Virginia.[3]	Washington.	Wisconsin.[1]	All other states.
Women, 16 years and over	1900	....	98	27	....	11	....	6	73	....	24
	1890	....	....	....	3	....	....	....	....	....	32
Wages	1900	....	$14,125	$2,418	....	$1,494	....	$1,325	$13,730	....	$2,100
	1890	....	....	....	$680	....	....	....	....	....	$5,700
Children under 16 years	1900	1	62	....	....	5	....	1	31	1	9
	1890	....	....	....	8	6	....	....	10	....	12
Wages	1900	$75	$6,550	....	....	$500	....	$225	$4,004	$290	$530
	1890	....	....	....	$1,100	$200	....	....	$1,000	....	$420
Miscellaneous expenses	1900	$1,318	$17,997	$11,741	$2,610	$147,858	....	$496	$285,353	$1,005	$6,801
	1890	....	....	....	$1,364	$92,972	$5,175	....	$33,801	....	$13,422
Cost of materials used	1900	$52,949	$190,441	$134,211	$70,406	$1,182,218	....	$13,239	$3,086,865	$28,142	$154,560
	1890	....	....	....	$21,388	$1,066,127	$91,885	....	$346,532	....	$224,759
Value of products	1900	$65,077	$337,939	$197,869	$251,040	$1,788,809	....	$24,700	$4,831,038	$35,792	$224,970
	1890	....	....	....	$42,759	$1,643,324	$126,370	....	$525,000	....	$381,424

[1] None reported in 1890.
[2] Reported under head of other states in 1900.
[3] Reported under head of other states in 1890.

Table 17 is interesting in that it shows concisely the status of the industry in each state in 1890 and 1900, and hence the growth and development in each state since 1890. In that year the canning and preserving of fish was carried on in 13 states by 110 establishments, and in 1900 the number had increased to 348, distributed among 24 states and territories. In order to avoid disclosing the operations of individual establishments, states having less than three establishments were grouped under the heading "all other states." Nearly every state and territory showed a marked increase in the number of establishments, capital, and value of products, with the exceptions of the District of Columbia, Ohio, and Pennsylvania. The former reported 3 establishments in 1890, the latter 5, but in 1900 no establishments were returned by either. Ohio, although reporting a decrease in the number of establishments since 1890, showed a notable increase in both the capital and the value of products. There is in this industry, as in the canning and preserving of fruits and vegetables, a tendency to centralize in points nearest the sources of the supply of material, and the states and territories located nearest the fish supply led in the number of establishments, capital, and value of products both in 1890 and in 1900, and have also shown the most marked increase and development during the decade. These states and territories, ranked according to the value of products for the census year, were as follows: Washington, $4,831,038; Maine, $4,779,733; Massachusetts, $4,619,362; Alaska, $3,821,136; Oregon, $1,788,809; California, $866,432. The total value of products of these 5 states was $20,706,510, or over 90 per cent of the total value of products of the industry. The number of establishments reported by these states and territories was 293, or 84.2 per cent of the total number, and the capital was returned as $18,891,164, as compared with $19,514,215 for the entire country—that is, the capital for these states and territories formed 96.8 per cent of the total capital. Of the remaining states, Louisiana and Mississippi have become engaged in the industry since 1890 and showed most gratifying returns.

The summary of establishments engaged in the canning and preserving of fish, classified according to the number of wage-earners employed, is shown in Table 18. In this connection, attention is here directed to the fact that the data contained in this table were computed from the greatest number of wage-earners employed at any one time during the year. This should be taken into consideration in making deductions.

TABLE 18.—FISH, CANNING AND PRESERVING: ESTABLISHMENTS CLASSIFIED BY NUMBER OF WAGE-EARNERS EMPLOYED, BY STATES AND TERRITORIES, ARRANGED GEOGRAPHICALLY, 1900.

	Total number of establishments.	NUMBER OF ESTABLISHMENTS EMPLOYING—							
		No wage-earners.	Under 5	5 to 20	21 to 50	51 to 100	101 to 250	251 to 500	501 to 1,000
United States	348	20	43	103	69	36	60	11	6
New England states	179	3	26	69	40	17	17	3	4
Maine	117	2	15	44	27	10	12	3	4
New Hampshire	1	1	....	....	....	....	....	....	....
Massachusetts	61	....	11	25	13	7	5	....	....

TABLE 18.—FISH, CANNING AND PRESERVING: ESTABLISHMENTS CLASSIFIED BY NUMBER OF WAGE-EARNERS EMPLOYED, BY STATES AND TERRITORIES, ARRANGED GEOGRAPHICALLY, 1900—Continued.

	Total number of establishments.	NUMBER OF ESTABLISHMENTS EMPLOYING—							
		No wage-earners.	Under 5	5 to 20	21 to 50	51 to 100	101 to 250	251 to 500	501 to 1,000
Middle states	18	4	4	7		1	1	1	
New York	9		4	4		1			
New Jersey	1			1					
Pennsylvania	1	1							
Delaware	3	3							
Maryland	3			1			1	1	
District of Columbia	1			1					
Southern states	18		1	6	3	1	7		
Virginia	5			3	2				
North Carolina	1						1		
South Carolina	1				1				
Mississippi	4			1			3		
Louisiana	6		1	2			3		
Texas	1					1			
Central states	18	7	6	3	1		1		
Ohio	3	2					1		
Michigan	4		1	2	1				
Illinois	4	1	3						
Wisconsin	6	4	2						
Missouri	1			1					
Pacific states	79	6	6	12	23	13	15	2	2
Washington	36		2	6	11	6	8	1	2
Oregon	24		1	3	10	5	4	1	
California	19	6	3	3	2	2	3		
Outlying districts	36			6	2	4	19	5	
Alaska	36			6	2	4	19	5	

Table 18 shows that the largest number of establishments employed from 5 to 20 wage-earners, and 6 establishments, 4 of which were located in Maine and 2 in Washington, gave employment to over 500 wage-earners. Maine, with her sardine factories, and Washington and Alaska, with their salmon canneries, reported the largest number of establishments, employing the greatest number of wage-earners. The largest number of establishments in Maine was reported for the group from 5 to 20, for Massachusetts the same, for Washington 21 to 50, and for Alaska 101 to 250. It appears that the establishments located in the New England states employed the greatest number of wage-earners, while the Pacific states ranked second and Alaska third. In 20 small establishments no wage-earners were employed, presumably all the work being done by the owners.

Table 19 presents a comparative summary of the statistics of capital for 1890 and 1900, with the percentages of the total and the increase for the several items.

TABLE 19.—FISH, CANNING AND PRESERVING: STATISTICS OF CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$19,514,215	100.0	$3,186,975	100.0	512.3
Land	757,510	3.9	466,970	14.6	62.2
Buildings	3,914,853	20.1	467,340	14.7	737.7
Machinery, tools, and implements	5,164,046	26.4	487,420	15.3	959.5
Cash and sundries	9,677,806	49.6	1,765,245	55.4	448.2

Every item of capital except the value of land showed a most notable increase, and even the value of land showed an increase of 62.2 per cent. The item, cash and sundries, including cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, formed the principal item of capital in both years, but constituted a relatively larger per cent of the total in 1890 than in 1900. This follows from the nature of the industry, which does not necessitate the use of intricate machinery and mechanical appurtenances or costly structures for housing the same. The value of machinery, tools, and implements formed the second largest item in both years, and not only exhibited the most striking increase of all of the items of capital, but constituted a relatively larger per cent of the total than in 1890. This is a noteworthy fact and is significant of the increasing use of machinery especially adapted for the different processes employed in the canning and preserving of fish. The value of land, although showing an increase, formed a much smaller per cent of the total than in 1890.

As the several items of miscellaneous expenses for 1890 can not be shown separately, a detailed comparison with those reported for 1900 can not be made. The expenses of this nature in this industry do not call for special comment, but the several subdivisions for 1900 are shown in Table 24.

The cost of materials used, with the proportion each formed of the total, for 1900, is given in Table 20.

As shown in Table 20 the total cost of materials for 1900 was $13,232,001, of which the amount reported for principal materials formed 97.1 per cent. The materials purchased in the raw state, including the several varieties of fish, and also the cost of fruits and vegetables, which were canned in connection with the fish industry, amounted to $6,512,438, or 49.2 per cent of the total cost. The amount reported as the cost of materials purchased in partially manufactured form was $6,343,635, or 47.9 per cent of the total. This item includes the cost of cans, solder, boxes, etc., and such other materials reported under "all other materials" as were required in the preparation of the product. It also includes mill supplies which, together with all other materials, are shown separately in Table 24. The amount paid for fuel and rent of power and heat was insignificant. The cost of freight should only be considered in connection with the cost of the principal materials, as many establishments buy their materials delivered, and it was impossible in every instance to segregate the amount chargeable to freight.

TABLE 20.—FISH, CANNING AND PRESERVING: COST OF MATERIALS USED, 1900.

	Amount.	Per cent of total.
Total	$13,232,001	100.00
Principal materials[1]	12,856,073	97.1
Fuel	175,935	1.3
Rent of power and heat	6,365	.1
Freight	193,628	1.5

[1] Includes mill supplies and all other materials, which are shown separately in Table 24.

Table 21 shows the value of products, by states, for 1900.

TABLE 21.—FISH, CANNING AND PRESERVING: VALUE OF PRODUCTS, BY STATES AND TERRITORIES, ARRANGED GEOGRAPHICALLY, 1900.

STATES AND TERRITORIES.	VALUE.		
	Total products.	Fish.	All other products.
United States	$22,253,749	$20,808,709	$1,445,040
New England states	9,400,565	9,147,420	253,145
Maine	4,779,733	4,753,071	26,662
All other states[1]	4,620,832	4,394,349	226,483
Middle states	484,842	446,365	38,477
New York	197,869	175,392	22,477
Delaware	8,473	8,473	....
Maryland	248,100	232,100	16,000
All other states[2]	30,400	30,400	....

[1] Includes establishments distributed as follows: New Hampshire, 1; Massachusetts, 61.
[2] Includes establishments distributed as follows: New Jersey, 1; Pennsylvania, 1; District of Columbia, 1.

TABLE 21.—FISH, CANNING AND PRESERVING: VALUE OF PRODUCTS, BY STATES AND TERRITORIES, ARRANGED GEOGRAPHICALLY, 1900—Continued.

STATES AND TERRITORIES.	VALUE.		
	Total products.	Fish.	All other products.
Southern states	$550,118	$380,972	$169,146
Virginia	24,700	24,700	....
Mississippi	337,939	211,001	126,938
Louisiana	144,379	108,121	36,258
All other states[1]	43,100	37,150	5,950
Central states	510,809	188,144	322,665
Ohio	251,040	79,140	171,900
Michigan	65,077	64,877	200
Wisconsin	35,792	35,227	565
All other states[2]	158,900	8,900	150,000
Pacific states	7,486,279	6,824,672	661,607
Washington	4,831,038	4,281,962	549,076
Oregon	1,788,809	1,746,073	42,736
California	866,432	796,637	69,795
Outlying districts	3,821,136	3,821,136	....
Alaska	3,821,136	3,821,136	....

[1] Includes establishments distributed as follows: North Carolina, 1; South Carolina, 1; Texas, 1.
[2] Includes establishments distributed as follows: Illinois, 4; Missouri, 1.

Table 21 is designed to show the relative proportion of the value of all other products canned to the value of preserved fish. Of the total value of products, $20,808,659, or 93.5 per cent, was given as the value of canned and preserved fish, and $1,445,090, or 6.5 per cent, as the value of "all other products." The latter item includes the value of fresh fish handled in bulk by establishments engaged in the canning and preserving of fish, and as it was impracticable to separate the amounts directly chargeable to this branch of the industry, the totals were included under "all other products." It will be noticed that in some states this item reaches goodly proportions while in others it is insignificant.

The tables which have thus far been shown give an incomplete showing of the fish canning and preserving industry for the reason that, as has been explained, establishments are classified according to the predominating product, and in many instances the canning and preserving of fish is carried on in connection with some other branch of the canning industry, and the totals have not been included in the above tables. It is possible, however, to show the total quantity and value of fish canned and preserved during the census year as reported by establishments of any character. This is done in Table 22.

TABLE 22.—FISH, CANNING AND PRESERVING: QUANTITY AND VALUE OF PRODUCTS,

		UNITED STATES.	NEW ENGLAND STATES.			MIDDLE STATES.				
			Total.	Maine.	All other states.[1]	Total.	New York.	Delaware.	Maryland.	All other states.[2]
1	Aggregate value	$20,856,057	$9,179,616	$4,756,271	$4,423,345	$446,365	$175,392	$8,473	$232,100	$30,400
	Canned fish—									
2	Total pounds	172,856,178	50,854,624	48,451,808	2,402,716	2,817,467	166,896	...	2,650,571	...
3	Total value	$14,639,127	$4,584,849	$4,312,384	$272,465	$255,125	$23,025	...	$232,100	...
	Salmon—									
4	Pounds	114,645,144	314,310	303,750	10,560	...	...	...	...	...
5	Value	$9,287,162	$17,180	$16,200	$980	...	...	...	...	...
	Sardines—									
6	Pounds	44,951,244	44,562,536	44,420,236	142,300	...	...	...	...	...
7	Value	$4,212,351	$4,133,491	$4,049,784	$83,707	...	...	...	...	...
	Clams—									
8	Pounds	4,456,718	3,216,670	3,136,270	80,400	566,896	166,896	...	400,000	...
9	Value	$345,774	$216,254	$210,401	$5,853	$63,025	$23,025	...	$40,000	...
	Oysters—									
10	Pounds	4,104,818	...	...	...	1,920,000	...	...	1,920,000	...
11	Value	$266,018	...	...	...	$100,000	...	...	$100,000	...
	Mackerel—									
12	Pounds	2,155,820	2,155,820	34,464	2,121,356	...	...	...	...	...
13	Value	$180,213	$180,213	$2,488	$177,725	...	...	...	...	...
	Shrimps—									
14	Pounds	1,126,139	7,200	...	7,200	...	...	...	...	...
15	Value	$147,862	$800	...	$800	...	...	...	...	...
	Crabs—									
16	Pounds	656,055	...	...	...	330,571	...	...	330,571	...
17	Value	$142,480	...	...	...	$92,100	...	...	$92,100	...
	Other varieties—									
18	Pounds	760,240	597,988	557,088	40,900	...	...	...	...	...
19	Value	$57,317	$36,911	$33,511	$3,400	...	...	...	...	...
	Smoked fish—									
20	Total pounds	21,723,426	13,377,788	6,765,196	6,612,592	2,668,250	2,309,600	138,550	...	220,100
21	Total value	$986,003	$491,812	$150,310	$341,502	$129,095	$101,082	$6,833	...	$21,180
	Herring—									
22	Pounds	13,147,789	9,919,714	6,422,476	3,497,238	1,937,050	1,694,000	135,550	...	107,500
23	Value	$353,252	$255,001	$136,310	$118,691	$28,083	$17,040	$6,133	...	$4,910
	Halibut—									
24	Pounds	3,621,462	1,862,462	...	1,862,462	2,000	...	...	...	2,000
25	Value	$271,032	$156,432	...	$156,432	200	...	...	...	$200
	Salmon—									
26	Pounds	1,975,647	25,392	...	25,392	116,500	97,000	...	...	19,500
27	Value	$136,331	$4,059	...	$4,059	$17,800	$13,900	...	...	$3,900
	Sturgeon—									
28	Pounds	514,900	...	...	...	480,800	454,000	...	...	26,800
29	Value	$77,879	...	...	...	$72,770	$66,110	...	...	$6,660
	Finnan haddie—									
30	Pounds	1,360,500	1,307,500	80,000	1,227,500	53,000	...	1,000	...	52,000
31	Value	$75,360	$71,120	$8,800	$62,320	$4,240	...	$600	...	$3,640
	Other varieties—									
32	Pounds	1,103,128	262,720	262,720	...	78,900	64,600	2,000	...	12,300
33	Value	$72,149	$5,200	$5,200	...	$6,002	4,032	$100	...	$1,870
	Salted fish—									
34	Total pounds	125,669,131	99,169,822	17,845,321	81,324,501	1,375,614	1,167,814	31,800	...	176,000
35	Total value	$5,260,927	$4,102,955	$293,577	$3,809,378	$62,145	$51,285	$1,640	...	$9,220
	Mackerel—									
36	Pounds	10,458,313	10,262,099	...	10,262,099	146,214	111,214	...	...	35,000
37	Value	$662,008	$644,523	...	$644,523	$10,485	$7,785	...	...	$2,700
	Herring—									
38	Pounds	15,933,426	10,696,995	3,549,045	7,147,950	1,106,600	1,046,600	...	...	60,000
39	Value	$394,020	$238,176	$73,029	$165,147	$44,300	$42,500	...	...	$1,800
	Cod—									
40	Pounds	65,418,710	57,036,427	8,535,000	48,501,427	52,000	...	...	...	52,000
41	Value	$3,108,645	$2,625,006	$80,454	$2,544,552	$3,120	...	...	...	$3,120
	Haddock—									
42	Pounds	6,927,919	6,844,919	681,050	6,163,869	...	...	...	...	...
43	Value	$197,360	$195,520	$12,652	$182,868	...	...	...	...	...
	Other varieties—									
44	Pounds	26,930,763	14,329,382	5,080,226	9,249,156	70,800	10,000	31,800	...	29,000
45	Value	$898,994	$399,730	$127,442	$272,288	$4,240	$1,000	$1,640	...	$1,600

[1] Includes establishments distributed as follows: Massachusetts, 61; New Hampshire, 1.
[2] Includes establishments distributed as follows: New Jersey, 1; District of Columbia, 1; Pennsylvania, 1.

BY STATES AND TERRITORIES ARRANGED GEOGRAPHICALLY, 1900.

SOUTHERN STATES.					CENTRAL STATES.					PACIFIC STATES.				OUTLYING DISTRICT.	
Total.	Virginia.	Mississippi.	Louisiana.	All other states.[1]	Total.	Ohio.	Michigan.	Illinois.	Wisconsin.	Total.	Washington.	Oregon.	California.	Alaska.	
$426,124	$69,902	$211,001	$108,121	$37,100	$188,144	$79,140	$64,877	$8,900	$35,227	$6,824,672	$4,281,962	$1,746,073	$796,637	$3,821,136	1
3,638,647	344,448	2,375,190	616,417	302,592	...	...	...	...	...	63,533,988	43,195,262	16,469,602	3,869,124	52,011,552	2
$389,514	$50,202	$211,001	$91,211	$37,100	...	...	...	...	...	$5,800,901	$3,762,169	$1,697,064	$341,668	$3,608,738	3
...	...	...	...	...	...	...	...	...	...	62,338,482	42,969,114	15,915,352	3,454,016	51,992,352	4
...	...	...	...	...	...	...	...	...	...	$5,662,144	$3,745,957	$1,655,329	$260,858	$3,607,838	5
...	...	...	...	...	...	...	...	...	...	388,708	...	...	388,708	...	6
...	...	...	...	...	...	...	...	...	...	$78,860	...	...	$78,860	...	7
213,600	36,000	...	...	177,600	...	...	...	...	...	440,352	221,952	192,000	26,400	19,200	8
$28,600	$5,000	...	...	$23,600	...	...	...	...	...	$36,995	$15,045	$20,000	$1,950	$900	9
1,822,568	...	1,822,568	...	...	...	...	...	...	...	362,250	...	362,250	...	...	10
$144,283	...	$144,283	...	...	...	...	...	...	...	$21,735	...	$21,735	...	...	11
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13
1,118,939	...	539,782	514,165	64,992	...	...	...	...	...	...	...	...	...	...	14
$147,012	...	$62,707	$79,805	$4,500	...	...	...	...	...	...	...	...	...	...	15
321,288	308,448	12,840	...	...	...	...	...	...	...	4,196	4,196	...	...	...	16
$49,213	$45,202	$4,011	...	...	...	...	...	...	...	$1,167	$1,167	...	...	...	17
162,252	...	...	102,252	60,000	...	...	...	...	...	...	...	...	...	...	18
$20,406	...	...	$11,406	$9,000	...	...	...	...	...	...	...	...	...	...	19
...	...	...	...	...	1,501,588	146,500	834,169	52,019	468,900	4,175,800	3,700,800	250,000	225,000	...	20
...	...	...	...	...	$120,104	$13,100	$64,877	$6,900	$35,227	$244,992	$225,992	$10,000	$9,000	...	21
...	...	...	...	...	697,425	100,000	597,425	...	...	593,600	593,600	...	...	...	22
...	...	...	...	...	$52,668	$7,000	$45,668	...	...	$17,500	$17,500	...	...	...	23
...	...	...	...	...	...	...	...	...	...	1,757,000	1,757,000	...	...	...	24
...	...	...	...	...	...	...	...	...	...	$114,400	$114,400	...	...	...	25
...	...	...	...	...	11,355	...	...	11,355	...	1,822,400	1,347,400	250,000	225,000	...	26
...	...	...	...	...	$1,700	...	...	$1,700	...	$112,772	$93,772	$10,000	$9,000	...	27
...	...	...	...	...	31,300	22,500	1,300	7,500	...	2,800	2,800	...	...	...	28
...	...	...	...	...	$4,789	$3,500	$169	$1,120	...	$320	$320	...	...	...	29
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31
...	...	...	...	...	761,508	24,000	235,444	33,164	468,900	...	...	...	...	...	32
...	...	...	...	...	$60,947	$2,600	$19,040	$4,080	$35,227	...	...	...	...	...	33
1,405,200	1,310,000	...	95,200	...	2,246,571	2,218,000	...	28,571	...	15,782,824	8,303,160	335,328	7,144,336	5,689,100	34
$36,610	$19,700	...	$16,910	...	$68,040	$66,040	...	$2,000	...	$778,779	$293,801	$39,009	$445,969	$212,398	35
50,000	...	...	50,000	...	...	...	...	...	...	...	...	...	...	...	36
$7,000	...	...	$7,000	...	...	...	...	...	...	...	...	...	...	...	37
1,275,000	1,275,000	...	...	...	2,028,571	2,000,000	...	28,571	...	826,260	736,260	...	90,000	...	38
$19,000	$19,000	...	...	...	$62,000	$60,000	...	$2,000	...	$30,544	$15,344	...	$15,200	...	39
...	...	...	...	...	...	...	...	...	...	7,642,783	954,400	...	6,688,383	687,500	40
...	...	...	...	...	...	...	...	...	...	$452,919	$45,445	...	$407,474	$27,500	41
35,000	35,000	...	...	...	18,000	18,000	...	...	...	30,000	30,000	...	...	...	42
$700	$700	...	...	...	$540	$540	...	...	...	$600	$600	...	...	...	43
45,200	...	...	45,200	...	200,000	200,000	...	...	...	7,283,781	6,582,500	335,328	365,953	5,001,600	44
$9,910	...	...	$9,910	...	$5,500	$5,500	...	...	...	$294,716	$232,412	$39,009	$23,295	$184,898	45

[1] Includes establishments distributed as follows: North Carolina, 1; South Carolina, 1; Texas, 1.

The figures in Table 22 include the quantity and value of fish canned in fish-canning establishments as such, and also the quantity and value reported as a subsidiary product in establishments engaged primarily in the canning and preserving of oysters, or in the canning and preserving of fruits and vegetables. The values reported do not include the amounts reported as the value of all other products, and therefore the totals given in Table 22 do not agree with the total products given elsewhere in this report, or with those of the report on this industry as presented in the general report on Manufactures, Parts I and II. In addition to those included under "other varieties" there are some varieties of fish, known to be canned or preserved, which do not appear in Table 22. This is accounted for by the fact that it was impossible to ascertain the quantity and value of each, as they were not separately reported. Accordingly they were included under "all other products" in Table 21.

Table 22 shows that the total value of fish canned, smoked, and salted during the census year was $20,836,057. The total number of pounds of canned fish was 172,856,178, valued at $14,589,127; of smoked fish, 21,723,426 pounds, valued at $986,003; and of salted fish, 125,669,131 pounds, valued at $5,260,927. Attention is here directed to the fact that the values given are those fixed at the factory. In making deductions relative to the average value per pound this should be borne in mind.

It appears that the New England states led in this industry, reporting $9,179,616 as the value of the fish products, or 44 per cent of the total value. The Pacific states ranked second, reporting $6,824,672 as the value of prepared fish, or 32.7 per cent of the total value. Alaska ranked third, with $3,821,136. The Middle and Central states followed in the order given.

In the total number of pounds of canned fish, Alaska ranked first, reporting 52,011,552 pounds, or 30.1 per cent of the total number; Maine ranked second, with 48,451,808 pounds; Washington third, with 43,195,262 pounds; Oregon fourth, with 16,469,602 pounds, and California fifth, with 3,869,124 pounds. The total number of pounds of canned fish reported by these 5 states was 163,997,348, or 94.9 per cent of the total number of pounds reported for the entire country.

The smoking and salting of fish, although carried on extensively in the Pacific states, is principally confined to the states on the Atlantic coast.

The principal details of the statistics for the canning and preserving of fish as carried on in cities of over 20,000 population are shown in Table 23.

Table 23.—FISH, CANNING AND PRESERVING: STATISTICS OF CITIES OF 20,000 POPULATION OR OVER, 1900.

CITIES.	Rank by value of products.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
Total	....	108	$2,653,878	196	$184,150	1,977	$746,315	$192,637	$4,847,813	$6,857,803
Gloucester, Mass	1	38	1,479,647	85	68,106	1,154	398,703	100,759	2,845,657	3,746,326
Seattle, Wash	2	7	336,620	33	25,380	259	106,334	32,501	743,602	1,037,174
Boston, Mass	3	13	200,030	32	31,494	96	49,156	13,151	553,645	725,785
San Francisco, Cal	4	12	132,385	13	24,420	123	58,518	13,817	190,927	384,969
New York, N. Y	5	7	51,915	4	2,620	23	13,074	9,327	96,145	140,985
Tacoma, Wash	6	3	26,725	2	1,400	27	11,690	1,600	48,596	74,375
Portland, Me	7	5	10,290	....	....	14	6,180	906	27,881	39,975
Chelsea, Mass	8	3	5,125	....	....	4	2,128	784	22,136	31,895
Milwaukee, Wis	9	5	2,540	....	....	1	290	452	16,172	20,667
Chicago, Ill	10	4	2,655	....	....	5	2,642	526	3,195	8,900
All other cities[1]	....	11	405,946	27	30,730	271	97,600	18,814	299,857	646,752

[1] Includes establishments distributed as follows: Buffalo, N. Y., 1; Cleveland, Ohio, 1; District of Columbia, 1; Los Angeles, Cal., 1; New Britain, Conn., 1; New Orleans, La., 2; Philadelphia, Pa., 1; Portland, Oreg., 1; St. Louis, Mo., 1; Wilmington, Del., 1.

It appears from Table 23 that of the total value of products, $6,857,803, or 32.9 per cent, was reported for the cities named, and of this amount $3,746,326, or 18 per cent of the total for the United States, was returned for Gloucester. In this connection attention should be directed to the fact that in general the Eastern cities included in Table 23 are not only engaged in canning, but also in the salting and smoking of almost every variety of fish that is native of the surrounding waters. Many large establishments also handle fresh fish in large quantities, and as it was impossible to separate the amounts directly chargeable to the manufacturing branch of the business, the value of fresh fish handled is included in the total value of products. This is especially true of Gloucester, and should be taken into consideration in making comparisons and deductions. The Western cities named are engaged almost exclusively in the canning of salmon caught in the waters of the Columbia river and its tributaries. The industry has its center in the city of Astoria, Oreg., but, inasmuch as it has less than 20,000 population, separate statistics are not shown for that city.

HISTORICAL AND DESCRIPTIVE.

No food supply is so subject to rapid putrefaction as fishery products, and for their preservation all the generally known processes are employed. The canning of various kinds of fish has always been an important branch of the canning industry. Even before the processes of Soddington and Appert were known the people of Holland put up salmon in tin cans in the following manner: The head of the fish was severed immediately after caught, and the fish was then hung up by the tail to permit the blood to flow from it. The viscera were then removed, and the fish, after being carefully washed, was boiled in a brine of white salt. Before being completely cooked, however, it was taken out of the brine, cooled, smoked for a day or two by exposure to juniper, and then placed in tin cans liberally supplied with butter freshly salted and melted. In winter, olive oil was used instead of butter. The cans were then covered and soldered.[1]

After the introduction of the Appert process, and the substitution of tin cans for glass, fish canning was successfully and extensively carried on at Aberdeen, Scotland; Sligo, Ireland; and various other points in Europe. About the year 1845, the canning of sardines was successfully established on the coast of France, and up to the present time the industry in that country has had an uninterrupted and remarkable growth.

Prior to 1843, the canning of fish in the United States was very limited, but in that year the firm of Treat, Noble & Holliday, with the assistance of Mr. Charles Mitchell, a native of Scotland who had mastered the methods used in the canneries of Aberdeen, successfully began the canning of lobsters and mackerel at Eastport, Maine. Chiefly through the efforts of Mr. U. S. Treat they succeeded in introducing their goods, and with a ready market at their command the enterprise proved a success. The business after 1849, rapidly increased, and in 1860 canneries engaged in putting up lobsters, mackerel, and fruits and vegetables were found in many of the coast cities of Maine. The supply of lobsters on the coast of Maine rapidly decreased, and a prejudice also existed against the canneries, resulting in the enactment of stringent laws restricting the time of operation of canneries and canning of short lobsters. This caused a rapid decrease in the number of factories engaged in lobster canning, and in the year 1895 the last establishment engaged exclusively in the canning of lobsters suspended operations. During the census year, as indicated in Table 22, there were no lobsters reported as canned.

Salmon canning, one of the most important branches of the fish-canning industry, was carried on to a limited extent in Europe and the United States, prior to 1864. In that year the industry was started on the Pacific coast at Washington, Yolo county, Cal., on the Sacramento River, by Messrs. Hapgood, Hume & Co. Their success can be attributed to the fact that a member of the firm had previously mastered the process of canning as practiced on the eastern coast, and consequently the goods packed found a ready market. With the increasing demands for the product, an establishment was built on the Columbia River, at Eagle Cliff, in 1866. The industry developed rapidly and reached its maximum production in 1883. The constant fishing for salmon along the river seriously affected the possible supply, but the exhaustion of these fisheries, threatened in the early years of the decade, was averted by more rigid laws against improvident fishing and also by the artificial propagation of fish.[2] The waters of the streams and rivers of Alaska were found to possess an unlimited supply of salmon, and in 1878 canneries were located at Klawak and Old Sitka, the latter cannery being removed to Cook Inlet in 1882. In the following year there were 5 canneries located in Alaska, and six years later, 37 were in operation, with an output of 714,196 cases. The great production of these canneries in 1890 and 1891 glutted the markets, with a considerable loss to the owners of the canneries. This led to a combination of the firms engaged in this business to limit the yearly output of each salmon cannery. This plan has been successfully adopted, and the average output each year is now regulated to meet the probable consumption.

Since the beginning of the industry, in 1864, the methods in the process of canning have been greatly improved. The original appliances and devices used were very crude and involved considerable labor and expense in operation. The improvements made have mainly been in lessening the period of cooking, permitting the escape of heated air in the cans, softening the bones of the small fish, and in the filling, capping, labeling, and boxing of the cans.

Salmon canneries are generally located at the water's edge or partly projecting over the water. The fish are received by the Chinese, who have practically a monopoly on the labor performed in salmon canneries, weighed, and thrown from the scales upon a floor where they are washed and treated to an ice-cold water bath to keep them fresh and cool. They are then taken to the dressing tables, where the head, fins, and tail are severed. After this they are passed to another operator, who removes the viscera and thoroughly scrapes the carcass inside and out. The waste if not used for oil or fertilizer is thrown back into the water. The fish is then subjected to another washing and at the same time the scales are removed. It is now placed in a second tank of clear water for its final washing and cleaning. By a mechanical device, operated either by hand or machin-

[1] Treatise on fishing for herring, etc., published in 1800, at Dublin.

[2] United States Fish Commission Bulletin, 1898, pages 22–31.

ery, the fish is cut transversely in sections of the exact length of the cans to be filled. The fish is then ready for the fillers' table, where it is placed in cans either by machinery or by hand, after which the cans are topped and soldered together. After the cans are tested for defects they are sent to the "bathroom" for their first cooking. Here they are heated in retorts made of heavy plank well bolted to sustain the steam pressure, or in retorts made of iron or steel plate. It is necessary to cook not only the fish thoroughly but also the bones in order to make them crumble to pieces. After the first cooking, the cans are tested by the process known as "blowing" or "renting," which consists of making a small perforation in each can to permit the escape of the steam, which if allowed to remain would ruin the can. The can is then placed in another retort for its second or final cooking, after which it is subjected to a lye bath to remove the grease and dirt. Fresh water is then poured on the can to remove the lye. When once cooled, the cans are lacquered, and after being labeled and cased they are ready for the market.[1]

The sardine canning of Maine is next in importance to the salmon canning of the Pacific coast. The sardine is a general term applied to various small-sized fishes, varying in length from 5 to 10 inches. They are found in various parts of the world, the best known being the young of the pilchard, which are plentiful along the coast of France, and the young of the sea herring, found along the coast of Maine. The canning of the sardine was begun at Nantes, France, in 1834, and although attempts had been made to put up herring along the coast of Maine as early as 1867, it was not a decided success until 1875. For the first five years the industry was confined within narrow limits, but by 1880 the industry was augmented by the establishment of canneries at Eastport, Robinson, Lubec, Jonesport, East Lamoine, and Camden, Maine. This industry during its early days at Eastport and Lubec, outranked all other branches of business in importance, furnishing employment for a majority of the inhabitants.

The process used in putting up the sardine is an exceedingly complicated one, and the methods employed in different places are quite at variance. Wherein the treatment of the sardine differs from that accorded the salmon is the use of oil in putting up the former. The fish is fried in oil and then placed in a can with a solution of oil. The oil used in the French sardine canneries is either olive oil or peanut oil, while cottonseed oil is the most extensively used in Maine. The sardine is also put up in mustard, spices, and tomato sauce.

In addition to the fishes named, eels, herring, menhaden, smelt, sturgeon, halibut, Spanish mackerel, and several other varieties are canned in the principal canneries.

Canned marine products are very aptly divided into five general classes, viz: First, plain boiled, steamed, or otherwise cooked; second, preserved in oil; third, preserved with vinegar, sauces, spices, jellies, etc.; fourth, cooked with vegetables; fifth, preserved by some other process, but placed in cans for convenience. In the first class, salmon, mackerel, halibut, lobsters, clams, etc., are included, while sardines make up the second class. Herring put up as "brook trout," eels, sturgeon, etc., comprise the third division, and the fourth class is made up of fish chowder, clam chowder, codfish balls, etc. The last class includes fishes prepared by smoking and salting, and then canned for convenience.[2]

Table 24 shows the detailed statistics, by states and territories, for the industry as returned for 1900.

[1] United States Fish Commission Bulletin, 1893, pages 22–31.

[2] United States Fish Commission Bulletin, 1898, page 511.

TABLE 24.—FISH, CANNING AND PRESERVING:

		United States.	Alaska.	California.	Delaware.	Illinois.	Louisiana.
1	Number of establishments	348	36	19	3	4	6
	Character of organization:						
2	Individual	134	4	2	2	4	1
3	Firm and limited partnership	102	1	9			4
4	Incorporated company	112	31	8	1		1
	Capital:						
5	Total	$19,514,215	$3,203,228	$691,285	$1,935	$2,655	$186,689
6	Land	$757,510	$73,135	$51,000	$400	$475	$10,150
7	Buildings	$3,914,853	$971,094	$70,100	$500	$750	$35,121
8	Machinery, tools, and implements	$5,164,046	$1,849,264	$69,235	$185	$330	$33,538
9	Cash and sundries	$9,677,806	$309,735	$500,950	$850	$1,100	$107,880
10	Proprietors and firm members	386	7	33	5	4	12
	Salaried officials, clerks, etc.:						
11	Total number	618	64	33			8
12	Total salaries	$585,160	$106,430	$49,710			$9,500
	Officers of corporations—						
13	Number	72	6	11			
14	Salaries	$115,030	$18,240	$27,000			
	General superintendents, managers, clerks, etc.—						
15	Total number	546	58	22			8
16	Total salaries	$470,130	$88,190	$22,710			$9,500
	Men—						
17	Number	486	58	20			8
18	Salaries	$450,956	$88,190	$21,670			$9,500
	Women—						
19	Number	60		2			
20	Salaries	$19,174		$1,040			
	Wage-earners, including pieceworkers, and total wages:						
21	Greatest number employed at any one time during the year	26,984	4,931	737		6	536
22	Least number employed at any one time during the year	17,674	3,981	272		3	267
23	Average number	13,410	2,092	376		5	236
24	Wages	$4,229,638	$1,242,642	$158,888		$2,642	$44,710
	Men, 16 years and over—						
25	Average number	9,731	2,091	279		5	45
26	Wages	$3,733,606	$1,242,237	$136,422		$2,642	$22,450
	Women, 16 years and over—						
27	Average number	2,533	1	73			161
28	Wages	$369,781	$405	$19,680			$21,260
	Children, under 16 years—						
29	Average number	1,146		24			30
30	Wages	$126,351		$2,786			$1,000
	Average number of wage-earners, including pieceworkers, employed during each month—						
	Men, 16 years and over—						
31	January	2,240	7	118		6	46
32	February	3,147	801	118		6	46
33	March	6,626	3,678	168		6	71
34	April	9,113	3,974	291		5	71
35	May	14,770	4,603	317		4	64
36	June	15,321	4,805	315		4	29
37	July	16,360	4,605	343		4	36
38	August	14,579	2,201	507		3	36
39	September	12,156	419	447		5	46
40	October	10,879		332		5	37
41	November	8,580		195		5	27
42	December	3,001		194		5	27
	Women, 16 years and over:						
43	January	591		28			140
44	February	586		28			140
45	March	981		28			365
46	April	1,186		46			365
47	May	3,749		90			250
48	June	3,611		114			25
49	July	3,863		127			140
50	August	3,999	10	155			140
51	September	4,136	2	131			240
52	October	3,810		73			110
53	November	3,303		29			10
54	December	581		29			10
	Children, under 16 years.						
55	January	104		10			
56	February	94		10			
57	March	339		10			100
58	April	413		24			85
59	May	1,776		27			75
60	June	1,765		38			
61	July	1,855		32			
62	August	1,952		57			
63	September	1,985		47			50
64	October	1,776		12			50
65	November	1,538		10			
66	December	155		10			
	Miscellaneous expenses:						
67	Total	$883,363	$150,854	$23,370	$89	$526	$6,408
68	Rent of works	$45,178		$6,626	$64	$110	
69	Taxes, not including internal revenue	$91,645	$31,314	$1,885	$14	$13	$2,239
70	Rent of offices, interest, insurance, and all sundry expenses not hitherto included	$668,304	$118,540	$14,709	$11	$403	$4,169
71	Contract work	$78,236	$1,000	$150			
	Materials used:						
72	Aggregate cost	$13,232,001	$1,587,883	$449,718	$6,238	$3,195	$67,583
	Principal materials—						
73	Total	$7,730,325		$406,764	$5,984	$2,650	$41,888
74	Purchased in raw state	$6,512,438		$336,775	$3,984	$1,750	$37,288
75	Purchased in partially manufactured form	$1,217,887		$69,989	$2,000	$900	$4,600
76	Fuel	$175,935	$38,150	$7,800	$104	$245	$2,215
77	Rent of power and heat	$6,365					
78	Mill supplies	$24,086	$6,003	$395			$300
79	All other materials	$5,101,663	$1,455,730	$33,834	$85	$300	$22,955
80	Freight	$193,628	$88,000	$925	$65		$225

BY STATES AND TERRITORIES, 1900.

Maine.	Maryland.	Massachusetts.	Michigan.	Mississippi.	New York.	Ohio.	Oregon.	Virginia.	Washington.	Wisconsin.	All other states.[1]	
117	3	61	4	4	9	3	24	5	36	6	8	1
59	...	27	2	1	3	...	5	2	12	5	5	2
33	3	27	2	...	5	2	2	3	8	1	2	3
25	...	7	...	3	1	1	17	...	16	...	1	4
$8,481,056	$65,600	$1,734,227	$6,800	$122,580	$100,564	$56,068	$2,658,642	$10,325	$2,222,726	$4,590	$65,245	5
$137,355	$7,500	$194,557	$700	$4,362	$17,021	$200	$127,522	$200	$118,288	$1,125	$13,520	6
$740,315	$8,900	$206,559	$1,850	$9,003	$25,653	$1,026	$1,539,129	$2,700	$284,804	$1,150	$16,300	7
$2,045,117	$7,400	$256,568	$250	$12,628	$10,005	$42,943	$363,795	$1,825	$457,473	$815	$12,675	8
$5,558,269	$41,800	$1,076,543	$4,000	$96,587	$47,985	$11,900	$628,196	$5,600	$1,362,161	$1,500	$22,750	9
135	8	85	6	1	15	3	10	9	36	7	10	10
177	6	122	...	9	7	5	58	6	116	...	7	11
$139,497	$2,880	$103,131	...	$7,600	$6,520	$4,160	$56,125	$650	$93,117	...	$5,940	12
15	...	7	...	4	3	1	11	...	14	...	...	13
$20,800	...	$11,500	...	$4,000	$3,900	$1,800	$13,370	...	$14,420	...	...	14
162	6	115	...	5	4	4	47	6	102	...	7	15
$118,697	$2,880	$91,631	...	$3,600	$2,620	$2,360	$42,755	$550	$78,697	...	$5,940	16
129	6	100	...	5	4	3	45	6	98	...	4	17
$111,181	$2,880	$85,223	...	$3,600	$2,620	$2,000	$42,205	$550	$76,957	...	$4,380	18
33	...	15	...	...	...	1	2	...	4	...	3	19
$7,516	...	$6,408	...	...	...	$360	$550	...	$1,740	...	$1,560	20
10,481	698	1,908	55	490	105	111	1,646	101	4,960	3	316	21
8,878	540	885	14	170	100	12	727	84	1,521	3	217	22
5,567	442	1,328	19	231	66	51	636	18	2,190	3	160	23
$1,184,850	$63,500	$475,123	$7,961	$41,028	$20,842	$21,600	$219,744	$4,545	$711,214	$1,010	$29,339	24
2,895	207	1,194	18	71	39	51	620	11	2,086	2	117	25
$833,157	$36,900	$449,781	$7,886	$20,353	$18,424	$21,600	$217,750	$2,995	$693,480	$720	$26,709	26
1,746	179	134	...	98	27	...	11	6	73	...	24	27
$245,302	$22,600	$25,342	...	$14,125	$2,418	...	$1,494	$1,325	$13,730	...	$2,100	28
926	56	...	1	62	...	...	5	1	31	1	9	29
$106,391	$4,000	...	$75	$6,550	...	...	$500	$226	$4,004	$290	$530	30
172	195	979	32	75	30	25	45	...	453	2	55	31
150	195	1,127	36	75	30	25	46	...	452	2	39	32
251	195	1,130	13	65	30	54	83	3	829	2	48	33
343	195	1,074	13	70	29	59	734	63	2,148	2	42	34
4,611	211	1,179	12	45	48	59	768	50	2,609	2	188	35
4,809	236	1,166	13	25	50	58	769	10	2,843	2	187	36
4,671	236	1,247	13	70	50	50	774	...	4,080	2	179	37
4,743	236	1,284	14	110	50	45	1,216	...	3,954	2	178	38
5,022	195	1,310	15	100	48	50	1,073	...	3,231	2	193	39
4,960	195	1,392	19	90	48	50	1,129	...	2,421	2	199	40
4,582	195	1,306	19	70	30	110	761	...	1,226	2	52	41
426	198	1,132	15	63	29	26	49	...	784	2	52	42
91	137	128	...	44	2	...	...	...	19	...	2	43
57	137	139	...	44	2	...	...	...	19	...	20	44
196	137	131	...	104	2	...	...	...	11	...	7	45
263	137	104	...	139	2	...	4	33	86	...	7	46
2,838	187	115	...	55	52	...	12	25	89	...	36	47
2,789	287	127	...	55	52	...	12	20	94	...	36	48
2,828	279	127	...	70	52	...	12	...	185	...	43	49
2,866	283	132	...	141	52	...	26	...	156	...	38	50
3,038	145	155	...	181	52	...	37	...	115	...	40	51
2,993	143	179	...	171	52	...	16	...	45	...	28	52
2,808	137	156	...	84	2	...	15	...	42	...	20	53
183	137	112	...	84	2	...	...	...	19	...	5	54
10	50	...	...	23	...	...	...	...	...	1	10	55
10	50	...	...	23	...	...	...	...	...	1	...	56
80	50	...	2	93	...	...	...	...	...	1	3	57
92	50	...	2	108	...	...	14	6	26	1	5	58
1,521	50	...	2	50	...	...	14	6	26	1	4	59
1,569	75	...	2	25	...	...	14	6	25	1	10	60
1,586	75	...	...	30	...	...	...	...	91	1	40	61
1,611	69	...	...	85	...	...	14	...	105	1	10	62
1,651	50	...	2	125	...	...	...	...	55	1	4	63
1,554	50	...	2	74	...	...	...	...	23	1	10	64
1,406	50	...	2	43	...	...	...	...	23	1	3	65
21	50	...	2	63	...	...	...	...	...	1	8	66
$97,859	$11,020	$118,058	$1,318	$17,997	$11,741	$2,610	$147,858	$496	$285,353	$1,005	$6,801	67
$3,777	...	$21,296	$100	$160	$1,100	$1,400	$3,376	$90	$6,989	$25	$75	68
$11,585	$770	$13,642	$51	$412	$1,056	$110	$7,502	$6	$20,619	$19	$408	69
$82,322	$10,250	$82,320	$1,077	$17,435	$9,585	$1,100	$76,015	$400	$242,689	$961	$6,318	70
$175	...	$800	$90	...	...	...	$60,965	...	$16,056	...	...	71
$2,578,636	$154,605	$3,471,112	$52,949	$190,441	$134,211	$70,406	$1,182,218	$13,239	$3,086,865	$28,142	$154,560	72
$807,806	$88,700	$3,077,215	$48,032	$128,281	$105,778	$50,396	$844,940	$9,447	$1,955,720	$27,654	$129,070	73
$532,187	$88,700	$2,356,054	$46,913	$128,281	$101,733	$5,200	$776,284	$7,272	$1,933,893	$27,544	$128,580	74
$275,619	...	$721,161	$1,119	...	$4,045	$45,196	$68,656	$2,175	$21,827	$110	$490	75
$64,719	$3,235	$8,007	$677	$1,580	$1,525	$510	$13,696	$60	$30,617	$346	$2,450	76
$1,201	...	$2,284	...	...	$200	...	...	...	$2,680	...	...	77
$5,976	$600	$232	$10	$1,719	$75	...	$1,127	$140	$7,178	...	$330	78
$1,676,862	$62,050	$372,799	$3,430	$58,861	$23,973	$19,500	$304,536	$2,932	$1,055,994	$142	$7,680	79
$22,072	$20	$10,575	$800	...	$2,660	...	$17,920	$660	$34,676	...	$15,030	80

[1] Includes establishments distributed as follows: District of Columbia, 1; Missouri, 1; New Hampshire, 1; New Jersey, 1; North Carolina, 1; Pennsylvania, 1; South Caroli a, 1; Texas, 1.

TABLE 24.—FISH, CANNING AND PRESERVING:

		United States.	Alaska.	California.	Delaware.	Illinois.	Louisiana.
	Products:						
1	Aggregate value	$22,253,749	$3,821,136	$866,432	$8,473	$8,900	$144,379
	Canned fish—						
2	Total pounds	171,941,626	52,011,552	3,869,124			616,417
3	Total value	$14,574,741	$3,608,738	$341,668			$91,211
	Salmon—						
4	Pounds	114,645,144	51,992,352	3,454,016			
5	Value	$9,287,162	$3,607,838	$260,858			
	Sardines—						
6	Pounds	44,951,244		388,708			
7	Value	$4,212,351		$78,860			
	Clams—						
8	Pounds	4,416,534	19,200	26,400			
9	Value	$342,574	$900	$1,950			
	Oysters—						
10	Pounds	4,104,818					
11	Value	$266,018					
	Mackerel—						
12	Pounds	1,589,900					
13	Value	$164,179					
	Shrimps—						
14	Pounds	1,126,139					514,165
15	Value	$147,862					$79,805
	Crabs—						
16	Pounds	347,607					
17	Value	$97,278					
	Other varieties—						
18	Pounds	760,240					102,252
19	Value	$57,317					$11,406
	Smoked fish—						
20	Total pounds	21,252,066		225,000	138,550	52,019	
21	Total value	$973,041		$9,000	$6,833	$6,900	
	Herring—						
22	Pounds	12,676,429			135,550		
23	Value	$340,290			$6,133		
	Halibut—						
24	Pounds	3,621,462					
25	Value	$271,032					
	Salmon—						
26	Pounds	1,975,647		225,000		11,355	
27	Value	$136,331		$9,000		$1,700	
	Sturgeon—						
28	Pounds	514,900				7,500	
29	Value	$77,879				$1,120	
	Finnan haddie—						
30	Pounds	1,360,500			1,000		
31	Value	$75,360			$600		
	Other varieties—						
32	Pounds	1,103,128			2,000	33,164	
33	Value	$72,149			$100	$4,080	
	Salted fish—						
34	Total pounds	125,669,131	5,689,100	7,144,336	31,800	28,571	95,200
35	Total value	$5,260,927	$212,398	$445,969	$1,640	$2,000	$16,910
	Cod—						
36	Pounds	65,418,710	687,500	6,688,383			
37	Value	$3,108,545	$27,500	$407,474			
	Mackerel—						
38	Pounds	10,458,313					50,000
39	Value	$662,008					$7,000
	Herring—						
40	Pounds	15,933,426		90,000		28,571	
41	Value	$394,020		$15,200		$2,000	
	Haddock—						
42	Pounds	6,927,919					
43	Value	$197,360					
	Other varieties—						
44	Pounds	26,930,763	5,001,600	365,953	31,800		45,200
45	Value	$898,994	$184,898	$23,295	$1,640		$9,910
46	All other products, value	$1,445,040		$69,795			$36,258
	Comparison of products:						
47	Number of establishments reporting for both years	213	7	15	1	4	1
48	Value for census year	$12,331,453	$800,416	$804,242	$6,833	$8,900	$97,800
49	Value for preceding business year	$10,185,844	$621,300	$574,789	$6,150	$7,080	$81,000
	Power:						
50	Number reporting power	144	26	7			3
51	Total horsepower	4,306	577	98			77
	Owned—						
	Engines—						
	Steam—						
52	Number	231	31	9			6
53	Horsepower	3,954	577	73			72
	Gas or gasoline—						
54	Number	12		2			
55	Horsepower	132		25			
	Water wheels—						
56	Number	1					
57	Horsepower	1					
	Electric motors—						
58	Number	7					1
59	Horsepower	82					5
	Furnished to other establishments—						
60	Horsepower	3					
	Rented—						
61	Horsepower	137					
	Establishments classified by number of employees:						
62	Total number of establishments	348	36	19	3	4	6
63	No employees	20		6	3	1	
64	Under 5	43		3		3	1
65	5 to 20	103	6	3			2
66	21 to 50	69	2	2			
67	51 to 100	36	4	2			
68	101 to 250	60	19	3			3
69	251 to 500	11	5				
70	501 to 1,000	6					

BY STATES AND TERRITORIES, 1900—Continued.

Maine.	Maryland.	Massachusetts.	Michigan.	Mississippi.	New York.	Ohio.	Oregon.	Virginia.	Washington.	Wisconsin.	All other states.[1]	
$4,779,733	$248,100	$4,619,362	$65,077	$337,939	$197,869	$251,040	$1,788,809	$24,700	$4,831,038	$35,792	$224,970	1
48,411,624	2,650,571	1,836,796		2,376,190	166,896		16,469,602	36,000	43,195,262		302,592	2
$4,309,184	$232,100	$256,481		$211,001	$23,025		$1,697,064	$5,000	$3,762,169		$37,150	3
303,750		10,560					15,915,352		42,969,114			4
$16,200		$980					$1,655,329		$3,745,957			5
44,420,236		142,300										6
$4,049,784		$83,707										7
3,096,086	400,000	80,400			166,896		192,000	36,000	221,952		177,600	8
$207,201	$40,000	$5,853			$23,025		$20,000	$5,000	$15,045		$23,600	9
	1,920,000			1,822,568			362,250					10
	$100,000			$144,283			$21,735					11
34,464		1,555,436										12
$2,488		$161,691										13
		7,200		539,782							64,992	14
		$800		$62,707							$4,550	15
	330,571			12,840					4,196			16
	$92,100			$4,011					$1,167			17
557,088		40,900									60,000	18
$33,511		$3,400									$9,000	19
6,766,196		6,141,232	834,169		2,309,600	146,500	250,000		3,700,800	468,900	220,100	20
$150,310		$328,540	$64,877		$101,082	$13,100	$10,000		$225,992	$35,227	$21,180	21
6,422,476		3,025,878	597,425		1,694,000	100,000			593,600		107,500	22
$136,310		$105,729	$45,668		$17,040	$7,000			$17,500		$4,910	23
		1,862,462							1,757,000		2,000	24
		$156,432							$114,400		$200	25
		25,392			97,000		250,000		1,347,400		19,500	26
		$4,059			$13,900		$10,000		$93,772		$3,900	27
			1,300		454,000	22,500			2,800		26,800	28
			$169		$66,110	$3,500			$320		$6,660	29
80,000		1,227,500									52,000	30
$8,800		$62,320									$3,640	31
262,720			235,444		64,600	24,000				468,900	12,300	32
$5,200			$19,040		$4,032	$2,600				$35,227	$1,870	33
17,845,321		81,240,501			1,167,814	2,218,000	335,328	1,310,000	8,303,160		260,000	34
$293,577		$3,807,908			$51,285	$66,040	$39,009	$19,700	$293,801		$10,690	35
8,535,000		48,501,427							954,400		52,000	36
$80,454		$2,544,552							$45,445		$3,120	37
		10,262,099			111,214						35,000	38
		$644,523			$7,785						$2,700	39
3,549,045		7,147,950			1,046,600	2,000,000		1,275,000	736,260		60,000	40
$73,029		$165,147			$42,500	$60,000		$19,000	$15,344		$1,800	41
681,050		6,163,869				18,000		35,000	30,000			42
$12,652		$182,868				$540		$700	$600			43
5,080,226		9,165,156			10,000	200,000	335,328		6,582,500		113,000	44
$127,442		$270,818			$1,000	$5,500	$39,009		$232,412		$3,070	45
$26,662	$16,000	$226,483	$200	$126,938	$22,477	$171,900	$42,736		$549,076	$565	$155,950	46
63	1	51	1	4	8	3	15	3	24	6	6	47
$1,208,104	$2,100	$4,474,351	$2,168	$337,939	$196,469	$251,040	$794,152	$19,000	$3,094,077	$35,792	$198,070	48
$959,493	$2,100	$3,931,912	$1,900	$223,433	$181,005	$245,800	$675,782	$19,000	$2,254,100	$25,900	$175,100	49
41	1	10	1	3	2		18		28		4	50
1,421	220	127	3	99	10		312		1,258		104	51
83	3	3		4	1		26		60		5	52
1,354	220	80		99	2		262		1,111		104	53
2		1	1				2		4			54
15		7	3				40		42			55
									1			56
									1			57
3							2		1			58
52							10		15			59
		3										60
		40			8				89			61
117	3	61	4	4	9	3	24	5	36	6	8	62
2						2				4	2	63
15		11	1		4		1		2	2		64
44	1	25	2	1	4		3	3	6		3	65
27		13	1				10	2	11		1	66
10		7			1		5		6		1	67
12	1	5		3		1	4		8		1	68
3	1						1		1			69
4									2			70

[1] Includes establishments distributed as follows: District of Columbia, 1; Missouri, 1; New Hampshire, 1; New Jersey, 1; North Carolina, 1; Pennsylvania, 1; South Carolina, 1; Texas, 1.

OYSTERS, CANNING AND PRESERVING.

Table 25 is a comparative summary of the statistics for the establishments engaged in the canning and preserving of oysters as returned at the censuses of 1890 and 1900, with the percentages of increase for the decade.

TABLE 25.—OYSTERS, CANNING AND PRESERVING: COMPARATIVE SUMMARY, 1890 AND 1900, WITH PER CENT OF INCREASE FOR THE DECADE.

	1900	1890	Per cent of increase.
Number of establishments	39	16	143.8
Capital	$1,240,696	$1,106,962	12.1
Salaried officials, clerks, etc., number	119	[1] 61	95.1
Salaries	$112,879	[1] $69,891	61.5
Wage-earners, average number	2,779	3,453	[2] 19.5
Total wages	$630,016	$642,610	[2] 2.0
Men, 16 years and over	1,355	1,482	[2] 8.6
Wages	$419,032	$303,778	37.9
Women, 16 years and over	1,123	1,702	[2] 34.0
Wages	$175,865	$316,080	[2] 44.4
Children, under 16 years	301	269	12.0
Wages	$35,119	$22,752	54.4
Miscellaneous expenses	$93,707	$80,199	16.8
Cost of materials used	$2,608,757	$2,088,867	24.9
Value of products	$3,670,134	$3,260,766	12.6

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 34.)

[2] Decrease.

Although the canning and preserving of oysters existed as an industry as early as 1850, it was usually carried on in connection with the canning and preserving of fish, and as the statistics were included under this classification they do not appear separately until the census of 1890. In that year the number of establishments engaged primarily in this industry had increased to 16, and the capital to $1,106,962. They reported 3,453 wage-earners, $642,610 paid for wages, $2,088,867 for materials, and $3,260,766 as the value of products. Between 1890 and 1900 the increase in the number of establishments was more than the total number reported for 1890, while the capital and value of products showed a normal increase. Thus the average capital, per establishment, has decreased from $69,185 to $31,813—that is, the average capital in 1900 was less than one-half that reported for 1890. This is probably accounted for in a great measure by the fact that some of the largest establishments have become engaged in the canning and preserving of fruits and vegetables or fish, and have made oyster canning subsidiary to these. The table further indicates that a number of small establishments have engaged in the industry during the decade. The total number of wage-earners has decreased 674, or 19.5 per cent, and the wages have also decreased, but they show a relatively smaller decrease than is shown in the number of wage-earners. The number of children employed, however, and their wages, have exhibited a substantial decrease. The apparent decrease in the number of wage-earners is due, as has been explained before, to the difference in the method of computing adopted for the two censuses. An examination of the schedules for different states shows that the establishments engaged in canning and preserving oysters were in operation eight months during the census year, but many large plants continued in operation during the summer months canning and preserving fruits and vegetables. The operations of these large establishments during the summer months, increased the average time of employment for the wageearners employed in this industry to nine and one-half months. Reduced to the basis of 1890 the average number of employees in 1900, for the "industrial year" of eight months, was 3,510, which is greater than the average reported for 1890. The relative proportion of the cost of materials to the value of products has slightly increased since 1890.

In the canning and preserving of oysters, as in the other two branches of the canning industry included in this report, the individual form of organization predominates. Of the total number of establishments, 20, or 51.3 per cent, were conducted by individuals; 11, or 28.2 per cent were operated by firms and limited partnerships; and the remaining 8, or 20.5 per cent by incorporated companies.

Table 26 shows, by states arranged geographically, the number of establishments from which returns were received in 1900, with the increase during the decade.

TABLE 26.—OYSTERS, CANNING AND PRESERVING: COMPARATIVE SUMMARY, NUMBER OF ACTIVE ESTABLISHMENTS, 1890 AND 1900, AND INCREASE DURING THE DECADE, BY STATES, ARRANGED GEOGRAPHICALLY.

	1900	1890	Increase.
United States	39	16	23
Middle states	17	8	9
Delaware	1		1
Maryland	16	8	8
Southern states	18	7	11
Virginia	1	1	
North Carolina	1		1
South Carolina	1		1
Georgia	1		1
Florida	6	1	5
Kentucky		1	[1] 1
Alabama	1	1	
Mississippi	4	3	1
Louisiana	3		3
Central states	1	1	
Michigan		1	[1] 1
Iowa	1		1
Pacific states	3		3
Washington	3		3

[1] Decrease.

It appears that the greatest increase occurred in the Southern states, which group reported 7 establishments in 1890 and 18 in 1900, an increase of 11, or 157.1 per cent. Of the states of this group, Florida showed the greatest development, reporting an increase of 5. The number in the Middle states increased from 8 to 17, an increase of 9. The greatest increase in this group was shown by Maryland, which reported an increase of 8, or an even 100 per cent.

The above table should be considered in connection with Table 27, which is a summary of the totals for the canning and preserving of oysters as returned at the census of 1890 and 1900.

TABLE 27.—OYSTERS, CANNING AND PRESERVING: COMPARATIVE SUMMARY BY STATES, 1890 AND 1900.

	Year.	United States.	Florida.	Louisiana.	Maryland.	Mississippi.	Washington.	All other states.
Number of establishments	1900	39	6	3	16	4	3	[2] 7
	1890	16	(3)	....	8	3	....	[4] 5
Capital:								
Total	1900	$1,240,696	$78,895	$64,250	$799,005	$205,549	$9,800	$83,197
	1890	$1,106,962	(3)	....	$953,232	$132,940	....	$20,790
Land	1900	$95,000	$16,000	$4,900	$51,650	$17,500	....	$4,950
	1890	$234,200	(3)	....	$229,000	$4,000	....	$1,200
Buildings	1900	$238,713	$10,820	$31,200	$135,793	$42,000	....	$18,900
	1890	$180,750	(3)	....	$148,000	$32,000	....	$750
Machinery, tools, and implements	1900	$151,717	$18,975	$8,700	$77,748	$31,000	$5,300	$9,994
	1890	$89,300	(3)	....	$68,000	$18,000	....	$3,300
Cash and sundries	1900	$755,266	$33,100	$19,450	$533,814	$115,049	$4,500	$49,353
	1890	$602,712	(3)	....	$508,232	$78,940	....	$15,540
Salaried officials, clerks, etc., number	1900	119	8	9	79	7	2	14
	1890	[1] 61	(3)	....	46	7	....	8
Salaries	1900	$112,879	$7,001	$6,540	$81,048	$9,300	$1,400	$7,590
	1890	[1] $69,891	(3)	....	$59,060	$6,625	....	$4,206
Wage-earners, average number	1900	2,779	148	97	1,444	419	24	647
	1890	3,453	(3)	....	2,834	391	....	228
Total wages	1900	$630,016	$32,392	$33,915	$379,591	$81,954	$12,070	$90,094
	1890	$642,610	(3)	....	$559,040	$63,300	....	$20,270
Men, 16 years and over	1900	1,355	44	81	712	113	22	383
	1890	1,482	(3)	....	1,161	171	....	150
Wages	1900	$419,032	$12,957	$32,165	$247,117	$47,254	$11,550	$67,989
	1890	$303,778	(3)	....	$255,380	$35,300	....	$13,098
Women, 16 years and over	1900	1,123	80	7	618	219	2	197
	1890	1,702	(3)	....	1,523	125	....	54
Wages	1900	$175,865	$16,300	$1,000	$114,000	$26,100	$520	$17,945
	1890	$316,080	(3)	....	$294,460	$16,200	....	$5,420
Children, under 16 years	1900	301	24	9	114	87	....	67
	1890	269	(3)	....	150	95	....	24
Wages	1900	$35,119	$3,135	$750	$18,474	$8,600	....	$4,160
	1890	$22,752	(3)	....	$9,200	$11,800	....	$1,752
Miscellaneous expenses	1900	$93,707	$5,881	$3,123	$70,100	$8,518	$1,249	$4,836
	1890	$80,199	(3)	....	$43,301	$33,450	....	$3,448
Cost of materials used	1900	$2,608,757	$48,029	$109,205	$1,771,377	$427,490	$38,061	$214,595
	1890	$2,088,867	(3)	....	$1,877,353	$153,957	....	$57,557
Value of products	1900	$3,670,134	$100,543	$165,458	$2,417,331	$569,000	$65,980	$351,822
	1890	$3,260,766	(3)	....	$2,834,400	$334,250	....	$92,116

[1] Includes proprietors and firm members, with their salaries: number only reported in 1900, but not included in this table. (See Table 34).
[2] Includes establishments distributed as follows: Alabama, 1; Delaware, 1; Georgia, 1; Iowa, 1; North Carolina, 1; South Carolina, 1; Virginia, 1.
[3] Included under all other states in 1890.
[4] Includes establishments distributed as follows: Alabama, 1; Florida, 1; Kentucky, 1; Michigan, 1; Virginia, 1.

Table 27 gives a concise résumé of the industry for 1890 and 1900 and indicates the growth and development in each state during the decade. In 1890 the canning and preserving of oysters was carried on by 16 establishments distributed among 7 states, whereas in 1900 there were 39 establishments reported by 12 states, the number of establishments having increased 23, and the number of states engaged in the industry, 8. The same arrangement as has been explained before was pursued in order not to divulge the operations of individual establishments, and states reporting fewer than 3 establishments were reported under "all other states." The states generally reported a substantial increase in the number of establishments, capital, and value of products. Maryland, however, although showing twice as many establishments in 1900 as in 1890, showed a considerable decrease in both the capital and value of products, owing to the fact that a number of small establishments have engaged in the industry since 1890, while several of the larger factories on the other hand had become interested principally in the canning and preserving of fruits and vegetables, and were so classified by this office, according to the rule adopted to classify according to the predominating product. As in the case of the other industries treated in this report, the canning of oysters is localized in points nearest the supply of oysters. Maryland, which is in close proximity to the famous oyster beds, notwithstanding the apparent decrease which is above accounted for, led in both years in the number of establishments, in capital, and in the value of products. The value of products for the census year for this state was $2,417,331, or 65.9 per cent of the total value of products of this industry. Mississippi, Louisiana, and Florida, which were supplied by the oyster beds of the Gulf of Mexico, followed Maryland in the order named.

The summary, by states, of the establishments engaged in the canning and preserving of oysters, classified according to the number of wage-earners employed, is shown in Table 28. In this connection attention is here directed to the fact that the data contained in this table were computed from the greatest number of wage-earners employed at any one time during the year. This should be taken into consideration in making deductions.

TABLE 28.—OYSTERS, CANNING AND PRESERVING: ESTABLISHMENTS CLASSIFIED BY NUMBER OF WAGE-EARNERS EMPLOYED, BY STATES, ARRANGED GEOGRAPHICALLY, 1900.

STATES.	Total number of establishments.	NUMBER OF ESTABLISHMENTS EMPLOYING— 5 to 20	21 to 50	51 to 100	101 to 250	251 to 500	501 to 1,000
United States	39	6	9	9	9	4	2
Middle states	17	2	5	4	2	2	2
Delaware	1			1			
Maryland	16	2	5	3	2	2	2
Southern states	18		4	5	7	2	
Virginia	1		1				
North Carolina	1				1		
South Carolina	1			1			
Georgia	1					1	
Florida	6		2	1	3		
Alabama	1				1		
Mississippi	4			1	2	1	
Louisiana	3		1	2			
Central states	1	1					
Iowa	1	1					
Pacific states	3	3					
Washington	3	3					

As indicated by Table 28, the classes of establishments employing 21 to 50, 51 to 100, and 101 to 250 wage-earners, each reported 9 establishments, while 6 establishments were reported in group 5 to 20, 4 in the group 251 to 500, and only 2 in the group 501 to 1,000. The Middle states reported the largest number of establishments employing from 21 to 50 wage-earners, but the Southern states returned the largest number for the groups 51 to 100, and 101 to 250. All of the establishments located in the Central and Pacific states were small ones, employing from 5 to 20 operatives. Maryland was the only state having establishments employing over 500 wage-earners, but in this state the largest number of establishments employed from 21 to 50 wage-earners. Florida reported 3 establishments employing over 100 wage-earners, and Maryland and Mississippi each reported 2 in this class.

Table 29 presents a comparative summary of the statistics of capital for 1890 and 1900, with the percentages of the total and of the increase for the several items.

TABLE 29.—OYSTERS, CANNING AND PRESERVING: STATISTICS OF CAPITAL, 1890 AND 1900.

	1900 Amount.	1900 Per cent of total.	1890 Amount.	1890 Per cent of total.	Per cent of increase.
Total	$1,240,696	100.0	$1,106,962	100.0	12.1
Land	95,000	7.7	234,200	21.2	[1]59.4
Buildings	238,713	19.2	180,750	16.3	32.1
Machinery, tools, and implements	151,717	12.2	89,300	8.1	69.9
Cash and sundries	755,266	60.9	602,712	54.4	25.3

[1] Decrease.

The item cash and sundries, including cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, formed the principal item of capital in both years. This is but natural in an industry which neither requires large and expensive buildings especially adapted for the purpose, nor necessitates the use of costly and complicated machinery and mechanical appliances in the preparation of its product. This item also formed a relatively larger per cent of the total capital in 1900 than in 1890. The value of land, which formed the second largest item in 1890, actually decreased to $95,000, or 59.4 per cent, and formed but 7.7 per cent of the total as compared with 21.2 per cent in 1890.

As the several items of miscellaneous expenses for 1890 can not be shown separately, a detailed comparison with those reported for 1900 is impossible. The expenses of this nature in the oyster-canning industry do not call for special comment, but the several subdivisions for 1900 may be found in Table 34.

The cost of materials used with the proportion each formed of the total, for 1900, is given in Table 30.

TABLE 30.—OYSTERS, CANNING AND PRESERVING: COST OF MATERIALS USED, 1900.

	Amount.	Per cent of total.
Total	$2,608,757	100.0
Principal materials[1]	2,571,027	98.5
Fuel	25,090	1.0
Rent of power and heat	60	(2)
Freight	12,580	0.5

[1] Includes raw materials, mill supplies, and all other materials. These are shown separately in Table 34.
[2] Less than one-tenth of 1 per cent.

Of the total cost of materials the amount reported for principal materials formed 98.5 per cent. This included the materials purchased both in the raw state and in partially manufactured form. Those purchased in the raw state, including oysters and fish, amounted to $1,792,725, or 68.7 per cent of the total cost of materials. The remainder of principal materials, amounting to $778,302, includes mill supplies and "all other materials," the cost of cans, solder, and such other materials as were necessary to prepare the product for the market, which amounted to $768,927, or 29.5 per cent of the total. These items are shown separately in Table 24. It is a significant fact that the cost of fuel formed only 1 per cent of the total cost of materials. The cost of freight is an insignificant item in this industry, but it should be considered only in connection with the cost of materials, as the latter in many cases are bought delivered, and manufacturers find it impossible to report separately the amount directly chargeable to freight.

Table 31 shows the value of products by states for 1900.

TABLE 31.—OYSTERS, CANNING AND PRESERVING: VALUE OF PRODUCTS, BY STATES, ARRANGED GEOGRAPHICALLY, 1900.

STATES.	VALUE.		
	Total products.	Oysters, etc.	All other products.
United States	$3,670,134	$1,649,480	$2,020,654
Middle states	2,417,331	570,478	1,846,853
Maryland	2,417,331	570,478	1,846,853
Southern states	1,186,823	1,049,547	137,276
Florida	100,543	97,743	2,800
Mississippi	569,000	569,000	....
Louisiana	165,458	94,702	70,756
All other states[1]	351,822	288,102	63,720
Pacific states	65,980	29,455	36,525
Washington	65,980	29,455	36,525

[1] Includes establishments distributed as follows: Alabama, 1; Delaware, 1; Georgia, 1; Iowa, 1; North Carolina, 1; South Carolina, 1; and Virginia, 1.

Table 31 is of interest as showing some curious facts regarding the industry. It will be noticed that of the total value of products, $1,649,480, or 44.9 per cent, was reported as the value of oysters, while $2,020,654, or 55.1 per cent, was given as the value of all other products. In 2 states, Maryland and Washington, the value of all other products exceeded the value of oysters. This is especially true of Maryland, which reported 76.4 per cent of the value of products under "all other products." The value of all other products for the industry includes the value of fish canned and preserved in connection with oysters; but it is the correlation of fishing industry with the canning and preserving of fish and oysters that is chiefly responsible for the apparent inconsistency. Over 75 per cent of the value of other products represents the value of fresh oysters which are handled in bulk in large quantities by several large oyster-canning houses. As it was impossible to separate the amounts directly chargeable to the manufacturing branch of the business, the value of fresh oysters has been included in the total value of products.

The tables which have thus far been shown give an incomplete statistical picture of the oyster canning and preserving industry for the reason that, as pointed out above, establishments are classified according to the predominating product. In many instances, the canning and preserving of oysters is carried on in connection with some other branch of the canning industry, and the totals have not been included in the above tables. It is possible, however, to show the total quantity and value of oysters canned and preserved during the census year as reported by establishments of any character. This is done in Table 32.

TABLE 32.—OYSTERS, CANNING AND PRESERVING: QUANTITY AND VALUE OF PRODUCTS, BY STATES, ARRANGED GEOGRAPHICALLY, 1900.

STATES.	Pounds.	Value.	PER CENT OF TOTAL.	
			Pounds.	Value.
United States	33,356,677	$2,380,711	100.0	100.0
Middle states	17,295,216	1,249,478	51.9	52.5
Maryland	17,295,216	1,249,478	51.9	52.5
Southern states	16,011,961	$1,114,698	48.0	$46.8
Florida	1,504,416	96,793	4.5	4.0
Mississippi	7,900,472	639,603	23.7	26.9
Louisiana	1,272,750	71,625	3.8	3.0
Other states[1]	5,334,323	307,677	16.0	12.9
Pacific states	49,500	16,535	.1	.7
Washington	49,500	16,535	.1	.7

[1] Includes establishments distributed as follows: Alabama, 1; Georgia, 1; Iowa, 1; North Carolina, 1; and South Carolina, 1.

Table 32 shows the quantity and value of oysters canned and preserved in oyster-canning establishments as such and also the quantity and value reported as a subsidiary product in establishments engaged primarily in the canning and preserving of fish and fruits and vegetables. The values reported do not include the amounts reported as the value of all other products, therefore the totals given in Table 32 do not agree with the total products given elsewhere in this report, or with those of the report on this industry as presented in the general report on Manufactures, Parts I and II. This should be taken into consideration if comparisons are made with the figures reported in Table 31, as the totals given in the latter table include the value of "all other products"—the value of shrimps, crabs, and other fish canned. Furthermore, there are in Baltimore several large establishments engaged in handling fresh oysters in bulk in connection with the canning business, and, as it was impossible to segregate the amounts directly chargeable to the manufacturing part of the business, the value of raw oysters sold is included under the heading "all other products."

Table 32 indicates that there were 33,356,677 pounds of oysters canned during the census year, valued at $2,380,711, an average value of $0.071 per pound. It should be noticed that the average value is that fixed at the factory and is obtained from the totals of the whole number of establishments reporting, and that it therefore does not represent the actual value in any particular locality. Quite naturally, Maryland, the home of the famous "cove oyster," took first rank in this industry, and the quantity and value of oysters canned in that state formed over 50 per cent of the totals for the country. Mississippi followed Maryland with a product about half as large, or approximately 25 per cent of the total for the United States. Florida and Louisiana followed Mississippi in the order named, the combined totals for these states constituting nearly 9 per cent of the total. The oysters canned in Mississippi, Florida, and Louisiana are received from the Gulf of Mexico. The industry is also carried on to a limited extent in Washington and Oregon.

The principal details of the statistics for the canning of oysters as carried on in cities of over 20,000 population are shown in Table 33.

TABLE 33.—OYSTERS, CANNING AND PRESERVING: STATISTICS OF CITIES OF 20,000 POPULATION OR OVER, 1900.

CITIES.	Rank by value of products.	Number of establishments.	Capital.	Salaried officials, clerks, etc.		Wage-earners.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Wages.			
Total		19	$798,446	81	$82,608	1,442	$389,441	$69,570	$1,772,094	$2,443,948
Baltimore, Md.	1	15	784,271	77	80,248	1,416	376,591	67,988	1,724,513	2,364,968
All other cities[1]		4	14,175	4	2,360	26	12,850	1,582	47,581	78,980

[1] Includes establishments distributed as follows: Des Moines, Iowa, 1; Seattle, Wash., 3.

It appears from Table 33 that of the total value of products, $2,443,948, or 66.6 per cent, was reported for the cities named, and that of this amount $2,364,968, or 64.4 per cent of the total for the United States, was returned for Baltimore. With the exception of Baltimore, which since the inception of the industry has always been the home of oyster canning and preserving, the industry can not be said to be preeminently a city industry.

HISTORICAL AND DESCRIPTIVE.

The oyster is a marine bivalve mollusk of the genus Ostrea, the most important species being the *Ostrea edulis*, the oyster commonly found in Europe, and the *Ostrea virginiana*, the common American oyster. They are usually found attached to a solid substance in the most brackish waters at the mouth of rivers or in the shallow waters along the seacoasts, in depths varying from 15 to 180 feet, according to the temperature of the water. Moving sand or muddy ground is not conducive to their growth, as they require some solid substance to which to attach themselves.

Oyster fishing has always been an important industry in European, Asiatic, and American waters. The oyster, however, in the oyster regions of Europe and Asia, is not found at the present time in natural reefs in its primitive condition, but is produced on areas of ground under individual ownership or protection, as the public reefs in those countries have been depleted. France and Great Britain lead all European countries in the production of the oyster, and its culture is carried on more extensively and successfully in France than anywhere in the world.

When the first settlements were made in America, oysters were found in lavish abundance all along the Atlantic coast from Maine to Florida, the principal beds being in Chesapeake Bay, Cape Cod, and Long Island Sound. Constant fishing, however, soon had its effect upon the more Northern fisheries, and by the year 1860 the natural beds of the North Atlantic coast were exhausted. Chesapeake Bay and the waters along the coast of Virginia still produce a good supply, and the young were transplanted from these sections to the more Northern beds, where they were fattened and prepared for market. Were it not for the supply of seed oysters secured from these southern waters, the states north of Connecticut would be in the same condition as the European countries in oyster culture. The public beds along the coasts of Connecticut, New York, New Jersey, and Delaware are so far depleted that the supply is very irregular and uncertain and the oyster found is very small. In the Chesapeake Bay and Southern waters the public reefs are somewhat exhausted, the oysters are small, and many are transplanted to private grounds for maturing.[1] Oysters are found in the Gulf of Mexico, and also to a small extent along the Pacific coast. Seed oysters from the Atlantic coast have been planted on the Pacific coast, but with little success.[2]

The inception and growth of oyster canning has been practically simultaneous with the canning of fish. In the early days of the canning industry the two were often carried on under the same roof, and the canning of oysters as a distinct industry did not begin prior to 1850, although Thomas Kensett, the pioneer in this branch of canned goods, began in Baltimore as early as 1820. Kensett was followed by several others, and in the year 1850 the industry was established on a permanent footing.[3] Many New Englanders, attracted by the excellent fisheries of the place, located in Baltimore, and in time engaged in oyster canning. Oysters are canned at one or two Chesapeake ports, and at four or five cities on the northern coast of the Gulf of Mexico. The term "cove" is applied to oysters put up in tin cans, cooked, hermetically sealed, and kept for some time. The original "cove oysters" were found in coves on the west side of Chesapeake Bay, above the Potomac, and were famous for their size and quality.

Improvements in the methods of preserving have been as marked in oyster canning as in any other branch of the canning industry. Originally the oyster shells were opened by hand, but in 1858, Louis McMurray, of Baltimore, introduced the scalding of the oysters before they were "shucked," and this treatment greatly facilitated their removal from the shell. This method was replaced two years later by steaming, a process in which the oysters were put in baskets having a capacity of three pecks or more, and a large number of the baskets were placed

[1] Stevenson, Report on Industries of Maryland, 1894.
[2] Oyster Culture, by H. F. Moore.
[3] Fish Bulletin, 1899, page 516.

in a huge box, through which steam was passed. The modern method of "shucking" was inaugurated by Henry Evans in 1862. His process consists of placing the oysters in cars of iron framework, 6 to 8 feet long, and holding about 20 bushels of unshucked oysters, and the cars are run on a track from the wharf to a steam-tight box, ranging from 15 to 20 feet long, and fitted with appliances for admitting the steam at any desired pressure, and a door at each end of the box permitting the entry of the car, and then so arranged that the doors can be closed, thus making a practically air-tight compartment.[1] The steam is turned on for about fifteen minutes, the chest is then opened and the cars run into the shucking shed, where employees, each provided with a knife, are able to separate very easily the oysters from the shell. After they are steamed and "shucked" they are washed in cold water and sent to the "fillers' table." Here they are placed in cans, weighed, and hermetically sealed. The cans are then put into a cylindrical basket and lowered into the "process kettle," in which they are steamed to a sufficient degree to kill all germs of fermentation. After coming from the "process kettle," they are cooled in a large vat of cold water and then transferred to the labeling and packing department.[2] The total cost of handling a bushel of oysters in the Baltimore canneries has been estimated at 29 cents, while the average price during recent years of a bushel of oysters for the canning trade has been about 55 cents.[3]

The structure of the oysters on the Gulf of Mexico is such that it disintegrates and is shiny in appearance when canned in the manner of the more Northern oyster. In canning this variety, the following process was introduced in 1880 by Mr. J. T. Maybury: "To ten gallons of pure water, add one-half gallon of good commercial vinegar and one-tenth gill of a saturated aqueous solution of salicylic acid, to which mixture sufficient common salt is added to impart the requisite salty flavor to the oysters. The mixture is boiled a few minutes and poured over the oysters in the cans, which are at once sealed and placed in a steam bath, the temperature of which is 202° F. This temperature is gradually raised to 240° and maintained at that degree for about forty-five minutes. The cans are then vented, resealed, and steamed as before for about thirty minutes, after which they are ready to be labeled and packed."[4] By this process the fatty portion of the oyster is coagulated and the body made more dense and firm.

Table 34 shows the detailed statement, by states, of the industry for 1900.

[1] Letters Patent, No. 35511, June 10, 1862.
[2] Fish Bulletin, 1899, page 517.

[3] Fish Bulletin, 1899, page 517.
[4] Ibid, page 518.

TABLE 34.—OYSTERS, CANNING AND PRESERVING: BY STATES, 1900.

	United States.	Florida.	Louisiana.	Maryland.	Mississippi.	Washington.	All other states.[1]
Number of establishments	39	6	3	16	4	3	7
Character of organization:							
Individual	20	3	1	11	2	1	2
Firm and limited partnership	11	1	2	2	1	2	3
Incorporated company	8	2	...	3	1	...	2
Capital:							
Total	$1,240,696	$78,895	$64,250	$799,005	$205,549	$9,800	$83,197
Land	$95,000	$16,000	$4,900	$51,650	$17,500	...	$4,950
Buildings	$238,713	$10,820	$31,200	$135,793	$42,000	...	$18,900
Machinery, tools, and implements	$151,717	$18,975	$8,700	$77,748	$31,000	$5,300	$9,994
Cash and sundries	$755,266	$33,100	$19,450	$533,814	$115,049	$4,500	$49,353
Proprietors and firm members	47	6	5	15	5	5	11
Salaried officials, clerks, etc:							
Total number	119	8	9	79	7	2	14
Total salaries	$112,879	$7,001	$6,540	$81,048	$9,300	$1,400	$7,590
Officers of corporations—							
Number	15	1	...	9	2	...	3
Salaries	$34,850	$1,000	...	$26,350	$5,100	...	$2,400
General superintendents, managers, clerks, etc.—							
Total number	104	7	9	70	5	2	11
Total salaries	$78,029	$6,001	$6,540	$54,698	$4,200	$1,400	$5,190
Men—							
Number	96	7	9	63	5	1	11
Salaries	$74,967	$6,001	$6,540	$52,136	$4,200	$900	$5,190
Women—							
Number	8	...	...	7	...	1	...
Salaries	$3,062	...	...	$2,562	...	$500	...
Wage-earners, including pieceworkers, and total wages:							
Greatest number employed at any one time during the year	5,122	521	180	2,603	875	40	903
Least number employed at any one time during the year	2,051	399	118	506	374	15	639
Average number	2,779	148	97	1,444	419	24	647
Wages	$630,016	$32,392	$33,915	$379,591	$81,954	$12,070	$90,094
Men, 16 years and over—							
Average number	1,355	44	81	712	113	22	383
Wages	$419,032	$12,957	$32,165	$247,117	$47,254	$11,550	$67,989
Women, 16 years and over—							
Average number	1,123	80	7	618	219	2	197
Wages	$175,865	$16,300	$1,000	$114,000	$26,100	$520	$17,945
Children, under 16 years—							
Average number	301	24	9	114	87	...	67
Wages	$35,119	$3,135	$750	$18,474	$8,600	...	$4,160

[1] Includes establishments distributed as follows: Alabama, 1; Delaware, 1; Georgia, 1; Iowa, 1; North Carolina, 1; South Carolina, 1; Virginia, 1.

TABLE 34.—OYSTERS, CANNING AND PRESERVING: BY STATES, 1900—Continued.

	United States.	Florida.	Louisiana.	Maryland.	Mississippi.	Washington.	All other states.[1]
Average number of wage-earners, including pieceworkers, employed during each month:							
Men, 16 years and over—							
January	1,632	98	110	642	205	32	545
February	1,599	88	110	621	205	30	545
March	1,629	90	110	651	205	28	545
April	1,298	86	114	384	205	19	490
May	835	5	25	472	19	12	302
June	736	...	...	650	14	12	60
July	582	...	...	500	10	12	60
August	709	...	...	625	10	12	62
September	1,348	14	116	838	22	15	343
October	1,868	12	130	1,003	155	28	540
November	2,002	58	130	1,082	155	32	545
December	2,022	80	130	1,076	155	36	545
Women, 16 years and over—							
January	1,001	175	...	199	350	2	275
February	966	165	...	174	350	2	275
March	1,494	178	...	690	350	2	274
April	1,097	142	4	355	350	2	244
May	799	50	20	557	6	2	164
June	1,021	...	...	963	6	2	50
July	601	...	...	545	6	...	50
August	1,208	...	...	1,150	6	2	50
September	1,348	5	...	1,080	81	2	180
October	1,402	5	20	735	375	2	265
November	1,266	105	20	489	375	2	275
December	1,273	139	20	464	373	2	275
Children under 16 years—							
January	273	68	...	5	120	...	80
February	273	68	...	5	120	...	80
March	341	65	...	75	120	...	81
April	317	36	5	75	120	...	81
May	218	2	25	130	...	...	61
June	230	...	...	200	...	...	30
July	180	...	...	150	...	...	30
August	230	...	...	200	...	...	30
September	311	...	...	200	50	...	61
October	460	...	30	170	175	...	85
November	400	10	25	105	170	...	90
December	379	39	25	55	170	...	90
Miscellaneous expenses:							
Total	$93,707	$5,881	$3,123	$70,100	$8,518	$1,249	$4,836
Rent of works	$8,615	$705	...	$5,770	...	$610	$1,530
Taxes, not including internal-revenue	$7,649	$201	$463	$4,870	$768	$41	$1,306
Rent of offices, interest, insurance, and all sundry expenses not hitherto included	$76,643	$4,175	$2,660	$59,460	$7,750	$598	$2,000
Contract work	$800	$800	...	...	...	...	...
Material used:							
Total cost	$2,608,757	$48,029	$109,205	$1,771,377	$427,490	$38,061	$214,595
Principal materials	$1,792,725	$18,507	$101,295	$1,228,548	$266,000	$34,762	$143,613
Fuel	$25,090	$2,950	$800	$12,742	$6,040	$100	$2,458
Rent of power and heat	$60	...	...	...	...	$60	...
Mill supplies	$9,375	$710	$3,510	$3,325	$1,700	$20	$110
All other materials	$768,927	$23,802	$3,300	$526,502	$146,950	$2,564	$65,809
Freight	$12,580	$2,060	$300	$260	$6,800	$555	$2,605
Products:							
Aggregate value	$3,670,134	$100,543	$165,458	$2,417,331	$569,000	$65,980	$351,822
Total pounds	22,196,976	1,530,812	1,688,700	6,915,734	6,850,875	224,388	4,986,467
Total value	$1,649,480	$97,743	$94,702	$570,478	$569,000	$29,455	$288,102
Oysters—							
Pounds	20,792,371	1,504,416	1,272,750	6,915,734	6,077,904	49,500	4,972,067
Value	$1,535,693	$95,793	$71,625	$570,478	$495,320	$16,535	$285,942
Shrimps—							
Pounds	802,821	...	450	...	772,971	15,000	14,400
Value	$78,115	...	$25	...	$73,680	$2,250	$2,160
Crabs—							
Pounds	92,400	...	...	...	...	92,400	...
Value	$7,295	...	...	...	...	$7,295	...
Clams—							
Pounds	67,488	...	...	...	...	67,488	...
Value	$3,375	...	...	...	...	$3,375	...
Other varieties—							
Pounds	441,896	26,396	415,500	...	...	...	...
Value	$25,002	$1,950	$23,052	...	...	...	...
Value of all other products	$2,020,654	$2,800	$70,756	$1,846,853	...	$36,525	$63,720
Comparison of products:							
Number of establishments reporting for both years	32	4	1	15	3	3	6
Value for census year	$3,399,761	$72,470	$107,633	$2,364,968	$504,000	$65,980	$284,710
Value for preceding year	$3,116,591	$71,300	$97,600	$2,232,501	$449,000	$65,650	$200,540
Power:							
Number of establishments reporting	20	4	2	6	4	2	2
Total horsepower	922	145	80	387	115	10	185
Owned—							
Engines—							
Steam—							
Number	42	4	2	24	7	2	3
Horsepower	920	145	80	387	115	8	185
Electric horsepower	2	...	...	...	...	2	...
Establishments classified by number of persons employed:							
Total number of establishments	39	6	3	16	4	3	7
No employees	...	...	...	...	...	...	...
Under 5	...	...	...	...	...	...	...
5 to 20	6	...	...	2	...	3	1
21 to 50	9	2	1	5	...	...	1
51 to 100	9	1	2	3	1	...	2
101 to 250	9	3	...	2	2	...	2
251 to 500	4	...	...	2	1	...	1
501 to 1,000	2	...	...	2	...	...	...

[1] Includes establishments distributed as follows: Alabama, 1; Delaware, 1; Georgia, 1; Iowa, 1; North Carolina, 1; South Carolina, 1; Virginia, 1.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 210. WASHINGTON, D. C. June 25, 1902.

MANUFACTURES.

CHEMICALS AND ALLIED PRODUCTS.

Hon. WILLIAM R. MERRIAM,

Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, the statistics of chemicals and allied products, prepared under my direction by Charles E. Munroe, Ph. D., professor of chemistry, Columbian University, Washington, D. C., and by T. M. Chatard, Ph. D., his associate, acting as expert special agents of the division of manufactures.

The unusually exhaustive and valuable character of the work is described in the introduction to this report by the expert special agents. Nothing approaching it in any particular has ever before been presented at any census of the United States.

The statistics are presented in 9 tables: Table 1 is a summary of the statistics for the entire industry, by states, 1900; Table 2 is a summary for fertilizers, by states, 1900; Table 3 is a summary for dyestuffs and tanning materials, by states, 1900; Table 4 is a summary for paints, by states, 1900; Table 5 is a summary for varnishes, by states, 1900; Table 6 is a summary for explosives, by states, 1900; Table 7 is a summary for essential oils, by states, 1900; Table 8 is a summary for chemicals, by states, 1900; and Table 9 is a summary for bone, ivory, and lampblack, by states, for 1900.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

In some instances, the number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations or cooperative establishments. The number of salaried officials, clerks, etc., is the greatest number reported employed at any one time during the year.

The reports show a capital of $238,529,641 invested in the manufacture of chemicals and allied products. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations of the state. The value of the products is returned at $202,582,396, to produce which involved an outlay of $11,340,385 for salaries of officials, clerks, etc.; $21,799,251 for wages; $14,825,112 for miscellaneous expenses, including rent, taxes, etc.; and $124,043,837 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of the products during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the shop or factory. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures.

CHEMICALS AND ALLIED PRODUCTS.

By Charles E. Munroe and Thomas M. Chatard.

The publication of special reports relating to the manufacture of chemicals, which was begun in the Tenth Census, was a feature of the Eleventh Census, although, as stated in the report on "chemicals and allied products" of the latter census (Eleventh Census, Manufacturing Industries, Part III, page 275), "owing to changes in the form of inquiry and the inclusion of certain allied industries not reported as chemicals at the census of 1880, and the exclusion of others that were included under this head at the Tenth Census, a true comparison is impossible."

The same may be said of the report on chemicals and allied products for the Twelfth Census, now presented. Pharmaceutical preparations, included as chemicals by the Eleventh Census, have been excluded from the present report, while "bone, ivory, and lamp black," previously reported elsewhere, is here included. Still, the data for so many of the industries included in the classification are comparable that a fairly correct idea of the growth of the combined industries as a whole, during the past decade, may be obtained.

The total number of active establishments included in this inquiry, as set forth in this report, is 1,827. Thirty-six establishments were reported as idle, making the total number of establishments 1,863. The report on "chemicals and allied products" for 1890 covered 1,626 establishments, including those making pharmaceutical preparations as the principal product, but the latter are not considered in the present report. The Census Office classifies an establishment according to the nature of its principal product, this being determined by its value as compared with that of any other product which may be made therein. The special schedules for the various industries call for the main products of the industry with sufficient detail, while subordinate products are, in most cases, brought together under the caption "all other products." Hence, chemical products made by works belonging to other categories can not, in most cases, be ascertained from the returns and do not appear in this report except in a few specified instances. The amount so lost to this inquiry is, however, not so large as to materially affect these returns, and as the value of such products is included in the figures of the other categories, the final total value of all manufactures is not affected. Moreover, establishments whose products during the census year were valued at less than $500 are not included in the general tabulations, but are taken into consideration in this special report.

Owing to the hearty cooperation of most of the leading chemical works it is believed that the figures here presented are as nearly correct as the difficulties attending the collection of the information have permitted. In probably no branch of the census work is the need of a permanent, trained force more keenly felt than in this particular inquiry, the wide range of which is shown by the character of the "Special Schedule, No. 17," used in the collection of these returns. The products were classified under 19 groups, as follows: Group 1, Acids; II, Sodas; III, Potashes; IV, Alums; V, Coal-Tar Products; VI, Cyanides; VII, Wood Distillation; VIII, Fertilizers; IX, Bleaching Materials; X, Chemicals produced by the aid of Electricity; XI, Dyestuffs; XII, Tanning Materials; XIII, Paints, Pigments, and Varnishes; XIV, Explosives; XV, Plastics; XVI, Essential Oils; XVII, Compressed and Liquefied Gases; XVIII, Fine Chemicals; and XIX, General Chemicals. In the course of the work it was found necessary to form a subgroup, XIX A, to classify certain establishments whose main products were not originally included in "chemicals." A final group named "miscellaneous" includes a number of products not chemical but made by works belonging to the category of "chemical industries." By bringing such products together their nature, quantity, and value are given and the figures may be used to supplement the returns elsewhere given for such substances so far as they may be separately reported.

Separate tabulations have been made of the data for Group VIII, Fertilizers; Groups XI and XII, Dyestuffs and Extracts; Group XIII, Paints; also Group XIII, Varnishes; Group XIV, Explosives; and Group XVI, Essential Oils. The data for the remainder of the groups are included in the general tabulation of "chemicals." There is also a tabulation of "bone, ivory, and lamp black," but as results showed that the product was exclusively hydrocarbon black or lampblack, the figures may be properly included in those for "paints," and are so treated in the special group report. These tabulations are continued from previous censuses and are necessary in order that the condition of the manufactures of states, cities, etc., may be promptly shown with sufficient detail, but for the proper presentation of the chemical industries of the United States a certain reclassification of products became needful. For example, a certain large establishment made paints, acids, and general chemicals, its paint product being the largest in value; the establishment was classified under "paints," the other products being there reported as subproducts. In another instance a large fertilizer works, making its own acid, had such an extensive business in the manufacture of cottonseed products that, although it was really a chemical works of much importance, it could not be put in this category, but had to go elsewhere. So far as possible, the chemical products of this latter class of works have been taken into consideration in the special group reports, but separately noted, so that any duplication may be made evident.

In the special group reports, all of the products belonging to the group are brought together. When the main product of a works belongs to the group under consideration, the establishment is a "main" one and belongs to Class A. When the group product is a minor one for an establishment, this is counted in, but as a "sub" works and placed in Class B. The chemical product of an establishment not belonging to the category of "chemical industries," as noted above, is also taken into account, but the establishment and its chemical product are placed in a third class, C. By this system each group report can present its special operations and products in any desired detail; and while the figures of product may differ from and often exceed those of the general tabulations, no confusion can result if it is clearly understood that the purpose of the special group reports is to give as clear and complete a presentation of the American chemical industry as the available information may permit.

The following table gives, first, the totals for establishments, capital, labor, cost of materials, and value of products as shown in the tabulations, and second, for purposes of comparison, the total values for the same classes of products as shown by the reclassified figures of the group reports:

COMPARISON OF TABULATION VALUES WITH GROUP VALUES: 1900.

TABULATION.	Number of establishments.	Capital.	WAGE-EARNERS. Average number.	WAGE-EARNERS. Total wages.	Materials, cost.	Products, value.	Reclassified products, value.
Total	1,740	$238,529,641	46,766	$21,799,251	$124,043,837	$202,582,396	$221,217,217
Chemicals	459	89,091,430	19,054	9,401,467	34,564,137	62,676,730	[1] 78,414,840
Dyestuffs[2]	77	7,839,034	1,648	787,942	4,745,912	7,350,748	7,767,226
Essential oils	70	612,657	199	69,100	596,112	850,093	859,401
Explosives	97	19,465,846	4,502	2,383,756	10,334,974	17,125,418	[3] 16,950,976
Fertilizers	422	60,685,753	11,581	4,185,289	28,958,473	44,657,385	45,911,382
Paints and varnishes[4]	615	60,834,921	9,782	4,971,697	44,844,229	69,922,022	71,313,392

[1] Including miscellaneous, $4,175,656 from all tabulations.
[2] Including tanning materials.
[3] Excluding miscellaneous.
[4] Including bone, ivory, and lamp black.

Taking the table of "principal products, their quantity and value, 1890," given on page 275 of the above-mentioned special report of the Eleventh Census, and comparing the returns for the same products as given by the figures of the Twelfth Census, the following results are shown:

COMPARISON OF THE QUANTITIES AND VALUES OF THE PRINCIPAL PRODUCTS REPORTED: 1890 AND 1900.

PRODUCTS.	1890 Quantity.	1890 Value.	1900 Quantity.	1900 Value.
Total		$163,547,685		$221,217,217
Alum, pounds	93,998,008	1,616,710	179,467,471	2,446,576
Coal-tar products		687,591		1,421,720
Dyeing and tanning extracts and sumac, pounds	187,906,911	8,857,084	169,525,536	7,767,226
Gunpowder and other explosives, pounds	125,645,912	10,993,131	215,590,719	16,950,976
Fertilizers, tons	1,898,806	35,519,841	3,091,717	45,911,382
Paints, colors, and varnishes		52,908,252		71,313,392
Potash and pearlash, pounds	5,106,939	197,507	3,864,766	178,180
Sodas, pounds	333,124,375	5,432,400	1,279,082,000	10,237,944
Sulphuric acid, 50°, pounds	1,009,863,407	4,307,067	1,906,878,903	7,965,832
Sulphuric acid, 60°, pounds	20,379,908	122,940	34,023,131	246,284
Sulphuric acid, 66°, pounds	354,533,657	3,249,466	754,558,455	6,035,069
Wood alcohol and acetate of lime		1,885,469		5,775,290
Chemicals (including all acids, bases, and salts not heretofore enumerated)		24,751,974		[1] 40,791,690
All other products		13,018,253		4,175,656

[1] Including essential oils, $859,401.

This table shows that while the chemical industries of the United States have greatly advanced in quantity of product, the value per unit of product has much decreased, a tendency of much importance to those industries which use these products as materials for their own operations.

Each of the groups into which products are classified represents a special form of establishment, sometimes two or more forms, even though a single establishment may, and often does, furnish products belonging to two or more groups. Hence it is practically impossible to construct for this special branch of inquiry a single schedule which, by the wording of the interrogatories and the indications as to the proper nature of the replies, will enable the Census Office to elicit the desired information from all alike. The difficulties experienced in collecting the statistics have, however, indicated improvements needed for future work, and, with a permanent Census Bureau, there is every reason to expect that at the next census the statistics of chemical manufactures will show results of much wider scope than it has been possible to present even at the census of 1900.

The willingness of the manufacturers, notably of the great combinations, to furnish information has been most gratifying, and when difficulties have occurred in most cases they have been due to the fact that the establishments did not have such records as would give the information desired. The absence of such records has generally been regretted by the manufacturers, who have recognized the value such information would have been to them in their business. In the few cases where information was at first refused on the ground of interference with private business, a courteous letter of explanation rarely failed to elicit a pleasant reply, giving everything desired so far as it could be furnished.

While the groups above mentioned cover most of the products usually recognized as chemicals, inspection of the index of any standard work on chemical technology will show that the subjects considered as belonging to this domain are far more numerous. The reason for this becomes evident when it is remembered that every form of industry must be either physical or chemical or a combination of both. The manufacture of pig iron or the tanning of a hide is a chemical process, while the rolling of a rail or the making of a shoe is a physical process, but many manufacturing processes in which chemical reactions occur can not be sharply classified, since, while the products are the results of chemical action, the practical success of the operations depends upon the correct arrangement of the mechanical plant, a good example of this being the ammonia-soda process. Modern industrial chemistry tends to develop itself more and more along engineering lines; hence the increasing demand for the chemical engineer—a mechanical engineer with a special equipment of chemical science and technology.

A list of the topics treated of in Wagner's Chemical Technology is here given as an example of what the term "chemical technology" as a rule embraces, to which is added a list of the special schedules and bulletins issued by the Census Office showing how far these topics are the subject of special inquiries and reports at the census of 1900, thus facilitating the obtaining of a comprehensive view of this industrial complex.

COMPARISON OF THE TOPICS OF CHEMICAL TECHNOLOGY WITH THE CLASSIFICATIONS OF THE CENSUS OF 1900.

TOPICS.	Special schedule number.
Fuel:	
Charcoal (chemical manufactures)	17
Coke	7
Gas, illuminating and fuel	(no number)
Oil, mineral (petroleum refining)	8
Paraffin, etc (petroleum refining)	8
Metallurgy:	
Iron and steel	21 and 23
Copper	24
Lead	25
Zinc	26
Other metals, general schedule	3

COMPARISON OF THE TOPICS OF CHEMICAL TECHNOLOGY WITH THE CLASSIFICATIONS OF THE CENSUS OF 1900—Continued.

TOPICS.	Special schedule number.
Chemical manufactures, inorganic:	
Common salt	9
Acids, bases and salts	
Fertilizers	
Explosives (chemical manufactures)	17
Compressed gases	
Electrolytic products	
Paints and varnishes	
Chemical manufactures, organic:	
Alcohols and ethers	
Organic acids (chemical manufactures)	17
Organic coloring matters	
Coal-tar products and colors	
Glass:	
Pottery and fire-clay products	6
Bricks	5
Cements and mortar, general schedule	
Food, beverages, etc.:	
Starch, general schedule	
Sugar, general schedule	
Fermentation	
Brewing, general schedule	
Wine making, general schedule	
Spirits, general schedule	
Flour and grist products	31
Meat products (slaughtering and meat packing)	33
Milk, butter, and cheese	32
Fibers:	
Preparing, bleaching, dyeing, printing, and finishing	12
Silk	16
Wool	14 and 15
Cotton	11
Hemp, flax, and jute	13
Paper	34
Miscellaneous:	
Tanning (leather, tanned and curried)	18
Glue, size, gelatine, general schedule	
Bone distillation—	
Bone charcoal, general schedule	
Bone oil	
Fats, oils, soaps, general schedule	
Stearin and glycerin, general schedule	
Resins, general schedule	
Essential oils (chemical manufactures)	17
Wood preservation, general schedule	

While some of these topics may at first appear to the laymen to have but a very slight connection with chemistry, as, for example, the manufacture of flour or bricks, yet flour and bricks, as well as all of the other chemical substances named, are chemical substances, and they have been the subject of extended chemical study by specialists, through which there has resulted great improvement in the quality and cheapness of the products. In such industrial chemical investigation Germany leads all other countries, and its present preeminence in the field of chemical manufacture has been deservedly won by its work, although it has been materially aided by the character of the patent laws of England and of the United States.

The German chemical manufacturer is far in advance of those of all other nations in recognizing the value of specialized chemical skill in the conduct of the works and in employing trained chemists in laboratory investigations. Thus McMurtrie[1] points out that the Fabriken der Actien-Gesellschaft Farbewerke Meister Lucius und Bruning in Höchst, who were in 1890 making between 1,700 and 1,800 different colors, numbered

[1] The Relations of the Industries to the Advancement of Chemical Science, by William McMurtrie, Proc. A. A. A. S., Vol. 44, page 79, 1895.

among their 3,000 employees 70 chemists and 12 engineers. Green[1] states that in 1900 the six largest coal-tar color firms in Germany employed about 500 chemists and 350 engineers and technical men, while Sir Henry Roscoe[2] states that at the German works which he had visited, highly trained chemists were employed in original researches with a view to new discoveries. "One employee, who received £1,000 a year, worked for several years without producing any results; but eventually he made a discovery which repaid the firm ten times over, and placed an entirely new branch of manufacture in their hands."

Owing to the extended discussions going on in England and America relative to the tremendous growth of the chemical industries of Germany during the past twenty years, in which many have attributed much of this growth to the extensive employment of doctors of philosophy in chemistry and other university-bred chemists in the German technical works, a census has been taken of the establishments in the United States which are the subject of this report, with the following result:

CHEMISTS EMPLOYED IN THE ESTABLISHMENTS TREATED OF IN THIS REPORT.

GROUP NUMBER.	Group name.	Number of chemists.
I	Acids	28
II	Sodas	9
III	Potashes	
IV	Alums	11
V	Coal-tar products	7
VI	Cyanides	8
VII	Wood distillation	3
VIII	Fertilizers	10
IX	Bleaching materials	4
X	Electro-chemicals	9
XI	Dyestuffs	13
XII	Tanning materials	7
XIII	Paints and varnishes	53
XIV	Explosives	32
XV	Plastics	5
XVI	Essential oils	2
XVII	Liquefied gases	9
XVIII	Fine chemicals	25
XIX	General chemicals	41
	Total	276

When, in German works, the results of the investigations of the expert chemists indicate commercial possibilities, practical working tests follow, and, in the end, one more patent is added to those which hamper the development of chemical industry in countries which, like the United States, give the foreigner the monopoly of a patent without requiring that the protected article shall be made where the patent is issued. The effect is that since it is often more profitable to make the higher grade chemicals abroad than in the United States, foreign labor and capital are protected to the injury of the labor and capital of this country. Hence, while the manufacture of acids, alkalies, fertilizers, and other heavy chemicals has greatly increased in the United States, this is mainly because of transportation costs. The tariff on alkalies has certainly added much in the development of this branch because it has been to the interest of the foreign patentees to establish alkali works here either by their own capital or by granting licenses to others. When, as in the case of dyestuffs and other high-grade chemicals, the transportation cost is a minor consideration, the tariff has little effect in inducing the domestic manufacture of a foreign article protected by a local patent. So long as the demand for his article insures a sufficient price, the foreign patentee can make it abroad and ship it here, paying whatever duty may be demanded; by simply refusing to grant a license for manufacture here, he is secured from all competition. Other countries may have refused to grant him a patent, which may even have become void in the original country, and the article be made by others; yet under our laws, he, and he alone, may vend the article here. The English, who are suffering from a similar condition of their patent laws, are bestirring themselves to have the situation ameliorated, and a special committee of the Society of Chemical Industry has lately made a report upon this subject.[3] The effects of granting British patents to foreigners without requiring domestic operation are thus stated:

1. We foster foreign labor and assist in the development of foreign industries.
2. As the introduction of a new article generally replaces another article hitherto in use, we throw out of employment a certain number of our own workpeople.
3. Very frequently the foreign patentee has either not succeeded in getting a patent in his own country or such patent has already run its course there, whilst his British monopoly remains in full force. The result is that we stifle invention and increase the prices of a number of articles by closing the doors to our own inventors and manufacturers, whilst our foreign competitors may make and vend abroad the patented article without any restriction or payment of royalty.

Several examples are given of the practical working of the English patent laws. Artificial alizarine was invented in Germany but no patent was granted there. English patents were, however, granted, with the result that the patentees, having the monopoly of the English market anyhow, simply made it in Germany, as being cheaper so to do, and built up an enormous trade which was the foundation of Germany's present supremacy in the manufacture of coal-tar dyestuffs. Again, the production of artificial indigo is destroying the natural indigo industry of India and producing much distress there. England, which is thus a heavy loser, can do nothing to offset this loss, because the patent monopoly granted to the foreigner enables him to supply the English market on his own terms.

Every country, save England and the United States, has a provision in its patent laws that a patent can be revoked if not worked in the country granting the patent. Moreover, the French patent law has, in addi-

[1] The Coal-tar Industry, by A. G. Green, Science, Vol. 14, page 663; 1901.

[2] J. Soc. Chem. Ind., Vol. 16, page 570, 1897.

[3] J. Soc. Chem. Ind., 1902, pages 212 to 301.

tion, the following provision, article 32, section 3, "The patent shall be revoked if the patentee has introduced into France articles of manufacture made abroad and similar to those which are protected by the patent." In this way France provides that, in giving to anyone the protection of her patent laws, her domestic industry shall be fostered, and not, as in England and the United States, often injured and sometimes destroyed. Instances have occurred in this country where chemical substances once made here are no longer produced, because the foreign manufacturer, protected by his American patent, has been able to make the domestic manufacture unprofitable.

The report under consideration states that "There is but one remedy for this vexed question which is both simple and efficacious, viz, to enact that 'A patent may be revoked if it be proved that an article patented is worked abroad and not in the United Kingdom, the onus of proof that the patent is worked, bona fide, in this country, resting with the patentee or licensee.'" Some such provision as this in the laws of the United States would materially aid the development of our American chemical industry.

In order to bring out the relations existing between the growth of the chemical industry and of the patents which have been granted in this country covering inventions in this industry, an abstract has been made of all chemical patents issued from the founding of the United States Patent Office up to the year 1900, and this Digest of Chemical Patents is given as an appendix to this report. It was prepared by Mr. Story B. Ladd, M. E., whose experience as a patent attorney especially fitted him for this duty, and he elsewhere shows the effect which the granting of these monopolies has produced on the industries of the United States.

The Nineteenth century, the closing year of which is marked by the taking of the Twelfth Census, will always be a notable one in the history of chemical manufacture, since practically all of its present working processes have had their origin and development during this period. Indeed, chemical manufacture, as such, can hardly be said to have existed until the continuously working chamber process for sulphuric acid was introduced, about 1810, while the Leblanc soda process, although discovered by him in 1789, failed to get a footing until 1814, when it was introduced into England by Losh. Thereafter the development of chemical technology proceeded rapidly, and now, at the end of the century, we find that the great Leblanc process is approaching extinction through the inroads of the later ammonia-soda process and the electrolytic chlorine process, while the chamber process for sulphuric acid appears to be about to meet a formidable competitor in the recently developed contact process.

As the nature and working conditions of this process have been only lately made public, and as its general introduction will have such a profound effect upon industrial chemistry, especial attention is given to it in the next section. Moreover, contact action or catalysis continually occurs in chemical operations, has already numerous applications, and the number is continually increasing.

By catalysis in meant that peculiar action of a substance by which it can, when in contact with two or more substances capable of reacting upon each other, either cause the reaction, or, if the reaction is already occurring, greatly diminish the time required for its completion. At the same time, the catalytic substance, so far as respects the nature of the ultimate products, appears to have undergone no change. Hence, Ostwald's definition, "A catalytic agent is such material as affects the velocity of a chemical reaction without itself appearing in the final product." A very familiar example of catalytic action is the effect of adding manganese peroxide to potassium chlorate when making oxygen. Either of the substances gives off oxygen when heated to a temperature sufficiently high, but when mixed the reaction is effected at a much lower temperature and with much less danger of explosion. When the reaction is completed, examination of the residue shows that only the chlorate has lost its oxygen, becoming chloride, the peroxide being apparently unchanged. It is probable that the latter has taken full part in the reaction, giving off oxygen and taking it up again, but, looking only at the final result, it appears to have been effective merely by its presence.

The action of the niter gas in the sulphuric acid chamber is also catalytic. The union of sulphur dioxide and atmospheric oxygen can and does take place without the help of the niter gases, but the unassisted reaction is very slow and incomplete. The niter gases are oxygen carriers; the oxygen which they contain is in a much more active condition than that of the air, so that they oxidize the sulphur dioxide but replace the loss by taking up oxygen from the accompanying air. As water, in the form of steam, is always present in this reaction, the final product is sulphuric acid, which, in theory at least, is free from oxides of nitrogen, the niter gas remaining in its original active condition. In practice, however, a certain amount of this gas is reduced to inactive forms and this loss must be made up by addition of fresh gas, so that for every hundred parts of acid produced, a certain quantity of niter is used up, but this quantity, being theoretically nothing, depends upon the care of the management and other conditions.

Other applications of catalysis are met with in the Deacon chlorine process, the manufacture of chlorates, aldehydes (the formaldehyde lamp for disinfection being an example), acetone, carbon tetrachloride, and many other organic products, the entire subject being one of great and increasing importance.

Group I.—Acids.

Sulphuric Acid.—The manufacture of sulphuric acid has practically doubled during the past decade, the increase of product resulting more from the expansion of works than from an increase in their number. The following table gives a comparison between the output for the census year of 1900 and that for 1890. The figures for quantity and value of 50° acid include acid made and consumed in the works in the production of fertilizers and other products.

COMPARISON OF SULPHURIC ACID PRODUCED IN 1890 AND 1900.

STRENGTH, BAUMÉ.	1900—127 ESTABLISHMENTS.			1890—105 ESTABLISHMENTS.		
	Acid produced.			Acid produced.		
	Pounds.	Value.	Value per ton.	Pounds.	Value.	Value per ton.
Total..	2,695,460,489	$14,247,185	....	1,384,776,962	$7,679,473	....
50°	1,906,878,903	7,965,832	$8.35	1,009,863,407	4,307,067	$8.53
60°	34,023,131	246,284	14.47	20,379,908	122,940	12.06
66°	754,558,455	6,035,069	16.00	354,533,657	3,249,466	18.33

The figures of quantity and value of the 50° acid for both periods include the amount of this acid made at certain works and consumed there in the manufacture of fertilizers. In addition there is given the quantity and value of the acid consumed at works in 1900 for making mixed acids for explosives and for other purposes. The acid used for fertilizers was really 50° or chamber acid. The rest of the acid included for 1900 was of various strengths, but for purposes of comparison these have been reduced to 50°. In reducing 66° acid to 50°, the quantity is multiplied by 1.50, and for 60° acid, multiplied by 1.25, these factors being closely approximate to the usual strengths.

	1900.		1890.	
	Pounds.	Value.	Pounds.	Value.
Total	2,097,268,570	$8,819,526	581,536,200	$2,480,495
Fertilizers	1,578,718,000	6,591,147	581,536,200	2,480,495
Other purposes	518,550,570	2,228,379	(1)	(1)

[1] Not given.

The census report for 1890 also gave the total acid production reduced to a uniform strength of 50°. Doing this for the acid production of the present census gives the following comparison:

Total acid as 50°:	
1900	3,081,245,500
1890	1,567,138,777
Gain, practically 100 per cent	1,514,106,723

The census of 1870 was the first at which separate figures were given for sulphuric acid, but only the number of establishments and the total value of product were given. In 1880 the total quantity in pounds was given, but no separation into the various strengths was made, so that the returns are not strictly comparable. Even with these restrictions a comparison is interesting as showing the growth of this branch of manufacture.

YEAR.	Number of works.	Quantity of products.	Value of products.
1870	4	(1)	$212,150
1880	49	308,765,432	3,661,876
1890	105	1,384,776,972	7,679,473
1900	127	2,695,460,489	14,247,185

[1] Not given.

The first manufacturer of sulphuric acid in the United States appears to have been Mr. John Harrison, of Philadelphia, who in 1793 had a lead chamber capable of producing 300 carboys of acid per annum.[1] The business proving very remunerative, he built, in 1807, a lead chamber 50 feet long, 18 feet wide, and 18 feet high. This was a large chamber for the time, and was capable of making nearly half a million pounds of sulphuric acid annually, the price of the acid being then as high as 15 cents a pound. Mr. Harrison was also the first person in the United States to use a platinum still for the concentration of the acid, this having been up to then done in glass, a very precarious and dangerous operation. This first still was made in 1814 by Dr. Eric Bollman, and was at once put in use. It weighed 700 ounces, had a capacity of 25 gallons, and was in continuous use for fifteen years.

Powers & Weightman, of Philadelphia, report that they began the manufacture of sulphuric acid in 1825, while a letter from Mr. Nicholas Lennig, containing much valuable information, states that about 1829 his father, the late Mr. Charles Lennig, erected a sulphuric-acid plant which "was so successful that the then existing New York Chemical Company went into liquidation, and put the funds realized therefrom into a banking company now well known as the Chemical National Bank."

It also appears that, in 1829, the manufacture of sulphuric acid was begun in Baltimore by two companies, the Maryland Chemical Works and the Baltimore Chemical Manufactory. The industry extended, and the figures given at the census of 1870 of 4 works, with a total product of the value of $212,150, are undoubtedly erroneous. Of the works reporting acids as principal products at the census of 1900, 16 reported starting in business prior to 1870, while some of the fertilizer factories were making acid prior to that time. While nothing positive can now be said on this subject, it is not unlikely that in 1870 there were at least 25 sulphuric acid works in operation, with a product of over a million dollars in value. Such a supposition is certainly more reasonable when compared, as above, with the figures of subsequent censuses, since everyone, at all conversant with this subject, is well aware that between 1870 and 1880 there was no such outburst of energy in this branch of industry, as would be indicated by the

[1] Catalogue, Harrison Brothers & Company, Incorporated, Philadelphia, 1902.

figures of the respective years. Moreover, the figures of value for the total chemical industry, so far as they can be compared, were, for 1870, $60,998,214, and for 1880, $89,388,172; while the figures for 1890 were $161,067,190. The comparatively small increase of the figures of total value of product for 1880 over those for 1870 is what would be expected in the slow uphill course of business between 1873 and 1880, while the next decade opened with a revival which, with occasional backsets, held good until 1893.

The total number of sulphuric-acid works reporting at the census of 1900 was 127. Of these, 31 burned brimstone only, 79 burned pyrites only, while 17 reported that they used both brimstone and pyrites.

Brimstone Plants.—Seven brimstone-burning plants made 66° acid, burning 18,042,072 pounds of brimstone and producing 51,204,775 pounds of 66° acid, or an average of 279 parts of 66° acid (equivalent to 419 parts of 50° acid) to 100 brimstone, the figures for each plant running from 308 to 260 parts of acid. Thirteen brimstone plants, making 50° acid only, used 35,955,680 pounds of brimstone and produced 140,534,027 pounds of 50° acid, an average of 391 parts of acid to 100 parts of brimstone, the figures running from 446 to 321 parts of acid for 100 parts of brimstone. Two works reporting, respectively, a yield of 321 and 334 parts, stated that they were using a very low grade of brimstone, which was obtained under advantageous conditions. Taking the 20 works together and the whole product as 50° acid, it is found that the grand average is 402 parts of acid for each 100 parts of brimstone.

Pyrites Plants.—Nine pyrites plants, making 66° acid only, consumed 248,026,399 pounds of pyrites and produced 311,924,674 pounds of 66° acid, an average of 133.8 parts of acid (equivalent to 200.7 parts of 50° acid), for 100 parts pyrites. Thirty pyrites plants, making 50° acid only, consumed 425,050,296 pounds of pyrites and produced 889,222,560 pounds of 50° acid, an average of 209 acid to 100 pyrites, the figures running from 234 to 160 parts. The grand average for the 39 works is 206 acid to 100 pyrites.

The figure 160 is given by 3 works burning low grade domestic pyrites, while the highest figure, 234 parts acid, is furnished by a new model plant burning pyrites with an average content of 50.05 per cent of sulphur and using 1.26 parts of nitrate of soda to every 100 parts of pyrites. Other works give, per 100 pyrites, 224 acid, 1.66 niter; 213.4 acid, 2.13 niter, while a large combination reports that it allows 2.5 parts of niter and expects a yield of 225 parts of 50° acid. The brimstone works show approximately a consumption of 4.29 parts of niter per 100 brimstone. In considering these figures, it must be remembered that the 66° acid does not average more than 93 per cent of H_2SO_4, corresponding to 65.6° B. Similarly, the 50° acid runs from 52° to 48° B., and even lower, and the chamber acid made and used in fertilizer works is usually under 50°. The continued use of brimstone in this industry in the United States is remarkable. as practically no brimstone acid is now made in England or on the continent of Europe.

The Contact Process.—In 1900, at the meeting of the German Technical Chemists at Hanover, Clemens Winkler, the founder of the contact process, as we now have it, delivered an address entitled "The Development of the Sulphuric Acid Industry During the Nineteenth Century." In this paper, published in Zeitschrift fur Angewandte Chemie, 1900, page 731, he gives a short review of the history and present status of the chamber process, and then shows the lines he followed in his celebrated research upon contact action in the production of sulphur trioxide, which he made public in 1875. He then speaks of the subsequent development of this process, and concludes by impressively stating that the contact process has already demonstrated its ability to compete with and finally to supersede the chamber process. The subject is so important that a summary of this paper is given here, and, following it, an abstract of the very valuable paper by Knietsch upon the development of the contact process in the works of the Badische Anilin und Soda Fabrik to which Winkler calls attention. This paper is very recent, having been published in the "Berichte der Deutschen Chemischen Gesellschaft" for December, 1901, and is so full of valuable information that its presentation here, in abstract, seems appropriate.

Winkler stated that the only acid known to the ancients was vinegar, and that the first indication of the recognition of any other acid is when Geber, in the Eighth century, speaks of the "spirit" which can be expelled from alum and which possesses solvent powers. Albertus Magnus, Thirteenth century, speaks of a "spiritus vitrioli Romani" which can only have been sulphuric acid, while Basilius Valentinus, Fifteenth century, describes its preparation not only from copperas, but also by burning together sulphur and saltpeter, pointing out very distinctly not only that sulphur, in burning, produced some sulphuric acid, but also that the yield is much increased if saltpeter is added.

Dornaeus, in 1570, described its properties accurately; Libavius, 1595, recognized the identity of the acids from different processes of preparation; Angelus Sala, 1613, pointed out the fact, which had sunk into oblivion since Basilius, that sulphuric acid can be made by burning sulphur in moist vessels; after that time it was prepared by the apothecaries in that way.[1]

The addition of saltpeter was introduced by Lefevre and Lemery, 1666, and Ward, in London, 1740, began to make sulphuric acid on a large scale in glass vessels. The lead chamber was first used by Roebuck, of Birmingham, who, in 1746, erected such a chamber 6 feet square. The first chamber erected in France was at Rouen, in 1766. At this place, in 1774, De la Follie introduced the important improvement of the intro-

[1] Lunge: Sulphuric Acid and Alkali, 1891, Vol. I, page 7.

duction of steam into the chambers during the combustion of the brimstone. In 1793 Clement and Desormes showed that the chambers could be fed by a continuous current of air, by which much saltpeter could be saved. By this time the general principles of sulphuric-acid making were established, and by the end of the century there were already six or eight works in Glasgow alone, while the price of a kilogram (2.2 pounds), which, in 1740, in Germany, was about $1.12, sank in 1799 to 22 cents, and is now (1900) about three-fourths of a cent.

Lampadius (Grundriss d. tech. Chemie, Freiberg, 1815, p. 3) has given a description of a sulphuric-acid works and the manner of operation at the beginning of the Nineteenth century. From this it is learned that a mixture of five parts of sulphur and one part of niter was burned in successive charges in the lead chamber, steam being admitted at the same time and air being let in when deemed necessary. The acid obtained was weak and had to be concentrated in glass retorts up to about 1.80 sp. gr., while the yield was less than half of what would be obtained at present.

The proper construction of lead chambers involved great difficulties, it being almost impossible to make them gas-tight, until Debassyns de Richemont invented autogenic soldering. The chamber described by Lampadius contained about 300 cubic meters (10,594 cubic feet), but the dimensions have been increased until now the biggest chambers contain 4,000 to 5,000 cubic meters (140,000 to 176,000 cubic feet). The last figures appear to be too large, and the present practice is not to increase the chamber space, but to supplement the surface by means of other devices, such as the Lunge-Rohrmann plates.

Finally, in the earlier years of the Nineteenth century, the chamber process became a continuously working one, and thus was enabled to be what it now is, the foundation of the chemical industry and the measure of its extent. Improvements rapidly followed. The investigations of Gay-Lussac, on the recovery of the nitrogen oxides from the escaping gases, have given us the tower which bears his name, while the form of tower invented by Glover furnishes an efficient denitrator for the acid flowing from the Gay-Lussac tower. The simultaneous use of these two towers is a necessity in any modern, rationally managed establishment.

The use of pyrites, in place of brimstone, was first introduced in 1836, on a manufacturing scale, by Wehrle, in Nussbaum, near Vienna, and by Brem, in Bohemia. In 1862, Spanish pyrites began to be used in England, and by 1868 the use of brimstone in English works had almost entirely ceased, and now very little brimstone is used in any country of Europe for the manufacture of sulphuric acid, while the consumption in the United States for this purpose is still quite large, amounting, in the census year 1900, to 128,427,000 pounds, or about one-tenth of the total weight of the pyrites so used.

Attempts to use the roaster gases from smelting works were made in 1856–1858, and in 1859 a set of chambers using such gases was started at Oker. At present the smelting works in Germany produce (1899) 186,000 tons of H_2SO_4, about 22 per cent of the total production. As elsewhere, the principal use of this acid is in the manufacture of superphosphate, of which 500,000 tons were made in Germany in 1899.

The methods of concentration of the weaker acids have been greatly improved, the increasing cost of platinum making it necessary to exercise the greatest economy. Platinum, which in 1870 cost about $150 per kilogram, cost in 1900 over $700 per kilogram, and the price is now little less than that of gold. Heræus, in 1891, introduced the use of gold-plated platinum stills, which were found to be a great improvement.

Fuming sulphuric acid, or Nordhausen acid, as it is also called, is a mixture of sulphur trioxide (or sulphuric anhydride), with a varying proportion of monohydrated sulphuric acid. When the relation is about one part of SO_3, to one part of H_2SO_4, it is solid at ordinary temperatures, melting at 35° C., and is the "solid sulphuric acid" of the trade. As it is obtained by heating copperas, alum, or other metallic sulphates, it was the first form of sulphuric acid known, and the Pilsen acid works are already mentioned in 1526. This industry was destroyed during the Thirty Years War, but was revived at Nordhausen. In 1778 Starck reestablished the industry in Bohemia, where, on account of the cheapness of labor and of the necessary vitriol stone, his successors enjoyed a practical monopoly of this substance, until the increasing demand for it, in the manufacture of alizarin, and for many other purposes, led to researches which have given methods by which it can be made far more cheaply than by the distillation of vitriol stone, since when this is used only small charges can be worked, because the larger the charge, the higher the heat required, and the greater the loss of acid through the consequent splitting up of sulphur trioxide into sulphur dioxide and oxygen.

That these two gases could be made to recombine by the contact action of platinum and other substances, had long been known and methods of utilization proposed, but nothing of importance had been accomplished until Clemens Winkler published, in 1875, the results of his researches. In the beginning of his work, Winkler heated the vitriol stone in much larger quantities, without regard to the decomposition of the trioxides, passed the gases over platinized asbestos, thus recombining the SO_2 and O, and then absorbed the trioxide in strong sulphuric acid. The results were very satisfactory, but it was necessary to find a material cheaper than the vitriol stone. As the course of the work indicated that, for the best results, the SO_2 and O should be in stochiometrical proportions, sulphuric acid was used, because when heated sufficiently high it breaks up thus:

$$H_2SO_4 = SO_2 + O + H_2O.$$

The water vapor was easily removed and the residual gases remained in the exact proportion needed.

The need of a still cheaper material than sulphuric acid becoming manifest, Winkler began to experiment with the roaster gases of the Freiberg Smelting Works, and in time it was found that in this way two-thirds up to three-fourths of the SO_2 in these gases could be converted into SO_3. Still there were many difficulties in the way of commercial success, such as purification of the gases, etc., so that Winkler was unable to publish his further results for many years.

In the meantime the matter was taken up by the Badische Anilin und Soda Fabrik at Ludwigshafen on the Rhine, and after years of unwearied scientific investigation, in which no expense was spared, this great corporation has succeeded in solving the problem and has reaped a rich pecuniary reward.

What the commercial success of the contact process means for the future of industrial chemistry may best be expressed in the words of Winkler, who, having stated that at Ludwigshafen the new process can compete with the lead-chamber acid, goes on to say: "Therefore we can anticipate that, in no distant time, the lead chambers of to-day will be dispensed with, a condition amounting to a complete revolution in the domain of sulphuric-acid manufacture." Such a statement from so authoritative a source is a sufficient warrant for the presentation in this place of the following abstract of Knietsch's paper:

THE CONTACT PROCESS FOR THE MANUFACTURE OF SULPHURIC ACID.[1]

I. *Historical.*—The production of sulphuric acid is a matter of the greatest importance, as it is not only the foundation of the inorganic heavy-chemical industry and is used for many other purposes, but also has lately become a most important material in the organic dye-stuff industry, especially in the production of alizarine colors and of synthetic indigo. The contact process is causing a complete revolution in the methods of manufacture of sulphuric acid; hence an account of its historical development and present status should be of great interest. The historical development of this process may be divided into four periods.

First period: Phillips, in 1831, discovered the catalytic action of platinum in hastening the union of SO_2 and O to form SO_3.

Second period: Wohler and Mahla, in 1852, showed that many other substances besides platinum possess catalytic properties, and explained the character and course of the reaction.

Third period: Winkler used definite gas mixtures for the production of sulphuric anhydride, as it was then considered that only in this way could good quantitative yields be obtained.

Fourth period, the present one, is noted by the successful use of the furnace gases directly.

[1] R. Knietsch, Ber. d. d. Gesell, 1901, page 4069.

The investigations of the third period were directed toward the production of fuming sulphuric acid, which was then very expensive, while the investigations of the first and second periods had the same end as the work of the present time, that is, the replacement of the chamber process by improved methods.

The catalytic action of platinum was discovered by Humphry Davy in January, 1818, who showed that platinum wire, when warmed and then introduced into a mixture of oxygen (or air) with H, CO, ethylene, or cyanogen, became incandescent, and that the gas mixture oxidized, usually gradually, but often rapidly.

Edmund Davy, in 1820, discovered that finely divided precipitated platinum, when moistened with alcohol and exposed to the air, becomes incandescent and the alcohol burns.

Doebereiner, in 1822, found that finely divided platinum, obtained by heating ammonio-platinic chloride, acted in the same manner, and, in 1824, that such platinum could ignite a stream of hydrogen, when this impinged upon it in contact with air, and utilized this discovery in his celebrated "lighting machine."

The honor of having first utilized this catalytic action, for the production of sulphur trioxide, is due to Peregrine Phillips of Bristol, England, who, in 1831, took out an English patent for his discovery, and, in 1832, Doebereiner and Magnus each confirmed the observations of Phillips. Although this discovery attracted much attention, nothing practical followed until 1848, when Schneider exhibited a working model of an apparatus, which produced sulphuric acid through the contact action of a specially prepared pumice. This alleged discovery was presented with great claims, but never was able to show a success, although wonderful results were confidently predicted. The same may be said of the method of Richard Laming, who also used a contact mass of pumice, prepared by boiling it in concentrated sulphuric acid, washing it in ammoniacal water, drying, and then impregnating it with about 1 per cent of manganese dioxide, finishing by heating the mass in a retort to 600° and allowing it to cool out of contact with the air. Here we note for the first time, the use of another contact substance which, like platinum, can exist in various grades of oxidation, namely, manganese.

Especially noteworthy in this connection is the English patent of Jullion, 1846, because here, for the first time, the use of platinized asbestus as a contact mass is claimed. In 1849, Blondeau passed a current of a mixture of sulphur dioxide, steam, and air through a highly heated tube containing ferruginous, argillaceous sand and obtained sulphuric acid, while, in 1852, Wohler and Mahla found that oxides of iron, copper, and chrome also work catalytically upon a mixture of SO_2 and O, a mixture of cupric and chromic oxides being especially efficacious. These investigators gave, moreover, a correct explanation of this catalytic action; they found, namely, that cupric and ferric oxide, when heated in a current of sulphur dioxide free from oxygen, became reduced to cuprous and ferroso-ferric oxides with simultaneous formation of sulphuric acid which, however, ceased as soon as the reduction of the oxides was completed. On the other hand, chromic oxide, under similar conditions, remained entirely unaltered and no sulphuric acid was produced, while metallic copper, in spongy form, exerts no action upon a mixture of 2 vol. SO_2 + 1 vol. O at ordinary temperatures, but, when heated, cupric oxide is first formed, and then sulphuric acid.

They also call attention to the fact that this union of SO_2 and O can take place in the complete absence of H_2O.

Upon these important discoveries are based the later researches of Lunge and others upon the catalytic action of pyrites cinder in causing the formation of SO_3. Quartz has also been recommended for this purpose, as have also platinized asbestus, platinized pumice, and even platinized clay.

Hundt, 1854, passed the hot roaster gas through a flue, filled with quartz fragments and heated by the gas, expecting to convert the greater part of the SO_2 into sulphuric acid with further treatment of the residue. The work of Schmersahl and Bouk, 1855, followed the same lines, as did also the method of Henry Deacon, which was patented in 1871, and may be considered as closing the second period.

So far, not only had all attempts to supersede the chamber process failed, but also no practical method for the production of fuming sulphuric acid had been devised. In 1875, Clemens Winkler published his celebrated researches upon the formation of sulphuric anhydride, for which industrial chemistry must always be greatly indebted to him, as originating successful methods for the economical production of the fuming sulphuric acid for which, as it has become cheaper, many new uses have been discovered.

Winkler concluded, as a result of his experiments, that the SO_2 and O should always be present in the molecular proportion of 2:1, any excess of either gas having a deleterious influence upon the completeness of the reaction, and he obtained this desired proportion by simply breaking up ordinary hydrated sulphuric acid into H_2O, SO_2, and O, removing the H_2O, and then recombining the SO_2 and O by means of appropriate contact substances, the preparation of which he greatly improved by utilizing the reducing action of formic acid. All subsequent work in this branch continued to follow the lines laid down by Winkler; hence, while little progress was made toward superseding the lead chamber, the manufacture of fuming sulphuric acid became highly developed.

II. *Knietsch's Work—Purification of the Gas.*—This work was undertaken by the Badische Anilin und Soda-Fabrik to determine if a complete conversion of the SO_2 in roaster gas was as practically feasible as it is theoretically possible.

It is well known that the outgoing gases of the chamber process still contain 6 volume per cent of oxygen, and that the roaster gas employed in the contact work contained a similar excess. Hence it was difficult to understand why, in the latter process, the yields were not nearer that of the former.

Experiments showed that when pure SO_2 was used the yield was close to the theoretical, even when a very large excess of O was present, which was contrary to the accepted views of Winkler.

When roaster gas was used in laboratory experiments, it was found that when this was carefully cooled, washed with sulphuric acid, and completely purified before it was allowed to enter the catalytic tube, the results were very satisfactory, nor could any diminution of the efficiency of the contact mass be noted even after several days' use. It was therefore supposed that the problem had been solved, and arrangements were made to carry on the process on full working scale.

It was, however, soon found that in practice the contact mass gradually lost all of its efficiency, no matter how carefully the gases were cooled and purified. Extended laboratory investigations were undertaken to determine the cause of this inefficiency, and it was ultimately discovered that there are substances which, when present in the gas, even in excessively small quantities, injure the catalytic properties of platinum to an extraordinary degree. Of all of the substances which may be found in roaster gas, arsenic is by far the most deleterious, next mercury, while Sb, Bi, Pb, Fe, Zn, etc., are injurious only so far as they may coat the contact mass.

It was also found that as the white cloud of sulphuric acid which was present in the gas contained arsenic, the complete removal of this was necessary, although such removal had always been considered an impossibility. This was, however, finally accomplished after an enormous expenditure of time, labor, and money, so that, in the end, by extended washing and filtration, the gases were obtained in a condition absolutely free from all impurities. (D. R. P. 113933, July 22, 1898.)

Slow cooling of the gas was found to be absolutely necessary as a preliminary to its purification. It is a fact, the cause of which is not yet clearly known, that the removal of the white cloud is rendered far more difficult if the gas is rapidly cooled.

To insure slow cooling, a system of iron tubes was used because it was supposed that, as the sulphuric acid in the gas was in a so highly concentrated condition, any action upon the metal would yield SO_2 only. It was now found that although the contact mass remained active for a much longer period, it still gradually lost its power, no matter how carefully the gas was purified. The cause of this was ultimately found to be a gas containing arsenic, probably hydrogen arsenide, produced by the action of the acid upon the iron by which hydrogen was evolved, although the formation of this gas under such conditions had always been considered impossible. As soon as the cooling apparatus was so arranged that no condensed acid could attack the iron, the trouble from this source entirely ceased.

A final difficulty occurred in the occasional formation of a faint cloud of unburnt sulphur which contained arsenic. The cure for this was found to be a proper mixing of the hot gases, thus insuring complete combustion, and this mixing was effected by means of steam, which is also beneficial, by diluting the strong sulphuric acid present in the gas, so that it did not condense in the iron pipes of the first portion of the cooling apparatus, and attack them; when condensing in the lead pipes of the remainder of the apparatus, the acid was too weak to injure the lead. The use of steam also prevented the formation of hard dust crusts, which tend to stop up the pipes.

III. *Cooling of the Gases.*—The next important element in the successful carrying out of the contact process is the effective and economical utilization of the heat developed by the reaction which is exothermic.

$$SO_2+O=SO_3+22600 \text{ cal.}$$

The utilization of this heat had been suggested by Lunge, but only in the case of the use of a mixture of pure SO_2 and air, containing about 25 per cent of the former. On the other hand, it was universally considered that it was necessary to employ extra heat when the much weaker roaster gases are to be treated. Hence the apparatus used in this work was furnished with special heating arrangements so that the tubes could be kept at red heat, the tubes being arranged vertically like those of an upright boiler. Small, vertical tubes are much superior to the larger, horizontal ones, originally employed, as economizing the expensive platinized asbestus and insuring a more certain contact of the gases with the mass. The proper filling of the tubes with the asbestus is a matter of importance; it must be so done that no portion of the gas can pass through a tube without coming in contact with the mass, while the mass must not offer much resistance to the passage of the gas. Owing to the nature of the asbestus, this latter difficulty is likely to occur, but can be avoided by the simple device of packing the asbestus in successive layers, separated by perforated diaphragms sliding upon a central rod, but kept apart at regular intervals. In this way all of the tubes can be similarly and evenly packed.

As soon as this apparatus was started in the ordinary way at low red heat, the surprising discovery was made that not only was the output of acid increased, but that the strength of the gas current could be made greater when the tubes, instead of being heated artificially, were, on the contrary, cooled by the admission of cold air. This discovery, a contradiction of what had been considered correct practice, gave a rational method of work; i. e., the apparatus must be systematically cooled to obtain the maximum effect and production. As now operated, the tubes are cooled by the cold, purified gases, which thus become heated to the proper temperature for the reaction. In this way the following advantages are gained:

First. Overheating of the apparatus is avoided, and thus a yield of 96 per cent—98 per cent of the theoretical—is obtained.

Second. The iron parts of the apparatus are protected by this cooler working, and are therefore more durable.

Third. The contact mass does not become overheated and its efficiency remains unimpaired.

Fourth. The absolute efficiency of the contact mass, and of the entire apparatus, is greatly increased because the rapidity of the gas stream can be increased, and the contact mass be maintained at the most efficient temperature.

Another important discovery is that the reaction proceeds at atmospheric pressure, since it was formerly supposed that compression of the gases was necessary to overcome the hindrance of the indifferent gases present. In fact, if the other conditions are right the reaction proceeds almost quantitatively at atmospheric pressure. This is very important since, if this method is to compete with the chamber process, every unnecessary expense must be avoided.

IV. *Absorption of the Produced Anhydride.*—The affinity of sulphuric anhydride for water is greater than for concentrated sulphuric acid, as shown by the relative amount of heat developed during the absorption; hence it might be expected that the easiest and most complete absorption of anhydride from the contact process would be effected by the use of water. It is found, however, that oil of vitriol containing 97–99 per cent of H_2SO_4 is much more effective than either water or sulphuric acid of any other strength. The absorbing power of the acid at this degree of concentration is so great that a single absorption vessel is sufficient for the removal of the SO_3 from a very rapid current of gas, provided that the strength of the acid be kept uniformly between the above limits by a steady inflow of water or weak acid, and a proportional outflow of the excess of strong acid thus produced.

Sulphuric acid, at this particular degree of concentration, possesses certain marked qualities. Its boiling point is a maximum, so that if a weaker acid is evaporated, it loses water or weak acid until the residue attains a strength of 98.33 per cent H_2SO_4, at which point it distills without further change at a constant temperature of about 330°. Similarly, a stronger acid gives off anhydride until this constant strength is reached. Again, at this particular degree, the vapor pressure is at its minimum, the specific gravity is at the maximum, the electrical resistance suddenly rises, while the action on iron decreases considerably.

When fuming sulphuric acid is to be made, one or more absorption cells must precede the regular apparatus. For these, cast iron, which is quite suitable as the material for the other vessels, becomes unavailable, because, although it is only slowly attacked, it, what is worse, becomes fragile and even explodes. This appears to be due to the fuming acid diffusing into the iron and then breaking up into SO_2 and H_2S, thus causing a condition of internal stress. Wrought iron is attacked by fuming acid containing less than 27 per cent of SO_3, but when the contents of anhydride exceeds this, the acid has practically no action upon wrought iron, and vessels of this material can be used for years without sensible corrosion.

V. *Theory of the Contact Process.*—The results of many experiments showing the influence upon the reaction of variations in the temperature, the composition of the gases, the rate of flow (or the proportion of contact substance over which the gas passes) are given in the form of curves, and discussed, yielding the following results:

1. Complete conversion of the SO_2 into SO_3 occurs only when there is at least twice as much oxygen present as the reaction formula indicates. When using the gas obtained from the roasting of pyrites, and which contains about 7 vol. per cent of SO_2, 10 vol. per cent of O, and 83 vol. per cent of nitrogen, the nitrogen is absolutely without influence upon the reaction, except as diluting the gas and reducing the output.

2. The completeness of the reaction depends solely upon the temperature and not upon the nature of the contact substance. The reaction begins at about 200°. As the temperature rises, so does the degree of conversion, until, at about 400°, a nearly complete (98 to 99 per cent) conversion of the SO_2 is feasible. Any further rise in temperature is injurious, the degree of conversion falling so that at about 700° only about 60 per cent can be converted, while at about 900° the reaction ceases entirely.

3. The nature of the contact substance has no influence upon the completeness of the reaction, but, for practical results, a substance must be employed which shows a high degree of efficiency at the proper temperature of 400°. Substances, which require a higher temperature to develop their greatest efficiency, are evidently unsuited, since, as shown above, the degree of conversion falls with the rise in temperature. Up to the present time only one substance fulfilling the necessary conditions is known, and that is platinum. None of the other metals of the platinum group approaches it in efficiency.

This valuable paper concludes with a series of tables, giving the results of exhaustive sets of determinations of the following properties of sulphuric acid, and of fuming sulphuric acid of various strengths from 1 to 100 per cent of SO_3:

1. Melting point. 2. Specific gravity. 3. Specific heat. 4. Heat of solution. 5. Electrical resistance. 6. Action upon iron. 7. Boiling point. 8. Vapor pressure. 9. Viscosity. 10. Capillarity. 11. Table giving the percentage of free SO_3 in a fuming sulphuric acid when the total contents of SO_3 is known.

Production of Sulphur Trioxide.—The growth and present magnitude of the operations of this process in the works of the Badische Anilin-und-Soda-Fabrik are shown by the following figures:

Sulphur trioxide produced in—	Tons.
1888	18,500
1894	39,000
1899	89,000
1900	116,000

It will be seen from the foregoing, that this process has long passed the experimental stage, and now that the general conditions of successful operation are known, its speedy adoption in this country is to be expected. The advantages are many: First, no expense of construction and maintenance of the entire chamber system, including the Gay-Lussac and Glover towers and the steam and niter plant. Second, no expense for niter and for the sulphuric acid used therewith; although the resulting niter cake can be utilized, it is rarely a desirable product. Third, the acid produced is pure, strong oil of vitriol, requiring no concentration for sale or use. Concentration of chamber acid to high strengths requires the use of platinum stills, which thereby lose in weight, the dissolved platinum being irrevocably lost. The rate of loss is much reduced by previous purification of the acid, but is always a considerable item of cost. Fourth, the contact acid is also free from arsenic, lead, or iron salts. The fundamental difference in the character of the reactions in the chamber process and of those in the contact method indicates the possibility of substantial improvements in the methods of roasting. Fifth, although the 50 degree acid, as it comes from the chambers, is desirable for many purposes—for example, in making superphosphates—it is held by some authorities that it can be made more cheaply by diluting the strong acid with the needed proportion of cold water, than by introducing this water into the chambers in the form of steam. This, however, is denied by others, and it is probable that the chamber process will continue to exist, though in a more restricted field.

On the other hand, this new process appears to require a well planned and carefully managed system of purification for the roaster gases, and will need, for its successful operation, a higher order of chemical engineering skill than has usually been deemed necessary for the operation of an acid plant. This, however, should hardly be considered an obstacle in this country, where all other branches of engineering manufacture have reached such a height, mainly because the works have demanded and made liberal use of the highest order of trained ability, and have not hesitated to "scrap" expensive plant where it failed to give satisfactory results. In this connection the Badische Anilin-und-Soda-Fabrik is an instructive example. Its chemical force numbers over 100 men, many of whom are engaged solely upon researches, the results of which, when promising, are at once put into operation on a sufficiently large scale to determine their practical value. That such a course pays in a strict business sense is shown by the enormous dividends paid by this company, and by the practical monopoly which it has long maintained in certain lines, simply because it has been a little ahead of its competitors in knowing just how a given thing should be done, and then at once protecting the discovery by patents.

In addition to sulphuric acid, reports have been received regarding the production of the acids enumerated in the following table:

ACIDS, OTHER THAN SULPHURIC, BY KIND, QUANTITY, AND VALUE: 1900.

KIND.	Number of establishments.	Quantity.	Value.
		Pounds.	
Nitric	34	30,961,501	$1,454,909
Mixed	9	42,368,819	1,111,258
Muriatic	31	116,848,001	1,020,574
Boric	3	2,384,935	198,212
Acetic	12	26,660,565	426,892
Lactic and citric	3	3,886,382	335,297
Tartaric	4	2,677,004	781,603
Tannic	5	282,515	135,662
Gallic	3	141,291	20,275

It is to be understood that the quantities and values given in this table represent only the acids sold as such, or produced for sale in the establishments, for the actual production, in many cases, is much greater than that given above. Thus the first item on the list, nitric acid, is used in the making of the "mixed acids," which is the second item on the list. This mixed acid is not only manufactured in the acid factories and sold to explosive works, to manufacturers of pyroxylin for use in the making of plastics and of varnishes, and to other manufacturers, but many of the larger works now make the nitric acid which they consume in this manner. There is thus made and consumed more nitric acid than is sold as such, the production as reported amounting to 62,473,295 pounds, which is probably less than the total amount actually made for use and sale. Theoretically, 74.13 parts of nitric acid monohydrate can be made from 100 parts of pure sodium nitrate, but in practice, only 95 per cent of this is condensed, while 5 per cent passes to the towers. From this, then, there would be required 43,841 tons of nitrate of soda and 47,348 tons of sulphuric acid to produce the above-given quantity of nitric acid, and there would result as a by-product 52,609 tons of niter cake. It is to be borne in mind that nitric acids of various degrees of strength, ranging from single aquafortis of specific gravity 1.22, and double aquafortis of specific gravity 1.36, to the strongest nitric of 1.50 specific gravity, and red fuming of 1.60 specific gravity are to be found in the market, and that no attempt has been made to separate them as to quantity, or to reduce them to a common basis, so that the data must be regarded as of average value.

Nitric acid was manufactured at Philadelphia in 1834 by Carter & Scattergood. The most notable recent advance made in its manufacture is in the form of apparatus employed, which is due to Edward Hart and Oscar Guttman. It is used in the manufacture of nitrates like silver nitrate, or nitrites like sodium nitrite; in making "mixed acids" and aqua regia; in making nitrosubstitution compounds, like nitrobenzene, nitronaphthalene, and picric acid; organic nitrates, such as gun cotton and nitroglycerin; as an oxidizing agent in many chemical processes; and for the etching of metals.

By "mixed acids" is meant mixtures of nitric and sulphuric acids which are employed in "nitrating" organic substances such as glycerin, cellulose, and carbolic acid. The commercial use of such a mixture began with the manufacture of nitrobenzene and picric acid, but it received its greatest impetus about 1862 when the commercial manufacture of nitroglycerin began. Originally the users of this mixed acid purchased the sulphuric and nitric acids and mixed them in the desired proportions for use, the acids being transported in separate carboys of glass. These not infrequently became broken during transportation, and as the nitric acid rapidly reacts with and "fires" such organic matter as is used as packing for carboys, its transportation gave rise to many serious accidents, which led to restrictive legislation. It is not known to whom the credit is due for the discovery that mixed acids of the highest concentration did not act upon iron, but for upward of twenty years manufacturers have been making the desired mixtures at the acid works and shipping them in iron drums, old glycerin drums having been first employed. With the increase in the production in works, attention has naturally been given by chemists to the utilization of the residues, and large economies have resulted from the regaining of the "spent acids" by which the sulphuric acid has been obtained of a strength sufficient for reuse in the ordinary course of manufacture, and the nitric acid, though recovered in a weak state, has been of value in other arts.

Owing to the necessity of having concentrated nitric acid to mix with this regained sulphuric acid, and to the fact that the transportation charges on nitric acid are very high, and the necessary regulations governing its transportation are vexatious to the consumers, many of the larger establishments have erected nitric-acid plants. In considering the magnitude of this industry there is to be noted not only the mixed acid sold as such, 42,368,819 pounds, the mixed acid produced and consumed in chemical works, 8,902,371 pounds, and the mixed acid reported produced and consumed in explosive works, 12,000,000 pounds, making in all 63,271,190 pounds, but there is also to be taken into account this repeated reuse of the acid. From the products reported of all kinds, nitroglycerin and dynamite; gun-cotton; pyroxylin for varnishes, for smokeless powder, for plastics, and for photography; and the nitro-substitution compounds, it is safe to say that 65,000 tons of mixed acids were employed during the year 1899–1900.

Hydrochloric acid, commercially known as muriatic acid, is made by acting on common salt with sulphuric acid. The ordinary muriatic acid of commerce is an aqueous solution containing about 40 per cent by weight of dry hydrogen chloride. For the amount of hydrochloric acid reported on this standard there would be required for its production 37,000 tons of common salt and 39,000 tons of sulphuric acid of 60° Baumé, and there would be obtained in addition to the muriatic acid 47,000 tons of salt cake, which consists of sodium sulphate, together with some undecomposed common salt, and an excess of sulphuric acid. A new development in this trade is in the use of wooden barrels as containers in place of the glass carboys in which it was formerly transported.

Carter & Scattergood manufactured muriatic acid in Philadelphia in 1834, and Charles Lennig began its manufacture by modern methods in Philadelphia in 1869. Hydrochloric acid is used in the preparation of many organic and inorganic chlorides. Mixed with nitric acid it forms aqua regia, which is used in dissolving the precious metals. It has largely been used as a source of chlorine in the manufacture of bleaching powder and potassium chlorate. It is used in the manufacture of acetic acid and gelatin, in the manufacture of soda, and in a multitude of minor arts. The salt cake is used in the Le Blanc process for the manufacture of soda, for glass making, for ultramarine, in dyeing and coloring, and for the production of Glauber's salts.

Acetic acid as treated of under "chemicals" does not include vinegar, which is a very dilute acetic acid made largely by fermentation, but it covers such acid as is produced by chemical action from acetates, principally the calcium and sodium acetates. Calcium acetate is obtained in the destructive distillation of wood. The acetic acid is obtained from it by treatment with hydrochloric acid and distillation. This may be purified by rectification with potassium dichromate. A better product is obtained by converting the acid into a sodium salt and evaporating to dryness to destroy tarry matters and then distilling with hydrochloric or sulphuric acids. Acetic acid, varying in strength from 28 per cent to 90 per cent, is sent to the market in barrels holding on an average 425 pounds. Acetic acid is used in the preparation of metallic acetates, which are extensively used in dyeing and printing; or of organic acetates, such as ethyl and amyl acetates, which are used as solvents and flavors; in the manufacture of white lead; and the preparation of organic compounds. As an example of its use Lachman[1] states that in the preparation of the chloracetic acid used by the Badische Anilin-und Soda-Fabrik in the manufacture of synthetic indigo in 1900 there were used 4,500,000 pounds of glacial acetic acid, requiring 26,000 cords of wood for its production.

Lactic acid, citric acid, and tartaric acids are used in dyeing and in calico printing. Lactic acid is prepared by fermenting a sugar solution by means of certain bacteria, neutralizing the acid with calcium carbonate, and decomposing the calcium lactate thus formed with sulphuric acid. Lactic acid was manufactured by the Avery Chemical Company at Littleton, Mass., in 1882.

Citric acid occurs in the free state in the juices of all the plants of the genus *Citrus*, such as limes, lemons, and sour oranges. Good lemons yield about 5½ per cent of the crystallized acid. It is obtained by neutralizing the juice of the fruit with chalk and decomposing the resulting calcium citrate with an equivalent amount of sulphuric acid. This acid was manufactured by Carter & Scattergood at Philadelphia in 1834.

Tartaric acid occurs free or combined in many plants, but the only source from which it is commercially obtained is the grape. During the fermentation of grape juice, as the alcohol increases in quantity the calcium and potassium tartrates present in the juice are precipitated out, together with a quantity of organic coloring matter, forming what is known as argols. After purification it is treated with chalk and calcium sulphate to convert it into calcium tartrate, and this when decomposed with sulphuric acid yields free tartaric acid. This acid was manufactured by Carter & Scattergood in Philadelphia in 1834.

The foreign commerce in acids is exhibited in the following tables, compiled from the publications of the Bureau of Statistics, of the United States Treasury Department:

[1] J. Am. Chem. Soc., vol. 23, page 912: 1901.

IMPORTS FOR CONSUMPTION DURING THE YEARS ENDING JUNE 30, 1891-1900.

YEAR.	[1] SULPHURIC ACID OR OIL OF VITRIOL (N. E. S.).		[1] SULPHURIC ACID.		BORACIC ACID.						CHROMIC ACID.		CHROMIC AND LACTIC ACID.	
					Commercial.		Pure.		All kinds.					
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891	15,377	$836	....	....	152,093	$7,975	39,394	$2,906	475,378	$30,138	 506	$1,587 155	....	....
1892	8,277	478	8,735	$339	....	....	....	....	701,625	39,418	426	156	....	....
1893	634	43	8,736	1,033	....	....	....	....	771,776	40,568	3,318	609	....	....
1894	17,063	405	400	32	....	....	....	....	292,990	19,282	5,048	824	....	....
1895	12,574	186	7,459	461	....	....	....	....	925,154	42,056	4,461	707	....	....
1896	36,798	475	48,759	1,606	....	....	....	....	555,769	21,899	2,440	409	....	....
1897	3,200	43	59,729	4,074	....	....	....	....	548,603	19,494	2,708	430	....	....
1898	25,350	786	2,725	40	134,707	4,053	244,073	7,994	....	46,265	6,720	906	64,066	$4,917
1899	40,175	1,874	....	....	....	....	436,958	14,303	....	56,428	....	....	23,969	4,843
1900	34,944	972	....	....	....	....	466,879	17,467	....	53,625	....	....	34,741	6,044

YEAR.	CITRIC ACID.		TARTARIC ACID.		OXALIC ACID.		SALICYLIC ACID.		ACID, TANNIC OR TANNIN.		ALL OTHER ACIDS.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891	45,197	$16,482	1,511	$468	2,743,222	$200,595	....	....	659	$239	1,350,710	$380,054
1892	80,034	27,461	10	5	2,209,940	150,529	....	....	564	216	1,024,580	347,510
1893	13,315	4,633	130	39	2,464,443	143,194	260,027	$254,022	1,443	597	685,677	175,637
1894	5,502	1,810	113	32	2,783,876	159,026	262,332	231,946	794	287	835,215	134,665
1895	8,895	2,480	356	88	2,889,513	189,606	196,974	140,197	1,500	597	1,798,417	228,430
1896	39,671	12,521	212	66	3,164,969	219,630	335,354	138,013	1,745	681	1,027,235	240,522
1897	73,133	18,168	225	71	3,602,124	246,200	616,187	201,980	3,144	1,296	3,040,325	223,458
1898	4,323	1,108	455	128	3,747,041	242,276	92,943	28,688	2,335	927	....	45,265
1899	65,190	16,659	23,298	5,737	3,981,768	246,027	185,358	57,192	3,697	1,371	....	66,428
1900	60,354	14,213	954	252	4,990,123	275,747	240,687	89,175	1,415	671	....	53,625

[1] From the value given this would appear to be fuming sulphuric acid.

GROUP II.—SODA PRODUCTS.

The great increase in this branch noted in the Census report for 1890 has continued during the past decade. The number of establishments making soda products as the main part or as a subsidiary of their business has increased from 32 to 50, while the products have increased as shown in the following table. To these figures for 1900 must be added "other soda products," not otherwise specified, produced by these works and valued at $143,432, and also 11,756,000 pounds of borax, valued at $541,160, made by seven borax works. These items were not included in the report for 1890 and are therefore not taken into the comparison. Where the figures of this table show an increase over the figures for the same items in other tables of this census, the difference is due to the inclusion here of all such products made by works belonging to other groups, for example, the caustic soda produced by electrolysis, which is included in the products of that group and not separately reported. This table shows the total actual production of the United States for the census year from all sources; and while the figures differ, there is no discrepancy.

SODA PRODUCTS, BY QUANTITY AND VALUE, 1890 AND 1900.

	1900		1890	
	Pounds.	Value.	Pounds.	Value.
Total	1,279,082,000	$10,237,944	333,124,375	$5,432,400
Soda ash	781,306,000	4,859,656	94,801,200	1,179,720
Sal soda	126,498,000	876,243	144,641,705	1,581,766
Bicarbonate of soda	137,712,000	1 332,765	60,678,750	2,009,800
Caustic soda	233,566,000	3,170,280	33,002,720	661,114

The decrease in the production of sal soda is noteworthy and is due to the increasing use of soap powders and other specially prepared washing materials. A comparison of these totals with the corresponding figures for 1880 is interesting.

SODA PRODUCTS, BY DECADES, 1880 TO 1900, WITH PERCENTAGES.

YEAR.	Number of establishments.	TOTAL PRODUCT.		PER CENT OF INCREASE.	
		Pounds.	Value.	Quantity.	Value.
1880	3	40,259,938	$866,660	....	....
1890	32	333,124,375	5,432,400	727.4	526.9
1900	50	1,279,082,000	10,237,944	284.0	88.5

There are no figures for soda products anterior to 1880, except that at the census of 1860, 11 establishments were reported manufacturing saleratus, with a total value of $1,176,000, while at the census of 1870, only 4 were reported, with a value of products of $231,647, a decrease which is remarkable in view of the general development of other industries during that decade.

Although the production has almost quadrupled during the past decade, the value per unit has fallen greatly. Taking the customary unit of 100 pounds, we find the following decrease of values:

YEAR.	Soda ash.	Sal soda.	Bicarbonate of soda.	Caustic soda.
1890	$1.24	$1.09	$3.31	$2.00
1900	.62	.77	.97	1.35
Decrease	.62	.32	2.34	.65
Percentage	50.00	29.35	70.69	32.50

This great increase in domestic production has resulted in a corresponding diminution of importations. The Treasury report of importations for 1890 gives soda ash and sal soda together as 332,733,952 pounds, valued at $3,493,288; caustic soda, 80,125,732 pounds, valued at $1,470,335; and bicarbonate of soda, 917,034 pounds, valued at $16,319; while the same report for 1900 gives soda ash, 78,571,870 pounds, valued at $648,450; sal soda, 6,624,194 pounds, valued at $31,072; and caustic soda, 11,429,989 pounds, valued at $177,857; but does not report bicarbonate separately. A comparison of these quantities shows what progress has been made toward supplying the home market.

YEAR.	Soda ash and sal soda, pounds.	Caustic soda, pounds.
1890	332,733,952	80,125,732
1900	85,196,064	11,429,989
Decrease	247,537,888	68,695,743
Percentage	74.39	85.73

The ratios of quantities of these materials imported to the domestic production are as follows:

YEAR.	SAL SODA AND SODA ASH.		CAUSTIC SODA.	
	Foreign.	Domestic.	Foreign.	Domestic.
1890	100	72	100	41
1900	100	1,075	100	1,979

Some of the imported soda ash and caustic has undoubtedly been used to make a part of the soda products reported at the census of 1900, but the quantity so used can not be ascertained and is in any case not large. The remainder, so far as concerns works making soda products from purchased soda ash, etc., was drawn from domestic sources, hence to this extent there is a duplication of quantities and values. This duplication is unavoidable. Had there been no imported stock on hand at the beginning of the census year and no importations during it, there would have been no difficulty in making any deductions needed to make the totals of quantities and values given in the table of soda products by quantity and value, 1890 and 1900, quite accurate. The returns for 1900 have been sufficiently studied to show that this duplication is proportionally small, that the totals given above are fairly correct, and that the real growth and present condition of the industry is substantially as shown. Most of the soda ash and bicarbonate reported are products of the ammonia-soda process, the cryolite process being limited by the supply of the mineral, and the natural soda industry restricted by cost of transportation to markets.

Natural Soda.—The manufacture of soda products from the natural soda of the West has increased from 10,964,390 pounds, valued at $124,783, in 1890, to 20,420,000 pounds, valued at $106,600, in 1900. This increase is very small, because, although the raw material is available in inexhaustible quantities (and with a well-arranged plant, soda ash can be delivered f. o. b. cars at the works at a cost less than one-half of that of ash at any ammonia-soda works in this or any other country), the distance from large eastern markets and consequent high freight rates have precluded successful commercial competition, especially in the face of steadily falling prices of the product. Of late the economic conditions have materially changed and will continue to improve. The past two years have seen great enlargements in the industries and commerce of the Pacific states, while the recent political occurrences in the Pacific and in Asiatic countries have profoundly altered trade conditions and indicate an enormous increase in our Pacific commerce in the near future. In supplying the demands of this commerce our natural soda deposits, when properly developed, can distance all rivals.

Although the operations so far carried on have been on a comparatively small scale, the subject has been carefully studied and much valuable information obtained. For example, at Owens Lake, California, the cost of making a ton of soda ash under local conditions is fairly well ascertained, and the lines to be followed to reduce manufacturing cost clearly indicated. Again, the extent of land suitable for evaporating vats is, in this locality, the measure of the possible development of the industry, and this is known. Many other important data have thus been secured, and as a general conclusion it may be safely stated that at Owens Lake alone there is space for works large enough for a production of soda ash more than equivalent to the entire demand of this country for soda products. All this is unquestioned by anyone having a practical acquaintance with the matter, and only the limited radius of profitable marketing has retarded the development of this locality. This industry is therefore not a hypothetical one, but based on solid fact and experience, and because of this and the prospects for the future, it has been deemed advisable to devote especial attention to it in this report.

The report on chemical products for the census of 1880 gave an interesting résumé of the existing information concerning the occurrences of natural soda, and later the subject was investigated, the result being published in "Natural Soda, its Occurrence and Utilization," T. M. Chatard, Bulletin No. 60, United States Geological Survey, 1888. An extensive abstract of this paper was made by Prof. George Lunge and published in the Zeitschrift für Angewandte Chemie, 1893, pages 3–11, because, as he states, he considered the existence of such enormous quantities of natural soda a most important factor in the future of the alkali industry. This same eminent authority, in The Mineral Industry for 1892, page 64, also says:

There can be no doubt that the immense quantities of "natural soda" shown by Dr. Chatard and other authorities of the United States Geological Survey to exist in the Californian and other soda lakes, will not be allowed to lie dormant any longer. If these lakes are once worked with the energy which is otherwise not wanting in America, the days are numbered when Liverpool soda will rule in the New York market.

In 1892 Dr. Lunge visited Owens Lake, California, the most important natural soda locality, and, while confirming the general conclusions given in the above-mentioned bulletin, placed the cost of product at a much lower figure than there stated.

In the same volume of "The Mineral Industry" there is an article on "Natural Soda" which gives additional data and suggestions as to the lines to be followed in the commercial development of this industry.

Natural soda is the residue obtained by the evaporation of natural alkaline waters without the aid of artificial heat. It is composed of sodium carbonate and bicarbonate in varying proportions, mixed with other salts, mainly sodium sulphate and chloride. It is found to some extent in all dry regions, such as Hungary, Egypt, and the deserts of Africa and Asia, but in no other country does it occur in such enormous quantities as in the region lying east of the Sierra Nevadas. It forms the white incrustations of the alkali plains, but these are rarely of sufficient thickness and extent for prospective utilization, particularly as the "sinks," or lakes without outlet, in which nature has collected and concentrated the leachings and drainage of the alkaline districts, already contain more sodium carbonate than would suffice to supply the entire world demand for generations. That this is no exaggeration is made evident by considering only three of these lakes, the dimensions of which are known and the waters of which have been repeatedly and carefully analyzed.

In southeastern Oregon is Abert Lake; area 40 square miles, average depth 10 feet. In Mono County, Cal., we find Mono Lake; area 85 square miles, average depth 60 feet. In Inyo County, Cal., lies Owens Lake, with an area of 110 square miles and an average depth of over 17 feet. In computing the volume of water the usual unit is an acre-foot, which is equal to 43,560 cubic feet, and as the analysis tells the amount of the sodium carbonate, Na_2CO_3, and bicarbonate, $NaHCO_3$, in a given volume, we get the following results for these three lakes:

	Acre-feet.	Na_2CO_3, tons.	$NaHCO_3$, tons.
Abert Lake	256,000	3,428,352	1,560,000
Mono Lake	3,264,000	75,072,000	17,936,000
Owens Lake	1,088,000	39,875,200	8,431,000
Total		118,375,552	27,927,000

These are the largest occurrences, but there are many others, aggregating probably a far greater amount.

In addition to these two carbonates the waters of these lakes contain much sodium sulphate and chloride, with smaller proportions of sodium borate, potassium chloride, and other salts. The valuable constituents are the two carbonates, and the method of separating them from the other salts is based on fractional crystallization, which means the methodical stoppage of a crystallizing process by drawing off the mother liquor from the "crop" of crystals so far formed. This "first crop" may be either the desired material in a purer condition than it was in the original solution, or else may consist mainly of impurities which we wish to remove, this depending upon the proportions of the substances in solution or their relative solubilities under the conditions.

Now, all solutions of natural soda contain both sodium carbonate and bicarbonate, and it is upon the property of these two salts when in solution to unite to form a compound more soluble than bicarbonate but less soluble than carbonate, that the method of extraction is founded. If a solution of the two salts be exposed to spontaneous evaporation, there will be formed, at a certain degree of concentration, a crop of acicular crystals which have a composition corresponding to 46.90 per cent of Na_2CO_3, 37.17 per cent of $NaHCO_3$, and 15.93 per cent of H_2O (water). The scientific name of this salt is urao, but it is usually called "summer soda." The amount of this salt thus obtained will depend upon the amount of bicarbonate present, as every 37.17 parts of bicarbonate will, in crystallizing, take with it 46.90 parts of Na_2CO_3. If more bicarbonate is present than is needed to form summer soda, the excess will crystallize out before the summer soda forms. If too little is present, the excess of carbonate remains in solution.

If a sample of water be evaporated from any of these lakes to a certain concentration point (sp. gr. 1.260 for Owens Lake water), crystallization will begin, the crystals being crude summer soda. Owing to the presence of so much sulphate and chloride in the solution, the crop becomes more and more contaminated with these salts as the concentration proceeds. Hence, to obtain an article of a fair degree of purity, the process must be interrupted at some definite degree of specific gravity and the mother liquor drawn off. If the mother liquor be further evaporated, successive crops can be obtained, the earlier ones, in the case of Owens Lake, being principally sulphate and the later ones chloride. Finally remains a mother liquor rich in potash salts, from which, on cooling to a low temperature, the ordinary sal soda ($Na_2CO_3.10H_2O$) crystallizes.

While all of these localities can produce summer soda in the manner described, the proportion of bicarbonate present is, in each case, insufficient to give the largest possible yield. To obtain this, it is necessary to increase the proportion of bicarbonate, which can be done in several ways but most economically, probably, by utilizing the carbonic acid driven off in the process of furnacing to convert the urao into soda ash. When summer soda is heated to a moderate degree (about 150° C., 300° F.) it loses its water and excess of carbonic acid; 100 parts yielding 70.35 parts ash, 9.74 parts gas, and 19.91 parts of water. This furnacing must be done in any case to reduce weight and save transportation charges; hence, if the gas can be economically used, there is a clear gain in so doing. While the refining work in which the crude product is converted into various marketable forms requires special training and use of improved machinery, arranged and handled to save labor and fuel, the production of the crude material is comparatively simple and can be done on a large or small scale with probably equal advantage. At the "little lake" at Ragtown, Nev., two men, in 1886, made 300 tons and could have made much more had the conditions of the locality permitted. The product of the "big lake," made under very adverse conditions, required but little more labor in proportion. The entire product was hauled 16 miles to the railroad and shipped to San Francisco where it was refined. Notwithstanding these heavy transportation costs, the operations were profitable and the works have been running steadily ever since.

These examples show that in the development of this industry the innumerable small localities can be utilized quite as well as the larger ones, if transportation to the refining point be not too expensive. An intelligent, industrious man, working a small but well-situated pool, can produce, with only occasional outside aid, an amount of summer soda which a refining works can take at a price advantageous to itself and remunerative to him. Furnacing before shipping to the refinery is not always advantageous, since, although the reduction in weight is about 25 per cent, the saving in transportation will rarely pay for the cost of furnacing when this is done on a small scale. Moreover, refiners prefer unfurnaced material, and by devoting attention exclusively to the production of summer soda, regularity of composition, which is very important, can be better assured. Such work can therefore be made a "poor man's job," a thing much needed in that region, and in time there would be a large direct consumption of the crude materials.

Borax and Other Soda Products.—Seven establishments manufactured borax during the census year, with a combined production of 11,756,000 pounds, valued at $541,160. No figures for borax were given at the census of 1890, so that no comparison can be instituted. The present number of borax works is undoubtedly smaller than it was ten years ago, because it has been found more economical to ship the crude material to central points for treatment than to work it up locally, as was formerly done.

"Other soda products," valued at $143,432, represent the total value of products so reported by many establishments. As they are not otherwise specified, no further distribution is possible.

The following table gives the geographical distribution of the soda industry, states having less than three establishments being grouped:

SODA PRODUCTS, BY STATES, ARRANGED GEOGRAPHICALLY: 1900.

STATES.	Number of establishments.	Value of products.
United States	55	$10,922,536
North Atlantic division	28	6,559,295
New Jersey	3	105,507
New York	12	4,699,481
Pennsylvania	9	861,195
Massachusetts, Rhode Island, Maryland, and Virginia	4	893,112
North Central division	16	3,694,436
Illinois	4	353,429
Michigan	3	2,814,969
Wisconsin	4	173,101
Indiana, Missouri, and Ohio	5	352,937
Western division	11	668,805
California	6	647,175
Nevada	5	21,630

The foreign commerce in soda products is set forth in the following table, compiled from the reports of the Bureau of Statistics of the United States Treasury Department:

SODA ASH IMPORTED DURING THE YEARS ENDING JUNE 30, 1891 TO 1900.

YEAR.	Pounds.	Value.
1891	[1]354,744,335	$4,382,917
1892	[1]339,057,006	4,496,597
1893	388,910,183	4,855,098
1894	256,293,395	2,520,921
1895	300,599,257	2,367,109
1896	251,067,856	1,950,981
1897	162,585,074	1,241,321
1898	87,809,619	589,714
1899	45,444,305	310,742
1900	78,571,870	648,450

[1] Includes sal soda for 1891 and 1892.

SAL SODA IMPORTED DURING THE YEARS ENDING JUNE 30, 1893 TO 1900.

YEAR.	Pounds.	Value.
1893	27,531,554	$238,029
1894	16,893,760	120,794
1895	28,761,108	167,325
1896	17,966,996	84,423
1897	18,875,029	82,695
1898	8,851,011	40,266
1899	4,224,680	20,905
1900	6,624,314	31,072

CAUSTIC SODA IMPORTED DURING THE YEARS ENDING JUNE 30, 1891 TO 1900.

YEAR.	Pounds.	Value.
1891	78,743,976	$1,874,700
1892	64,741,106	1,598,903
1893	57,485,106	1,344,525
1894	38,987,832	850,753
1895	57,653,959	1,044,809
1896	61,713,044	1,071,169
1897	66,476,152	1,147,763
1898	29,697,185	476,032
1899	18,405,272	252,297
1900	11,429,989	177,857

ALL OTHER SALTS OF SODA IMPORTED DURING THE YEARS ENDING JUNE 30, 1891 TO 1900.[1]

YEAR.	Pounds.	Value.
1891	18,136,888	$118,713
1892	22,348,570	167,634
1893	47,664,938	297,761
1894	14,829,622	104,800
1895	11,803,171	141,070
1896	9,090,367	149,248
1897	3,919,339	67,684
1898	21,400,585	225,628
1899	23,891,185	317,032
1900	23,632,374	314,425

[1] 1893 to 1900 includes bicarbonate of soda.

Group III.—Potashes.

This classification was intended to include not only potash, which is an impure potassium carbonate, but also pearlash, which is the refined potassium carbonate, yet, though returns for the census year 1900 were received from 67 establishments, producing 3,864,766 pounds of potash, valued at $178,180, no pearlash was reported manufactured. Of these 67 establishments, 12 produced products valued at less than $500.

The burning of wood and the lixiviation of the ash to extract the potash, though of minor importance so far as the monetary value of the product is concerned, is one of the oldest of the purely chemical industries. Cognizance was taken of it in the census reports of the United States as early as 1850, so that the data is at command for comparing the condition of the industry in this country for each decade since 1850, as set forth in the following table:

TOTAL PRODUCTION OF POTASHES, BY DECADES: 1850 TO 1900.

YEAR.	Number of establishments.	PRODUCT.		Average price per pound (cents).
		Pounds.	Value.	
1850	569	....	$1,401,533	....
1860	212	....	538,550	....
1870	105	....	327,671	....
1880	68	4,571,671	232,643	5.09
1890	75	5,106,939	197,507	3.86
1900	67	3,864,766	178,180	4.82

This table shows that there has been a constant decrease in the value of the product, though the quantity has varied somewhat. Starting with 1880, for which year both quantity and value were reported, it appears that the increase in the quantity of product for 1890 over that for 1880 was 11.7 per cent, but the decrease in the value for 1890 compared with that for 1880 was 15.1 per cent. In 1900 the decrease in the quantity as compared with that of 1890 was 24.3 per cent, while the decrease in the value was 9.8 per cent. The establishments reported were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF POTASH FACTORIES: 1900.

STATES.	Number of establishments.	Average number of wage-earners.	Capital.	Value of product.	Per cent of total.
United States	67	92	$70,899	$178,180	100.0
Michigan	44	52	25,851	79,642	44.7
Ohio	15	25	20,050	35,519	19.9
Indiana	3	4	2,275	6,560	3.7
Maine, Wisconsin, and Illinois	5	11	22,723	56,459	31.7

There were reported as having been used in this manufacture 812,399 bushels of wood ashes, valued at $40,191. The yield of potash per bushel of ashes, as reported, varied from 2.4 to 7 pounds. In the product given above there is included potash packed in cans, amounting to 820,000 pounds, having a value of $53,349. Excluding this, as being in the nature of a duplication, it appears that the total production of potash for 1900 was 3,044,766 pounds, and that therefore the average yield of potash per bushel of wood ashes, as shown by the entire returns, was 3.75 pounds. Pelouze and Fremy[1] give the yield by weight as 10 per cent, and this appears in other text-books; but all returns for ashes received at the census of 1900 were given in bushels.

As stated, potash is prepared by dissolving out the soluble contents of wood ashes and evaporating the solution to dryness. The process as carried out on a commercial scale is described by Muspratt,[2] as follows:

The American process for the extraction of potashes is thus described by Morfit. The incineration of the plant is effected in dry pits sunk into the ground to a depth of 3 or 4 feet. The plant is thrown in in portions, and burned until the pit is nearly full of ashes. The latter are then removed, mixed with about 5 per cent of lime, and drenched with successive portions of fresh water. The ash tubs or vats employed in this operation are usually formed from tar barrels, by cutting them in half. A number of these are furnished with two crossbeams, upon which rests a false cullendered bottom covered with straw, and below this is a cock for the removal of the lye. The first liquor running through, being saturated, is passed at once to the evaporating pan; while the second or third runnings, being weaker, are reserved and poured upon fresh ash until completely saturated. The evaporating pans are broad and shallow, and made of iron, with corrugated bottoms, to produce greater extent of heating surface; and as evaporation progresses, new supplies of strong liquor are poured in, and the heat is continued until a sirupy consistence is attained, when the fire is gradually slackened and the contents of the pan, becoming solid, are dug out and placed aside as *crude potashes*. By subjecting this mass to the heat of a reverberatory furnace, most of the sulphur (*sic*) and all excessive water and empyreumatic matters are expelled, causing a loss of 10 to 15 per cent. This modified product is white, with a bluish tinge; contains more carbonic acid than the original crude product, and takes the name of *pearlash*. The process em-

[1] Traité de Chimie, 1865, Vol. II, page 225.
[2] Chemistry as Applied to Arts and Manufactures, Vol. II, page 729.

ployed in Russia and northern Europe is the same in principle as that above described, and is conducted in a similar manner, except that no lime is used in the lixiviation process.

According to Mendeléeff:[1]

For the extraction of potash, which was formerly carried on extensively in the east of Russia (before the discovery of the Stassfurt salt), the ash of grasses and the green portions of potatoes, buckwheat, etc., are taken and treated with water (lixiviated), the solution is evaporated, and the residue ignited in order to destroy the organic matter present in the extract. The residue thus obtained is composed of raw potash. It is refined by a second dissolution in a small quantity of water, for the potash itself is very soluble in water, whilst the impurities are sparingly soluble. The solution thus obtained is again evaporated, and the residue ignited, and this potash is then called refined potash, or pearlash.

According to Wiley:[2]

The composition of the ash of woods is extremely variable. Not only do different varieties of trees have varying quantities of ash, but in the same variety the bark and twigs will give an ash quite different in quantity and composition from that furnished by the wood itself. In general, the hard woods, such as hickory, oak, and maple, furnish a quality of ash superior for fertilizing purposes to that afforded by the soft woods, such as the pine and tulip trees. The character of the unleached wood ashes found in the trade is indicated by the subjoined analyses. The first table contains the mean, maximum, and minimum results of the analyses of 97 samples by Goessmann.[3]

	MEAN COMPOSITION OF WOOD ASHES.		
	Means.	Maxima.	Minima.
Potash	5.5	10.2	2.5
Phosphoric acid	1.9	4.0	0.3
Lime	34.3	60.9	18.0
Magnesia	3.5	7.5	2.3
Insoluble	12.9	27.9	2.1
Moisture	12.0	28.6	0.7
Carbon dioxide and undetermined	29.9	....	....

The data obtained in sixteen analyses made at the Connecticut station are given below:[4]

	Means.	Maxima.	Minima.
Potash	5.3	7.7	4.0
Phosphoric acid	1.4	1.8	1.9

In fifteen analyses of ashes from domestic wood fires in New England stoves the following mean percentages of potash and phosphoric acid were found:

Potash	9.63
Phosphoric acid	2.32

[1] Principles of Chemistry, 1897, Vol. I, page 548.

[2] Principles and Practice of Agricultural Analysis, 1895, Vol. II, pages 251 to 253.

[3] Annual report, Massachusetts agricultural experiment station, 1888, page 202.

[4] Annual report, Connecticut agricultural experiment station, 1890, page 110.

In leaching, ashes lose chiefly the potassium carbonate and phosphate which they contain. Leached and unleached Canada ashes have the following composition:

	Unleached (per cent).	Leached (per cent).
Insoluble	13.0	13.0
Moisture	12.0	30.0
Calcium carbonate and hydroxide	61.0	51.0
Potassium carbonate	5.5	1.1
Phosphoric acid	1.9	1.4
Undetermined	6.6	3.5

In the wood ashes of commerce, therefore, it is evident that the proportion of the potash to the lime is relatively low.

The number of parts by weight of the chief ingredients of the ash in 10,000 pounds of woods of different kinds is given in table below, together with the percentage composition of the pure ash; that is, the crude ash deprived of carbon and carbon dioxide.

POUNDS OF THE INGREDIENTS NAMED IN 10,000 POUNDS OF WOOD.

	Dogwood (*Cornus Florida*).	Sycamore (*Platanus Occidentalis*).	Post oak (*Q. obtusiloba*).	Ash (*F. Americana*).	Red oak (*Quercus rubra*).	Hickory (*Carya tomentosa*).
Potash	9.02	18.06	16.85	14.94	13.95	13.80
Phosphoric acid	5.72	9.55	6.96	1.15	5.98	5.83
Lime	6.41	24.73	35.61	7.60	27.40	18.40
Magnesia	14.67	0.49	5.28	0.10	3.05	4.86

	White oak (*Q. alba*).	Magnolia (*M. grandiflora*).	Georgia pine (*P. palustris*).	Yellow pine (*P. mitis*).	Black pine (*Picea nigra*).	Chestnut (*Castana vesca or sativa*).	Old field pine (*P. mitis*).
Potash	10.60	7.13	5.01	4.54	3.02	2.90	0.79
Phosphoric acid	2.49	3.19	1.24	0.96	0.92	1.09	0.73
Lime	7.85	14.21	18.04	15.16	12.46	7.93	12.12
Magnesia	0.90	2.94	2.03	0.74	0.10	0.34	1.17

The pure ashes of the woods contain the following per cents of the ingredients named:

	Dogwood (*Cornus Florida*).	Sycamore (*Platanus Occidentalis*).	Post oak (*Q. obtusiloba*).	Ash (*F. Americana*).	Red oak (*Quercus rubra*).	Hickory (*Carya tomentosa*).
Potash	28.04	23.17	21.92	46.04	24.66	28.60
Phosphoric acid	8.51	12.23	9.00	3.58	10.55	11.97
Lime	38.93	31.62	46.39	23.57	48.26	37.94
Magnesia	6.80	0.62	6.88	0.60	5.38	10.04

	White oak (*Q. alba*).	Magnolia (*M. grandiflora*).	Georgia pine (*P. palustris*).	Yellow pine (*P. mitis*).	Black pine (*Picea nigra*).	Chestnut (*Castana vesca or sativa*).	Old field pine (*P. mitis*).
Potash	42.16	19.54	15.35	19.70	14.30	18.10	3.85
Phosphoric acid	9.48	8.75	3.82	4.18	4.33	6.76	4.11
Lime	29.85	38.94	56.24	65.53	58.98	49.18	67.73
Magnesia	3.43	8.05	6.25	3.20	0.60	2.11	6.54

From the data for production given above it is evident that, although the average price of potash for 1900 was higher than for 1890, the industry was not remunerative, and that consequently the quantity and value of the product decreased. Indeed, owing to the competition of foreign potash, the industry can now exist only in localities where wood is very cheap and where there is a local demand for the product. In such places the product is of domestic manufacture and is an article of trade at the country stores, but with the increasing value of timber, the field of operations is continually being contracted.

The cost of producing a barrel of 650 pounds of potash is stated in a private communication from a Michigan manufacturer to be as follows:

Ashes, 150 bushels, at 3 cents	$4.50
Hauling ashes	6.00
Fuel	2.00
Labor	3.00
Barrel, cost of	1.25
Repairs, interest, etc	1.50
Total cost	18.25
Selling price at works	25.00
Gross profit per barrel	6.75

The ashes therefore yielded 4⅓ pounds of potash per bushel, and the potash sold at 3.85 cents per pound. It will be noted that the weight of a barrel of potash is given above as 650 pounds. From the returns it appears that the net weight of a barrel of this material varies from 650 pounds to 740 pounds, the average being about 700 pounds.

Competition with the ashes of wood as a source of potash is found in beet-root molasses and residues; wool scourings, known as suint; and the potash salts mined at Stassfurt and elsewhere abroad. In the case of the beet-root molasses and residues, and of the suint, the mass is calcined and the potassium carbonate extracted, as is done for wood. The potassium exists in the Stassfurt and other mineral salts as chlorides and sulphates in combination with magnesium and calcium, and after the potassium chloride is extracted from them, it is converted into pearlash by the Le Blanc process, or it may be converted into carbonate by the Solvay process, using trimethylammonium carbonate. Mendeléeff[1] states that about 25,000 tons of potash annually are now (1897) prepared from KCl at Stassfurt. Other proposed sources of potash salts are sea water; the mother liquor of salt works and mineral springs; the residues from seaweeds; and the feldspars and similar rocks.

There are, moreover, some industries which produce considerable quantities of wood ashes as a by-product, from which potash may be extracted with profit. For example, the wood-distillation industry uses hard wood and consumes much of the charcoal produced as fuel under the retorts. Hard-wood ashes are richer in potash than soft-wood ashes, and as the extra cost of obtaining the potash should be very trifling in connection with the other operation, considerable quantities of it might be obtained from this source.

As potassium carbonate crystallizes with difficulty, it can not well be purified by the method often employed for purifying salts. The pure material must, therefore, be obtained by indirect means. Among other methods in vogue, one is to purify cream of tartar, obtained from grapes, by repeated crystallization, and then, by burning it, obtain the refined potash. When the cream of tartar is ignited by contact with air there is left a mixture of finely divided charcoal and potassium carbonate, and this comes into the market under the name of "black flux," and is used in smelting operations as a reducing agent.

Potash is used in the manufacture of soft soap; in making potassium salts, such as potassium chromate; in making caustic potash; and, in the form of pearlash, in the making of glass.

The potassium found in wood ashes is extracted from the soil by the plant during its growth, the presence of potassium compounds in the soil being essential to the growth of vegetation. Consequently, wood ashes are a valuable fertilizing material. Wiley[2] says of this:

> The beneficial effects following the application of ashes, are greater than would be produced by the same quantities of matter added in a purely manurial state. The organic origin of these materials in the ash has caused them to be presented to the plant in a form peculiarly suited for absorption. Land treated generally with wood ashes becomes more amenable to culture, is readily kept in good tilth, and thus retains moisture in dry seasons and permits of easy drainage in wet. These effects are probably due to the lime content of the ash, a property, moreover, favorable to nitrification and adapted to correcting acidity. Injurious iron salts, which are sometimes found in wet and sour lands, are precipitated by the ash and rendered innocuous or even beneficial. A good wood-ash fertilizer, therefore, is worth more than would be indicated by its commercial value calculated in the usual way.

From the census returns for 1900 it appears that the leached ashes have a certain manurial value and the returns show that the establishments reported above sold 87,040 bushels of leached ashes to be used as a fertilizer at a total value of $3,268, or, on an average, at 3.75 cents per bushel. It is stated by the manufacturers that wood ashes in leaching gain one-third in bulk; one manufacturer specifically stating that his 15,000 bushels of raw ashes yielded 20,000 bushels of leached ashes.

From Wagner's Chemical Technology, 1892, page 299, it appears that "the yearly production of potash, according to H. Grüneberg, is from

	Tons.
Wood ashes, Russia, Canada, United States, Hungary, and Galicia	20,000
Beet sugar ash, France, Belgium, Germany	12,000
Mineral salts, Germany, France, England	15,000
Suint, Germany, France, Belgium, Austria	1,000
Total from all sources	48,000

"These conditions differ strikingly from those which existed thirty [thirty-eight] years ago, when wood ash was in exclusive use and Russia potash ruled the mar-

[1] Principles of Chemistry, 1897, Vol. I, page 549.

[2] Principles and Practice of Agricultural Analysis, Vol. II, page 254.

ket. The potash extracted from wood ashes amounts to scarcely one-half of the total production; it decreases year by year, and the time when it will disappear from the market seems within measurable distance." This agrees with the data shown in the table above for the "Total Production of Potashes by Decades, 1850 to 1900."

The foreign commerce in potashes for the United States is exhibited in the following tables compiled from "The Foreign Commerce and Navigation of the United States for the years ending June 30, 1891–1900, Vol. II."

DOMESTIC EXPORTS OF ASHES, POT AND PEARL: 1891 TO 1900, INCLUSIVE.

YEAR.	Pounds.	Value.	YEAR.	Pounds.	Value.
1891	430,582	$24,432	1896	969,874	$41,208
1892	1,307,634	99,566	1897	511,830	21,727
1893	634,421	31,775	1898	869,841	33,202
1894	650,261	29,205	1899	745,433	29,676
1895	664,876	30,188	1900	1,273,905	49,566

IMPORTS OF ASHES, WOOD AND LYE OF, AND BEET-ROOT ASHES, FOR CONSUMPTION: 1891 TO 1900, INCLUSIVE.

YEAR.	Value.	YEAR.	Value.
1891	$42,624	1896	$67,393
1892	54,855	1897	66,423
1893	76,306	1898	62,206
1894	74,050	1899	59,970
1895	77,708	1900	66,453

IMPORTS OF POTASH, CARBONATE OF, OR FUSED, FOR CONSUMPTION: 1891 TO 1894, INCLUSIVE.

YEAR.	Pounds.	Value.
1891	....	$39,980
1891	6,207,419	219,557
1892	8,745,268	309,585
1893	10,115,017	329,895
1894	8,130,975	262,818

IMPORTS OF POTASH, CARBONATE OF, CRUDE OR BLACK SALTS, FOR CONSUMPTION: 1895 TO 1900, INCLUSIVE.

YEAR.	Pounds.	Value.
1895	11,602,272	$364,506
1896	12,439,180	401,819
1897	7,501,497	229,029
1898	15,844,374	471,919
1899	16,018,889	437,675
1900	21,191,258	625,922

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GROUP IV.—ALUMS.

During the census year 1900 there were 13 establishments engaged in the manufacture of alums either as a principal or subordinate product. The comparison with previous censuses is as follows:

PRODUCTION OF ALUMS, BY DECADES: 1880 TO 1900, INCLUSIVE.

YEAR.	Number of establishments.	PRODUCT.		PER CENT OF INCREASE.	
		Pounds.	Value.	Quantity.	Value.
1880	6	39,217,725	$808,165	....	....
1890	10	93,998,008	1,616,710	139.7	100.0
1900	13	179,467,471	2,446,576	90.9	51.3

There are no census statistics of production anterior to 1880, and the census of 1900 is the first one at which the various alums were separately reported, as shown in the table which follows:

KINDS OF ALUM PRODUCED IN 1900.

KIND.	Number of establishments.	Pounds.	Value.
Total	....	179,467,471	$2,446,576
Ammonia alum	4	6,580,373	102,308
Potash alum	5	14,200,393	215,004
Burnt alum	6	16,028,464	403,100
Concentrated alum	10	103,016,815	1,062,547
Alum cake	4	4,048,655	34,047
Other alums	7	35,592,771	629,570

The legend "other alums" is as reported on the schedules, and no doubt under it are included some of the kinds named in the list above, but it has not been possible to separate them. However, there are in the classification 1,526,000 pounds of aluminum hydroxide (hydrate of alumina), valued at $31,500. There are included under "burnt alum" 9,399,550 pounds of material, with a value of $228,500, returned as "soda alum" from 4 establishments. In addition, there were reported 3,928,160 pounds of ammonia alum, valued at $58,922, and 1,149,666 pounds of aluminum sulphate, valued at $10,922, as having been produced and consumed in the manufacture of other products.

It should be said that of the 13 establishments reported above but 2 of them were reported as producing alum only, the others being engaged in the manufacture of many other chemical substances. Taking the ratio of value which the alum bears to the total value of products for these last-mentioned establishments as a guide, it appears that these 13 establishments employed 802 wage-earners and a capital of $3,888,445 in the production of alum, and that there were consumed 34,000 tons of bauxite, having a value of $230,000; 5,000 tons of cryolite, of a value of $110,000; 2,000 tons of sodium sulphate, in the form of salt cake or niter cake, of a value of \$4,100; 360 tons of ammonium sulphate, of a value of \$21,900; 477 tons of potassium sulphate, of a value of \$19,600; and 61,424 tons of sulphuric acid, there being used for this acid 3,323 tons of sulphur, of a value of \$66,000; 49,081 tons of pyrites, of a value of \$107,000; and 513 tons of sodium nitrate, of a value of \$18,000.

The geographical distribution of these establishments is set forth in the following table:

GEOGRAPHICAL DISTRIBUTION OF ALUM FACTORIES: 1900.

STATES.	Number of establishments.	Average number of wage-earners.	Capital.	Value of product.	Per cent of total.
United States	13	802	\$3,888,445	\$2,446,576	100.0
Pennsylvania	6	530	2,747,482	1,411,652	57.7
Massachusetts	3	74	255,930	306,754	12.5
Illinois, New York, and Michigan	4	198	885,033	728,170	29.8

Alum was known to the ancients and was used by them in dyeing, tanning, and in making medicine. Aluminum sulphate, mixed with more or less iron sulphate, occurs as efflorescences on rocks and as the mineral *feather alum*, and it was this limited natural supply that was the source of the material used. The manufacture of alum is of oriental origin and was introduced into Europe about the Thirteenth century, the materials used being the mineral *alunite* or alum stone, which has the formula $K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3$ mixed with compounds of iron. This mineral is insoluble in water, but by calcining it and exposing it in heaps, with occasional moistening, the mass weathers, and after some months a potassium alum may be dissolved out which crystallizes in cubes and contains inclosed iron oxides which give it a red color. Such alum is known as "Roman alum" from its having been extensively manufactured at Tolfa, near Rome. Later, alum slates and shales, clay, bauxite, and cryolite have been employed as the raw materials of the alum manufacture, and the last-named two are the substances which are now almost exclusively used for this purpose.

When the minerals—clay, in its purer form of *kaolin* ($Al_2Si_2O_7.2H_2O$), or *bauxite*, which is aluminum hydroxide mixed with ferric, silicic, and other oxides in varying proportions, are used as the source of alumina, the process consists in decomposing the mineral with sulphuric acid and evaporating the solution of aluminum sulphate formed until, when cool, it sets to a stone-like mass. This cake contains impurities in the form of silica, ferric sulphate, and free sulphuric acid, there being usually from 2 to 3 per cent of the latter present. When but little iron is present, the substance is known as "alum cake;" when much iron is present it is known as "alumino-ferric cake." *Bauxite* is especially liable to yield this last-named product.

A purer aluminum sulphate is made from *bauxite* by calcining it with soda ash until sodium aluminate is formed. This is dissolved, the solution filtered, and carbon dioxide passed through it, by which the aluminum is precipitated as hydroxide. This purified hydroxide is dissolved in hot sulphuric acid and the solution formed run into leaden pans to cool, when it forms a crystalline mass much used in the arts under the name of "concentrated alum," and having the composition $Al_2(SO_4)_3 20H_2O$, though the separate crystals have but 18 molecules of water of crystallization. Manufacturers specify that bauxite for use in the manufacture of alum shall contain not more than 3 per cent of ferric oxide nor less than 60 per cent of aluminum oxide.

Cryolite is used not only as a source of alum, but also for the manufacture at the same time of caustic soda, calcium or sodium fluorides, and hydrofluoric acid. This mineral, which in commercial quantities is found only in southern Greenland, is a double fluoride of sodium and aluminum, having the formula $AlF_3(NaF)_3$. By calcining cryolite with powdered limestone and lixiviating the frit, or by boiling cryolite with milk of lime, sodium aluminate is obtained as one of the products of the reaction, and this may be converted into "concentrated alum" by the means above described. A modification of this consists in boiling sodium aluminate liquor with powdered cryolite, through which the sodium in each molecule is converted into sodium fluoride and the aluminum into alumina, and then producing "concentrated alum" by dissolving the alumina in sulphuric acid.

When "concentrated alum" is dissolved in water and mixed with a solution of potassium sulphate, the solution, on concentration, deposits beautiful, transparent, colorless, octahedral crystals, which have a vitreous luster and the composition $K_2Al_2(SO_4)_4.24H_2O$. This substance is known as "potassium alum" or "potash alum," and was the first complex alum recognized. It was the first to be manufactured commercially, since by this means the easily soluble aluminum sulphate was separated from the iron sulphates, and a very superior article for use in dyeing was obtained. Since purer raw material has been found, and improved methods for purification have been devised, concentrated alum has largely displaced the complex alums in dyeing as well as in the other arts.

Crystallized potassium alum of the composition given above is the type of a large number of complex alums which may be produced by mixing a solution of aluminum sulphate with a solution of an alkaline sulphate and crystallizing out the double salt. Among these we have in commerce crystallized ammonium and crystallized sodium alum, though the latter is not common, owing to its being difficult to crystallize and to the fact that the crystals, when formed, readily effloresce. When these crystallized alums are heated, the water of crystallization, and usually a little of the sulphuric acid, is driven off and the material falls to a white powder known as "burnt alum," which is used in pharmacy. A similar sodium alum which is largely used in baking powders is prepared by mixing concentrated solutions of sodium sulphate and aluminum sulphate, allowing them to set in a cake, and roasting the alum to drive off the water, or by mixing the sulphates in the solid condition and heating them. By varying the proportions of the sulphates and the temperature, various desired properties are imparted to the burnt alum, and these preparations are sold under various trade names.

Effloresced sodium alum is sometimes known under the name of "porous alum," but this name, in the trade, is given to porous alum cake containing a little sodium alum and basic aluminum sulphate, which is made by stirring into alum cake, just before it sets, a desired quantity of soda ash. As the aluminum sulphate possesses an acid reaction it reacts with the sodium carbonate and the carbon dioxide evolved puffs up the mass and leaves it in a condition so that it may be readily dissolved.

Alums may be formed with selenic and other acids in place of the sulphuric acid of ordinary alum. Moreover, chromic, ferric, manganic, and other sulphates form double salts with the alkali sulphates, and though these compounds contain no aluminum whatever, they are called alums because they crystallize in the same form, have the same crystalline habit, the same oxygen ratio, and the same number of molecules of water of crystallization as the double sulphates of alumina and the alkali metals. None of these numerous alums has any commercial importance except "chrome alum," which has the formula $K_2Cr_2(SO_4)_4.24H_2O$.

Potash and ammonia alums were made by Charles Lennig, of Philadelphia, in 1837, and concentrated alum was manufactured by him in 1859. Harrison Bros. & Co., of Philadelphia, began the manufacture of crystal alum about 1840, and they began the manufacture of concentrated alum from *bauxite* in 1877. The Pennsylvania Salt Manufacturing Company began the manufacture of concentrated alum at Natrona, Pa., in 1876, and they were the first to manufacture porous alum.

Alums are used in dyeing, printing, tanning, paper making, in making lakes and other pigments, in purifying water and sewage, as a constituent of baking powder, in medicine, in stucco work for hardening plaster, in photography for hardening films, in rendering wood and fabrics non-inflammable, in "carbonizing" wool, in bleaching, and in the preparation of various aluminum compounds.

The foreign commerce in alums is shown in the following table, compiled from the reports of the Bureau of Statistics of the United States Treasury Department:

IMPORTS OF ALUMS FOR CONSUMPTION: 1891 TO 1900, INCLUSIVE.

YEAR.	Pounds.	Value.	YEAR.	Pounds.	Value.
1891	4,652,985	$58,863	1896	5,525,825	$86,371
1892	4,140,916	59,336	1897	5,301,544	96,529
1893	4,572,923	73,806	1898	2,787,639	36,099
1894	1,838,728	30,831	1899	1,601,829	14,244
1895	2,983,682	46,815	1900	2,186,266	19,354

And in the following tables, obtained from the same source, are shown the quantities and values of the raw or partly manufactured materials so far as they were set forth:

IMPORTS OF CRYOLITE FOR CONSUMPTION: 1891 TO 1900, INCLUSIVE.

YEAR.	Tons.	Value.	YEAR.	Tons.	Value.
1891	7,129	$95,405	1896	7,024	$93,198
1892	8,298	76,350	1897	3,009	40,056
1893	8,459	111,796	1898	10,788	144,178
1894	12,756	170,215	1899	5,529	79,455
1895	8,685	116,273	1900	5,878	78,658

IMPORTS OF BAUXITE FOR CONSUMPTION: 1897 TO 1900, INCLUSIVE.

YEAR.	BAUXITE, CRUDE.		ALUMINUM HYDRATE, OR REFINED BAUXITE.	
	Pounds.	Value.	Pounds.	Value.
1897	8,722,074	$14,915	....	....
1898	....	....	2,092,082	$60,194
1899	7,722,000	14,168	2,955,339	92,019
1900	6,850,000	11,413	3,474,421	109,574

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Group V.—Coal-Tar Products.

Notwithstanding that as early as 1815 Accum had devised a process for obtaining a volatile oil from coal tar for use as a substitute for spirits of turpentine; that in 1845 A. W. Hofmann had discovered that this body contained benzene; that in 1856 a great impetus was given to tar distilling by the discovery of anilin colors by Perkin, since the benzol, which is the raw material for their manufacture, was exclusively derived from coal tar, and that from 1806, when coal gas was introduced for lighting by David Melville at Newport, R. I., coal tar had been a by-product of the industry in this country; yet it was not until 1880 that any mention was made in the United States Census Reports of these bodies, and they are apparently given there in two classifications, as follows: On page 1001 of Statistics of Manufactures there are reported 344,114 pounds of anthracene of a value of $99,242, and in the table of specified industries on page 20 of the same report, it is stated that three works produced "coal tar" having a value of $466,800, from which it is inferred that as the original coal tar was being produced in the several hundred gas works then existing, the three works enumerated were engaged in producing coal-tar products. On pages 288 and 289 of Part III, Census of Manufacturing Industries, 1890, there are reported coal-tar products of a value of $687,591. The establishments were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF FACTORIES FOR COAL-TAR PRODUCTS: 1890.

STATES.	Value of products.	Per cent of total.
United States	$687,591	100.0
New Jersey	330,200	48.0
Pennsylvania	168,180	24.5
New York	138,324	20.1
District of Columbia	20,000	2.9
Georgia	20,000	2.9
Massachusetts and Tennessee	10,887	1.6

At the census of 1900 there were reported 14 establishments devoted to the manufacture of coal-tar products, which amounted in value to $1,322,094, and 8 establishments in which this manufacture was of secondary importance, with a value of $99,626, the total value being $1,421,720. These establishments were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF FACTORIES FOR COAL-TAR PRODUCTS: 1900.

STATES.	Number of establishments.	Average number of wage-earners.	Capital.	Value of products.	Per cent of total.
United States	22	466	$1,448,622	$1,421,720	100.0
Missouri	3	155	381,959	415,600	29.2
Pennsylvania	6	177	651,482	396,759	27.9
New York	3	33	25,457	44,016	3.2
Louisiana, Tennessee, Ohio, California, Minnesota, Massachusetts, and New Jersey	10	101	389,724	565,345	39.7

Of these products, chemicals having a value of $205,047 were obtained from further action on the distillate of the coal tar. In addition, these factories produced tarred felt and tarred paper (in which part of the material from the coal tar was consumed), having a value of $442,529.

Coal tar, as its name implies, is obtained from coal, and it is produced by the destructive distillation of coal out of contact with the air, the other products being gas, coke, and ammoniacal liquor. From the beginning of the Nineteenth century the chief commercial source of the coal tar was found in the manufacture of coal gas for illuminating purposes, but to-day it is also obtained from the by-product coke ovens, while gas producers, blast furnaces, and water-gas plants furnish tars which now find commercial uses, though they differ in composition from coal tar. In the special report on coke for the census of 1900, it is reported that the production of tar from the by-product coke ovens for 1899 amounted to 104,687,330 pounds, or 52,344 tons. Although the returns for gas for 1900 are given in the special report on gas for the census of 1900, no separate returns are therein presented for the by-product of tar. This may, however, be estimated as follows: In Table 8 of that report it is stated that the total production of gas was 67,093,553,471 cubic feet, and in Table 9 that over 75 per cent of the gas manufactured during the census year was water gas. Putting the coal gas at 20 per cent, we have 13,418,710,694 cubic feet of coal gas.

The average yield of gas per ton of gas coal is 10,000 cubic feet, and dividing the volume of gas by this there results 1,341,871 tons of coal as having been used for making coal gas. The yield of tar per ton of coal is about 5 per cent by weight, which gives from the above figure 67,094 tons of tar. The total quantity of coal tar from the by-product coke ovens and the coal-gas industry in 1900 was, then, approximately 119,438 tons. The quantity of "water-gas tar" may also be estimated from the quantity of oil consumed, which is given in the special report on gas as 194,857,296 gallons. According to Douglas,[1] about 25 per cent of the oil is recovered as tar, which gives for the oil recorded above 48,714,324 gallons of tar. As, according to A. H. Elliott,[2] "water-gas tar" has a specific gravity of 1.1, a gallon will weigh 9.15 pounds, and therefore the total weight of "water-gas tar" obtained in the United States for 1900 as derived from the data given above is 222,868 tons. No tar is reported from any other source, though it is known that abroad the blast furnaces and gas producers are utilized as sources of this material. The total computed production of coal tar and water-gas tar for the United States for the census year 1900 is therefore 342,306 tons. It is worth noting that though the first by-product coke oven in the United States was erected in 1892,[3] yet the industry has grown so fast that the yield of coal tar from this source closely approaches that from coal gas making.

In connection with these estimates it is interesting to compare the following statement made by Lunge[4] in the recent edition of his standard work: "White and Hess (Jour. Soc. Chem. Ind., 1900, page 509), quote a number of analyses, from which they conclude that American coal tars are not well adapted to distillation for the recovery of benzol, etc., as they are inferior in

[1] J. of Gas-Lighting, page 1130. 1891.
[2] Am. Chem. J., page 248. 1884.
[3] J. D. Pennock, J. Am. Chem. Soc., vol 21, page 681. 1899.
[4] Coal Tar and Ammonia, 3d ed., Appendix, page 917.

quality to European tars except as regards anthracene. Their estimate of the production of coal tar in the United States, 400,000 tons, is probably much too high, since by far the greater portion of illuminating gas made there is (carburetted) water gas. Probably the quantity of 120,000 tons, which I gave as the production of coal tar in the United States in 1886, is not much, if at all, exceeded at the present time." The amount of coal tar reported as consumed in the United States in the census year 1900 was 22,004,650 gallons, which at 10 pounds per gallon gives 110,023 tons.

The yield of tar from the manufacture of gas in Europe in 1898 is given by Lunge[1] from data supplied by Dr. Bueb, as follows:

TAR PRODUCED IN MAKING GAS IN EUROPE IN 1898.

COUNTRY.	Tons.	COUNTRY.	Tons.
Total	1,120,000	Belgium	20,000
		Italy	16,650
Great Britain	666,650	Russia	16,650
Germany	166,650	Holland	15,000
France	135,000	Denmark	13,500
Austria-Hungary	41,500	Switzerland	6,750
Scandinavia	21,650		

The data of the census of 1900 places the United States fourth in the list of countries in the amount of tar produced in the distillation of coal for the manufacture of gas.

It is of historical interest that the first English patent referring to the destructive distillation of coal (that of John Joachum (sic) Becher and Henry Serle, dated August 19, 1681) does not treat of the manufacture of illuminating gas, but of "a new way of makeing pitch and tarre out of pit coale, never before found out or used by any other," and this German chemist, Johann Joachim Becher, appears to have been the originator of the coal-tar industry, he having employed the coal tar as a substitute for "Swedish tar from firwood" in tarring wood and ropes. The French metallurgist de Gensanne[2] describes a furnace in use before 1768 at Sulzbach, near Saarbrücken, for coking coal and recovering tar, the light oil from the tar being used for burning in lamps.

Notwithstanding the various inventions for producing coal tar, it is, according to Lunge[3]—

Certain that the manufacture of coal tar was never carried out on any extensive scale until it appeared as a necessary by-product in the manufacture of illuminating gas from coal, the idea of which seems to have occurred toward the end of the last century at the same time to the Frenchman Lebon and the Englishman William Murdoch. The former had already recommended the use of tar for preserving timber; but it was the latter who, along with his celebrated pupil Samuel Clegg, really laid the foundation of the enormous industry of gas making. The first private gas works was erected in 1798 at the engineering works of Bolton & Watts; the first public gas works in London in the year 1813; in Paris, 1815, and in Berlin, 1826.

The tar formed in the manufacture of coal gas necessarily forced itself upon the notice of the gas manufacturer, since it could not be thrown away without causing a "nuisance." It was probably from the first burnt under the retorts, but the method of doing this without giving very much trouble was not understood then. Other quantities, no doubt, were used, in lieu of wood tar, as a cheap paint for wood or metals, but it must have been soon found out that in the crude state it is not well adapted for this purpose. * * * It was also quickly perceived that in this respect tar is improved by boiling it down to some extent, and as early as 1815 Accum showed that if this boiling down is carried out in closed vessels (stills) a volatile oil is obtained which may be employed as a cheap substitute for spirits of turpentine. But this does not seem to have been carried out to any great extent, and coal tar remained, for more than a generation from the first introduction of gas lighting, a nuisance and hardly anything else.

In Germany the first more extensive employment of gas tar was for making roofing felt, for which purpose it has to be deprived of water and the more volatile constituents. Instead of condensing these, they were at first almost everywhere, and later on in many cases, removed by evaporating the tar in open vessels, thus creating a considerable risk from fire. In Germany, Brönner, of Frankfort, was the first (in 1846) to condense the more volatile tar oils, from which he prepared a detergent, long after known by his name, and consisting principally of benzene.

In England, where the manufacture of illuminating gas originated, and where it has always been, and still is, carried on to a very much greater extent than on the Continent, a more extensive industrial employment for coal tar was first opened out by the invention of Bethell (1838) for preserving timber, especially railway sleepers, by impregnation with the heavy oil distilled from gas tar. From that time dates the introduction of tar distilling on a large scale. The light oils may have been lost even here in some cases, but more usually they were condensed and employed as "coal-tar naphtha" for burning and for dissolving india rubber.

The day of the light tar oils came after A. W. Hofmann (1845) had shown the presence of benzene in them, but especially when Mansfield, in his patent specification (1847), for the first time accurately described the composition of these oils, along with a process for preparing benzene in a pure state and on a large scale, and with proposals for utilizing the tar oils of lowest boiling point for lighting purposes. The industrial preparation of benzene was soon followed by that of nitrobenzene, at that time only employed as a substitute for the essential oil of bitter almonds, and known by the French fancy name of "essence de Mirbane." But all these applications produced only a limited demand for the light oils which could be made from the rapidly increasing quantities of gas tar; so that the latter, except in a few instances locally, did not attain any considerable commercial value. But a sudden impetus was given to tar distilling in 1856 by the discovery of the anilin colors, the material which forms their starting point, benzol, being exclusively derived from coal tar.

Coal tar is an extremely complex mixture of chemical compounds, some of which have not yet been even isolated. As before stated, the tars from other processes than the destructive distillation of coal contain other constituents, and varying quantities of similar constituents, from those existing in coal tar. Likewise, coal tar will vary in its composition with the coal which is distilled and the manner in which the distillation is carried out. The "products" are obtained from the coal tar by fractional distillation, and the first products are crude naphtha and light oils of a specific gravity below 1.000, distilling over below 180° C.; dead oils and

[1] Coal Tar and Ammonia, 3d ed., page 17; ibid., page 4.
[2] De Gensanne, "Traité de la fonte des Mines," Paris, 1770, Vol. I, ch. 12.
[3] Coal Tar and Ammonia, pages 11-13.

creosote oils of a specific gravity above 1.000, distilling over between 180° C. and 270° C.; green or anthracene oils, distilling over between 270° C. and 360° C.; and soft pitch, which is left in the still.

The proportions of yields from different coals is shown in the following tables given by J. D. Pennock,[1] chemist in charge of the oldest by-product coke-oven plant in the United States:

ANALYSES OF COAL.

	A	B
	Per cent.	Per cent.
Volatile matter	34.20	32.68
Fixed carbon	57.15	59.40
Ash	8.65	7.92
Sulphur	0.93	1.19

ANALYSES OF TAR.

	A	B	I	II
Specific gravity	1.163	1.203	1.205	1.231
	Per cent.	Per cent.	Per cent.	Per cent.
Water	2.40	2.70	1.40	1.10
Light oil	4.60	2.03	3.12	1.63
Creosoting oil	1.26	0.50	0.29	0.34
Dead oil	22.81	16.40	25.09	19.23
Naphthalene	6.00	Trace.	0.20	1.72
Anthracene	0.60	Trace.	0.19	0.24
Soft pitch	68.80	70.50	67.40	74.14

Tars A and B, made from Coals A and B, whose analyses are given above, show what differences may exist in tars made from coals very similar in composition as shown by proximate analysis. Tars I and II represent two tars from gas works. They also vary greatly in composition. As a usual thing, they are found to be of much higher specific gravity and to contain less light oils than tars from the by-product coke oven, making them inferior as sources of benzene and for the manuture of tarred paper.

To obtain the desired commercial products, the distillate must be subjected to further treatment. Thus the light oil on fractional distillation, gives "benzol" to the extent, for the coke-oven practice, of from 0.6 to 0.9 per cent of the weight of the coal used. According to Lunge,[2] "the final products of general trade into which the crude benzol should be split up without residues, are the following:

	Furnishes distillate per cent up to—					Specific gravity.
	100°.	120°.	130°.	160°.	200°.	
90 per cent benzol	90					0.885
50 per cent benzol	50	90				0.880
Solvent naphtha			20	90		0.875
Heavy naphtha					90	0.880

[1] J. Am. Chem. Soc., vol. 21, page 696. 1899.
[2] Coal Tar and Ammonia, 3d ed., page 588.

"Ninety per cent benzol" is a product of which 90 per cent by volume distills before the thermometer rises above 100° C. A good sample should not begin to distill under 80° C., and should not yield more than from 20 to 30 per cent at 85° C., or much more than 90 per cent at 100° C., but it should distill completely below 120° C. A 90 per cent benzol of good quality contains about 70 per cent of benzene, 24 per cent of toluene, including a little xylene, and from 4 to 6 per cent of carbon disulphide and light hydrocarbons.

"Fifty per cent benzol," often called 50/90 benzol, is a product of which 50 per cent by volume distills over at a temperature not exceeding 100° C., and 40 per cent more (making 90 per cent in all) below 120° C. It should wholly distill below 130° C. It contains a larger proportion of toluene and xylene than the 90 per cent benzol. It is nearly free from carbon disulphide, and contains comparatively little of the light hydrocarbons. It is employed for producing the heavy anilin used in manufacturing rosaniline or magenta.

"Thirty per cent benzol" is a product of which 30 per cent distills below 100° C. and about 60 per cent more passing over between 100° and 120° C. It consists chiefly of toluene and xylene with smaller proportions of benzene and cumene.

"Solvent naphtha" consists of xylene, pseudocumene, and mesitylene and is used in dissolving caoutchouc in the manufacture of waterproof materials and other articles.

From these "light oils," by fractional distillation and purification with sulphuric acid, water, milk of lime, and caustic soda, pure benzene, C_6H_6, toluene, C_7H_8, and xylene, C_8H_{10}, may be obtained, the benzene being crystallized out.

According to Pennock[3] the light oil obtained is from 6.6 pounds to 8.5 pounds per long ton of coal and it varies with the percentage of volatile matter in the coal. The light oil contains from 58 to 63 per cent of benzene, divided thus:

	Per cent.
90 per cent benzol	57
50 per cent benzol	2
Solvent naphtha	4

The dead oils and creosote oils which compose the material that is collected from the coal-tar distillate between 180° and 270° C. contain the "middle oil," and this fraction on further treatment yields crystallized carbolic acid, cresols, heavy solvent naphtha, pyridine bases, and naphthalene. In practice this is divided into further fractions, the fraction between 240° and 270° C. furnishing the creosote oil, which is a commercial source of naphthalene, coal-tar creosote, and the cresols. The naphthalene, which exists to the extent of 40 per cent or more in the creosote oil, is removed by chilling the oil, which causes the naphthalene to crystallize out, leaving the cresols. The crystals are

[3] J. Am. Chem. Soc., vol. 21, page 703.

then drained and pressed and purified further by sublimation.

The heavy coal-tar oil is used not only as a source of the more valuable products obtained by rectification or by "breaking" in red-hot tubes, but also for "pickling" timber; softening hard pitch; preparing varnishes; preparing cheap mineral paints, where the heavy oil is used in place of linseed oil; as an antiseptic; in the blue steaming of bricks; in carburetting gas; in the manufacture of lampblack; and by burning, as a source of heat and light.

The fraction between 150° and 200° furnishes the carbolic acid, it being obtained by treating the oil with caustic soda, through which sodium phenolate is formed, which separates from the oil. The sodium phenolate is drawn off and then decomposed by sulphuric acid or carbon dioxide and the carbolic acid set free. The crude carbolic acid is now purified by distillation or other means and the pure carbolic acid, or phenol, which crystallizes in colorless crystals, obtained. Pure carbolic acid is used in the manufacture of the dyestuffs, picric acid, and corallin, and of some azo dyes, also in the manufacture of salicylic acid, but most of the carbolic acid, both pure and crude, is used for antiseptic purposes. The oil drawn off from the sodium phenolate contains some of the higher homologues of benzene, and naphthalene with pyridine bases. In commerce it furnishes principally naphthalene, pyridine bases, and solvent naphtha of various degrees, the treatment being determined by the products sought. The pyridine bases are used in the manufacture of pharmaceutical preparations and in denaturizing grain alcohol for use in the arts.

The anthracene oil, which is the portion of the coal-tar distillate passing over above 270° C., is known also as green oil, green grease, and red oil, and it contains naphthalene, methyl naphthalene, anthracene, phenanthrene, acenaphthene, diphenyl, methyl anthracene, pyrene, chrysene, retene, fluoranthene, chrysogen, benzerythrene, carbazol, and acridine, together with a mixture of liquid high-boiling oils, of whose composition nothing is yet known, the whole forming a mass rather thinner than butter, filled with crystalline scales of a greenish-yellow color. The anthracene oil is treated by cooling and pressing, the liquid portion being sent to the heavy oil to be reworked with it. The solid portion is either sold as rough anthracene or it is further purified by washing with solvents which dissolve the impurities. On oxidation anthracene yields anthraquinone, which is used for the production of alizarine and other coal-tar colors. According to Pennock[1] there is as yet no market for anthracene in this country, but it is necessary that some anthracene should be present in coal tar pitch in order to produce a pitch of the right consistency for roofing purposes.

As indicated, the naphthalene is accumulated in the creosote oil and extracted from it in the crude condition by freezing and pressing, when it is purified by sublimation. It is used in the manufacture of artificial colors and as a substitute for camphor in protecting goods from the ravages of moths.

The coal-tar pitch, which forms the residue in the still, is used in the manufacture of roofing compositions and tarred felt and tarred paper; incorporated with coal or coke dust, it is fashioned into briquettes for use as fuel; dissolved in creosote oil or other solvents, it is used as a paint for iron and woodwork; and it is used as a substitute for asphalt in street pavements.

Benzene is employed as a solvent in the manufacture of nitrobenzene and dinitrobenzene, which are used in several arts and in the manufacture of many benzene derivatives. One important product is anilin, which is obtained by the reduction of mononitrobenzene. The anilin of commerce, which is known as anilin oil, is obtained from benzol, and this, as before stated, is a mixture of different cyclic hydrocarbons, the particular mixture used being determined by the color which it is sought to produce. In this case, as with pure benzene, the mixture is nitrated by exposure to a mixture of nitric and sulphuric acids, and the nitrosubstitution compounds that are produced are reduced by exposure to tin and hydrochloric acid or some other source of nascent hydrogen. Benzol is also used as a cleansing agent and as a vehicle in paint.

The nitrosubstitution compounds, and amido bodies, like anilin oil, represent in this group the "chemicals made from coal-tar distillery products."

The foreign commerce in coal-tar products is set forth in the following tables, compiled from the reports of the Bureau of Statistics of the Treasury Department on imported merchandise entered for consumption into the United States:

IMPORTS FOR CONSUMPTION OF COAL TAR DURING THE YEARS ENDING JUNE 30, 1891 TO 1896.

YEAR.	COAL TAR, CRUDE, AND PITCH.	
	Barrels.	Value.
1891	89,313	$263,593
1892	117,056	302,791
1893	102,136	244,291
1894	96,068	218,514
1895	112,536	247,957
1896	139,976	288,750

IMPORTS FOR CONSUMPTION OF COAL-TAR PRODUCTS, NOT MEDICINAL AND NOT COLORS OR DYES,[1] DURING THE YEARS ENDING JUNE 30, 1898 TO 1900.

YEAR.	Value.
1898	$228,037
1899	393,602
1900	397,780

[1] These preparations are known as benzol, toluol, naphthalene, xylol, phenol, cresol, toluidine, xylidine, cumidine, binitrotoluol, binitrobenzol, benzidine, tolidine, dianisidine, naphthol, naphthylamine, diphenylamine, benzaldehyde, benzyl chloride, resorcin, nitrobenzol, and nitrotoluol.

[1] J. Am. Chem. Soc., vol. 21, page 697.

IMPORTS FOR CONSUMPTION OF PREPARATIONS OF COAL TAR, EXCEPT MEDICINAL, AND PRODUCTS OF, NOT SPECIALLY PROVIDED FOR, FOR THE YEARS ENDING JUNE 1, 1895 TO 1900.

YEAR.	Value.
1895	$187,373
1896	313,943
1897	
1898	134,416
1899	221,101
1900	274,946

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The Retort Coke Oven and the Chemistry of its By-Products, by J. D. Pennock, J. Amer. Chem. Soc., 21, 678–705. 1899.

The Spirit of Organic Chemistry, by Arthur Lachman: New York, 1899.

Coal Tar and Ammonia, by George Lunge: 3d ed. New York, 1900.

Group VI.—Cyanides.

In this classification are included potassium ferrocyanide, potassium ferricyanide, potassium and ammonium sulphocyanates (known commercially as sulphocyanides), and potassium, sodium, and other cyanides. No separate account was taken of the cyanides at any census previous to 1900. At the census of 1900 returns were made only for potassium ferrocyanide and for potassium cyanide. Twelve establishments were reported in which the cyanides were the principal products, the value being $1,466,061, and 6 establishments in which they formed secondary products, the value being $12,844. These 18 establishments employed $1,322,719 of capital and 391 wage-earners and produced $1,595,505 of product. They were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF CYANIDE FACTORIES: 1900.

STATES.	Number of establishments.	Average number of wage-earners.	Capital.	Value of product.	Per cent of total.
United States	18	391	$1,322,719	$1,595,505	100.0
New Jersey	6	166	533,001	1,053,472	66.0
Pennsylvania	4	107	317,816	303,245	19.0
Ohio	3	43	71,750	86,852	5.5
Maryland, Massachusetts, and Missouri	5	75	400,252	151,936	9.5

Of the products reported, 6,165,407 pounds, having a value of $994,014, were potassium ferrocyanide, and 2,317,280 pounds, having a value of $601,491, were the so-called potassium cyanide. There were consumed in this manufacture 9,315,080 pounds of potassium carbonate, having a value of $279,602; 3,456 tons of hoofs and of horn waste, having a value of $87,502; 19,417 tons of scrap leather, having a value of $150,213; 1,200 tons of spent iron oxide from the gas works, having a value of $3,000; 300,000 pounds of sodium, having a value of $93,183; 2,400 bushels of lime, having a value of $480; $9,520 worth of scrap iron, and 2,401,180 pounds of potassium ferrocyanide.

Potassium ferrocyanide (ferrocyanide of potassium; yellow prussiate of potash; blood-lye salt) was discovered by Macquer in 1752, through acting upon prussian blue with an alkali. It is made by fusing potassium carbonate in cast-iron vessels and adding to the fused mass a mixture of nitrogenous organic matter, such as horns, hair, blood, wool waste, and leather scraps, with from 6 to 8 per cent of iron turnings or borings, until the mixture added equals about 1¼ parts of the potash. The fused mass, when cooled, contains, among other substances, potassium cyanide, carbonate, and sulphide, iron sulphide, metallic iron, and separated carbon. This mass is broken up and digested with water at 85° C. for several hours, during which reactions take place by which the potassium ferrocyanide is formed. The solution is clarified and the potassium ferrocyanide purified by crystallization, when it appears in fine large yellow crystals, having the formula $K_4Fe(CN)_6.3H_2O$.

Potassium ferrocyanide is also prepared from the spent oxide of iron from gas works' purifiers, thereby utilizing the nitrogen compounds that have been taken up or formed during the process of purification. In this operation the oxide is lixiviated with warm water to remove the ammonium sulphocyanate and other ammonium compounds, and the residue is mixed with quicklime and heated by steam in closed vessels to 100° C., through which calcium ferrocyanide is formed, and separated by lixiviation. By treating this with potassium chloride, the difficultly soluble calcium potassium ferrocyanide is formed, and by decomposing this with potassium carbonate the potassium ferrocyanide results.

Potassium ferrocyanide was manufactured on a commercial scale by Carter & Scattergood in Philadelphia, before 1834. It is used largely for making prussian blue, potassium cyanide and ferricyanide, prussic acid, in calico printing, in dyeing, for case-hardening iron, and in white gunpowder and pyrotechnics.

Potassium ferricyanide (ferricyanide of potassium; red prussiate of potash) was discovered by Leopold Gmelin in 1822,[1] and is formed by passing chlorine gas through a solution of potassium ferrocyanide until the solution will no longer give a blue reaction with a ferric salt. Or the salt may be formed by exposing dry powdered ferrocyanide to the action of chlorine gas; or by acting on a calcium and potassium ferrocyanide solution with potassium permanganates; or, according to

[1] Schw. J., vol. 34, page 325.

Lunge,[1] by boiling a solution of the ferrocyanide with lead peroxide, while a stream of carbon dioxide is passed through the solution. Potassium ferricyanide crystallizes without water of crystallization in blood-red prisms. It is very soluble, yielding an intensely yellow solution which forms the blue pigment, known as Turnbull's blue, with ferrous salts.

Carter & Scattergood were manufacturing red prussiate of potash on a commercial scale at Philadelphia in 1846. When in solution with caustic potash, it is a powerful oxidizing agent, and as such is used in calico printing as a "discharge" on indigo and other dyes. It also forms a part of the sensitive coating for photographic "blue-print" papers, and has been recommended for use with potassium cyanide in the extraction of gold from its ores.

Ammonium sulphocyanate (sulphocyanate of ammonium; ammonium thiocyanate; ammonium sulphocyanide), the acid of which was first observed by Bucholz in 1799, is prepared by heating carbon disulphide and ammonium hydroxide to 125° C. in an autoclave until the pressure rises to 15 atmospheres, when the ammonium dithiocarbamate is formed. The pressure is now released and the autoclave heated to 110° C., when the dithiocarbamate is decomposed and the products distilled over. The ammonium sulphocyanate produced is obtained by evaporating the liquid remaining in the still in tin vessels and crystallizing out.

As pointed out above, ammonium sulphocyanate is also obtained by lixiviating the spent iron oxide used in purifying illuminating gas. The salt crystallizes in colorless plates which are very soluble in water and alcohol. It is used as a source of other sulphocyanates and in dyeing, to prevent the injurious action of iron on the color.

Among the sulphocyanates produced from it is the barium sulphocyanate which results from heating ammonium sulphocyanate with barium hydroxide solution under slight pressure; and this barium salt is used generally for the manufacture of potassium and aluminum sulphocyanates, which are used in textile dyeing and printing.

Potassium cyanide (cyanide of potassium) has been generally prepared by fusing potassium ferrocyanide with potassium carbonate until the evolution of gas ceases. Potassium cyanide, potassium cyanate,[2] carbon dioxide, and metallic iron are formed. The metallic iron sinks to the bottom of the crucible and the fused mixture of cyanide and cyanate is run off. Part of the cyanate may be reduced to cyanide by adding powdered charcoal to the fused mass, or it may be reduced by metallic zinc or sodium; or the cyanide may be extracted from the mass by a solvent such as alcohol, acetone, or carbon disulphide. By fusing the potassium ferrocyanide with sodium carbonate a mixture of sodium and potassium cyanide known under the name of "cyan-salt" may be produced. An almost pure cyanide can be obtained by heating the ferrocyanide *per se* according to the following equation:

$$K_4Fe(CN)_6=4\ KCN+N_2+FeC_2$$

but this method entails the loss of one-third of the nitrogen in the ferrocyanide, and to avoid the waste of nitrogen Erlenmeyer proposed to add the proper amount of an alkali metal to the melted ferrocyanide, giving for sodium the following reaction:

$$K_4Fe(CN)_6+2\ Na=4\ KCN+2\ NaCN+Fe$$

and it is in this way that most of the so-called chemically pure potassium cyanide now sold is made, though it consists of a mixture of potassium and sodium cyanides. It also contains a considerable quantity of potassium carbonate, which is added to it during the course of manufacture to reduce its strength, for the combined cyanides produced as above described have a higher percentage of cyanogen than chemically pure potassium cyanide could possibly have. The carbonate is added in sufficient amount to reduce the cyanogen contents to from 39 to 40 per cent, which is equivalent to from 98 to 100 per cent potassium cyanide.

Other processes have been devised for using sodium in making cyanides. One is to first convert the sodium into sodamine, thus: $2\ Na+2\ NH_3=2\ NaNH_2+H_2$ by heating it in contact with ammonia gas, and then heating the amine with carbon to form the cyanide thus: $NaNH_2+C=NaCN+H_2$. Another and later method by which it is claimed a better yield is obtained, is to form a stable cyanamid, at a temperature of about 400° C., from the sodamine and carbon, thus:

$$2\ NaNH_2+C=Na_2N_2C+2\ H_2,$$

and then reacting on the cyanamid with a further quantity of carbon at a temperature of 800° C. to form the cyanide according to the equation:

$$Na_2N_2C+C=2\ NaCN.$$

Each of these methods requires a large amount of expensive sodium for a given output of cyanide. J. D. Darling has lately devised a process of using sodium in the synthetic production of sodium cyanide, which gives good results and in which the larger portion of the metallic base is furnished in the form of caustic soda, and but a small amount of sodium is needed to finish the process. It is claimed that by this process a moderate-sized sodium plant can produce enough metal to manufacture a large amount of cyanide.

Potassium cyanide has been commercially manufactured by passing nitrogen over an intensely heated mixture of charcoal and potassium carbonate. Cyanides have also been produced by conducting ammonia

[1] Ding. poly. J., vol. 238, page 75.
[2] Gmelin, vol. 7, page 413.

gas through vertical retorts, heated to a red heat, and containing a mixture of charcoal and alkali carbonates. Potassium cyanide is sometimes obtained in considerable quantity from blast furnaces, being formed from the potassium carbonate in the ash of the fuel.[1] Because of this reaction between carbon and nitrogen in the presence of alkaline salts numerous efforts have been made to utilize the reaction in making the atmospheric nitrogen available.

Potassium cyanide was commercially manufactured by the H. V. Davis Chemical Works, at New Bedford, Mass., in 1852. As it is a powerful reducing agent, potassium cyanide is used as a flux in assaying and in metallurgy; as a solvent of silver sulphide it is used in cleaning silver articles; it has been used as a fixing solution in photography; for the preparation of Grénat soluble and potassium isopurpurate in dyeing; and, as it forms a soluble double cyanide with silver, gold, copper, and other metals, it is much used in electroplating; but its largest use is now found in the cyanide process for the extraction of gold from its ores.

The foreign commerce in the cyanides is set forth in the following tables, compiled from the publications of the Bureau of Statistics of the Treasury Department of the United States:

IMPORTS FOR CONSUMPTION DURING THE YEARS ENDING JUNE 30, 1891 TO 1900.

YEAR.	YELLOW PRUSSIATE OF POTASH.		RED PRUSSIATE OF POTASH.	
	Pounds.	Value.	Pounds.	Value.
1891	2,223,154	$368,366	35,826	$10,650
1892	1,302,632	232,058	35,933	11,111
1893	1,047,910	206,259	16,679	5,743
1894	599,103	114,826	11,135	3,339
1895	878,727	161,009	26,703	7,593
1896	1,056,562	157,457	30,390	8,579
1897	3,252,931	359,037	59,087	14,893
1898	1,340,305	132,508	77,246	18,674
1899	1,809,089	204,974	62,697	15,211
1900	1,771,394	224,274	53,716	12,954

IMPORTS FOR CONSUMPTION DURING THE YEARS ENDING JUNE 30, 1897 TO 1900.

YEAR.	CYANIDE OF POTASH.	
	Pounds.	Value.
1897	16,232	$4,190
1898	549,697	120,252
1899	1,102,780	253,613
1900	2,064,974	444,703

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Group VII.—Wood Distillation.

Wood distillation as now classified for census purposes deals solely with that treatment of wood by which wood alcohol, acetic acid, acetate of lime, pyroligneous acid, and charcoal, or any of these, are produced. This interpretation was given to it in 1880, the first census at which separate returns were set forth for the industry. The manufacture proceeds in two stages: First, the production of crude wood alcohol or wood spirits and crude acetate of lime; second, the refining of the alcohol, and the refining of the acetate of lime, or the production therefrom of acetic acid or acetone. The refining processes are usually carried out at other works than those in which the crude materials are produced, but while in the census reports the alcohol refineries remain identified and classified with the wood distillation works, the factories where the acetate of lime is treated are classified with "chemicals, acids." With this preface it can be stated that 99 establishments were reported as producing some of the crude substances enumerated above during the census year 1900. Of these, 84 were regular wood-distilling establishments and produced of crude alcohol 4,191,379 gallons, having a value of $1,660,061; of acetate of lime 81,702,000 pounds, having a value of $926,358; and of charcoal 14,428,182 bushels, having a value of $612,009.

These works employed $4,858,824 of capital, and 1,268 wage-earners. There were 9 establishments reporting the production of the crude material and the refining of the alcohol in the same factory; and these establishments produced of refined alcohol 637,856 gallons, having a value of $370,513; of acetate of lime 5,124,000 pounds, having a value of $54,928; and of charcoal 2,726,120 bushels, having a value of $114,663. They employed $760,156 of capital and 254 wage-earners. Besides these there were 9 establishments engaged in refining wood alcohol only, producing 2,400,284 gallons of refined alcohol, having a value of $1,926,385, and employing $1,098,719 of capital, and 52 wage-earners. Finally, there were 6 other establishments engaged in the production of pyroligneous acid or pyrolignite of iron as incidental to other manufacturing processes, the total quantity of pyroligneous acid reported from all sources being 182,446 gallons, valued at $9,481; of dye liquors 308,400 gallons, valued at $29,440, and of sundries, such as wood creosote,

[1] Bloxam's Chemistry, page 619. 1890.

wood oil, ashes, tar, and the like, amounting in value to $71,452.

At the first census of this industry in 1880 only crude materials were reported. At the census of 1890 refined wood alcohol was reported for the first time, and it was then stated that the total output of crude alcohol was found by adding to that produced at the "acid factories" that which was produced and refined in the same establishment. Proceeding in this way for the 9 establishments reported above for 1900 as producing the crude alcohol and refining it in the same establishment, and converting the refined 97 per cent alcohol into crude 82 per cent alcohol at a value of 42 cents per gallon, a total is obtained for these establishments of 754,584 gallons of crude alcohol having a value of $316,925. By taking, in these instances, the per cent of the total value for all products added in the refining of the alcohol, the proportion of capital and labor devoted to the production of the crude material is found to be, for these 9 establishments, $641,052 of capital and 219 wage-earners. There were, therefore, 93 factories producing crude alcohol, in which $5,499,876 of capital and 1,487 wage-earners were employed. The total output thus ascertained is compared with the returns for the previous censuses in the following table:

WOOD DISTILLATION, CRUDE MATERIAL PRODUCED: 1880 TO 1900.

YEAR.	Number of establishments.	WOOD ALCOHOL.		ACETATE OF LIME.		CHARCOAL.	
		Gallons.	Value.	Pounds,	Value.	Bushels.	Value.
1880	17	....	$86,274	6,593,009	$156,892	....	$31,770
1890	53	1,116,075	688,764	26,778,416	315,430	....	....
1900	93	4,945,963	1,976,986	86,826,000	981,286	17,154,302	726,672

The increase of 1890 over 1880 in acetate of lime was 306.2 per cent in quantity and 101 per cent in value. The increase for 1900 over 1890 was 224.2 per cent in quantity and 211.1 per cent in value. The increase for 1890 over 1880 in wood alcohol was 698.3 per cent in value. The increase for 1900 over 1890 was 343.2 per cent in quantity and 187 per cent in value.

These establishments were distributed as follows:

WOOD DISTILLATION, GEOGRAPHICAL DISTRIBUTION OF WORKS PRODUCING CRUDE PRODUCTS: 1900.

STATE.	Number of establishments.	Average number of wage-earners.	Value of products.	Per cent of total.
United States	93	1,487	$3,833,266	100.0
Pennsylvania	58	878	2,339,536	61.3
New York	24	354	786,252	20.3
Michigan	5	169	505,069	13.2
North Carolina	3	12	18,409	0.4
New Jersey, Indiana, and Massachusetts	3	74	184,000	4.8

Only the number of refineries and quantity of products were reported for 1890, and only with these can the present condition of the refined wood-alcohol industry be compared, but this is sufficient to show how marked the growth has been.

PRODUCTION OF REFINED WOOD ALCOHOL: 1890 AND 1900.

YEAR.	Number of establishments.	Gallons.	Value.
1890	4	166,342	....
1900	18	3,038,140	$2,296,898

The increase of 1900 over 1890 is more than seventeenfold.

Although wood is usually spoken of as consisting of cellulose, it really consists of cellulose associated with a great variety of other organic substances, the kind differing with the different species of wood, and it is only necessary to recall the various gums, resins, tannins, sugars, and coloring matters found in commerce, which are obtained by simple processes of extraction from wood, to make this fact especially apparent. When subjected to heat out of contact with the air, the constituents of the wood are decomposed into liquids, gases, and a solid residue, and this process has been resorted to for ages as a means for obtaining charcoal. During the middle ages it became known that wood vinegar or pyroligneous acid could be obtained by distilling wood, but the identity of the acetic acid present with that obtained by the fermentation of alcohol was not known until 1802, when it was established by Thènard. The presence of wood spirit in the distillate from wood was discovered by Robert Boyle, in 1661, but its analogy to grain alcohol was first recognized by Taylor in 1812, and its composition was definitely fixed by Dumas and Peligot in 1831. Although charcoal, acetic acid, and methyl alcohol are the principal commercial products of the wood distillation industry, there is also produced, besides methyl alcohol, other alcohols, acetic acid and other acids, furfural and other aldehydes, acetone and other ketones, methyl acetate and other esters, methylamine and other amines, wood-tar creosote containing guaiacol and other phenols, and various hydrocarbons.

Originally wood was treated for charcoal alone by charring it in heaps or in kilns, thus allowing all the other products named above to go to waste. This process is still carried on, but before the middle of the Nineteenth century the process of distillation in retorts, by which the acetic acid in the form of pyroligneous acid, pyrolignite of iron, or acetate of lime, and the wood spirits were recovered, was well established in Europe. The manufacture of pyroligneous acid was begun in the United States by James Ward in 1830, at North Adams, Mass. The manufacture of acetate of lime and methyl alcohol was started in the United States about 1867 by James A. Emmons and A. S.

Saxon, in Crawford County, Pa., and in 1874 George C. Edwards established the Burcey Chemical Works at Binghamton, N. Y.,[1] to refine the crude wood spirit produced by the various acetate manufacturers. In 1876 Dr. H. M. Pierce obtained the first of a series of United States letters patent relating to inventions in this industry, which he was the first to apply to the recovery of the by-products from the smoke of the charcoal kilns in Michigan, where charcoal was being produced for use in blast furnaces. From that time he was most active in the promotion of the wood distillation industry, and largely contributed to the revolution which has since been effected in our foreign commerce in the products of this industry.

The wood used for the making of wood alcohol and acetate of lime is hard wood, preferably oak, maple, birch, and beech. It is cut in 50-inch lengths, so that a cord of wood in this industry measures 48 by 48 by 50 inches. It should be seasoned two and one-half years before "burning," to get the best results. The wood is burned in retorts, in ovens, or in kilns. The retorts are cylindrical, are made of three-eighths inch steel, 9 feet long by 50 inches in diameter, and are provided with a large, tightly fitting door at one end and an outlet pipe about 15 inches in diameter at the other end. The retorts are set horizontally in pairs in brickwork, and batteries of from 6 to 16 pairs are common. The cord wood is fed through the door and carefully stacked so as to completely fill the retort. The ovens consist of rectangular iron chambers set in pairs in brickwork and provided with large doors at one end and three or more delivery pipes on the side of each oven. They are usually 27 feet long, 6 feet wide, and 7 feet high inside, and rails are laid upon the floor of the oven by which steel cars loaded with cord wood may be run in. These cars each hold 2½ cords of wood, and an oven of the above dimensions will receive two such cars. Ovens, however, are in use in this country that are from 48 to 50 feet in length and capable of receiving four cars at one charge. The retorts are heated from beneath by burning wood, coal, or charcoal, supplemented by the tar, red oil, and gas, which are by-products of the industry. A very large part of the charcoal made in retorts is thus consumed. This furnishes another example of a chemical industry in which the former by-products have now become the principal products. The ovens are heated by natural gas.

When the wood is heated the moisture is driven out, but no decomposition occurs until the temperature approaches 160° C. Between this and 275° C. a thin, watery distillate, known as pyroligneous acid, is chiefly formed; from 275° to 350° C. the yield of gaseous products becomes marked; and between 350° and 450° C. liquid and solid hydrocarbons are most extensively formed. The quantity and character of the yield depend upon the character and age of the wood and the temperature and rate at which the charge is heated. In the ovens the wood is heated for twenty-four hours and then the cars containing the charcoal are drawn and immediately run into iron sheds where, when the doors are closed and luted, the charcoal is allowed to cool. The volatile portions, from retorts or ovens, are carried to condensers where the pyroligneous acid and tar are condensed and the gases are carried off to be burned under the boilers for generating steam, or under the retorts.

The yield of pyroligneous acid is about 30 per cent and of tar about 10 per cent of the weight of the dry wood. The acid averages about 10 per cent of acetic acid, 1 per cent of methyl alcohol and 0.1 per cent of acetone. As acetone is produced by the heating of acetates the yield of these two bodies will vary with the manner in which the heating is carried on. The pyroligneous acid is a dark red-brown liquid, having a strong acid reaction and a peculiar empyreumatic odor, and its density varies between 1.02 and 1.05 specific gravity. It is used to a limited extent in the manufacture of an impure acetate of iron, known as "black iron liquor," or "pyrolignite of iron," but it is usually treated to separate the methyl alcohol, acetone, and acetic acid from it. This is done by distillation, the alcohol being concentrated by dephlegmators, as is done in the manufacture of grain alcohol, to 82 per cent, when it is shipped to the refinery in iron drums holding about 110 gallons each, or in barrels holding from 45 to 46 gallons each. The acetic acid is recovered in two forms, viz, as "gray acetate of lime" or as "brown acetate of lime;" the first being produced when vapors from the distillation are passed through milk of lime, while the second is produced when the pyroligneous acid is neutralized with lime before distilling off the alcohol, and the resulting acetate of lime is thus contaminated with considerable tar.

The crude wood alcohol is sent to the refinery to be purified and rectified, which is accomplished by further distillation from lime or caustic alkalies. The acetone can not be separated by simple distillation, but it may be converted into chloracetones of high boiling points and thus removed, or the separation may be effected by crystallizing out the methyl alcohol with calcium chloride, or the acetone may be converted into chloroform and volatilized by distilling the mixture with chloride of lime. Most of the methyl alcohol of commerce contains acetone in varying quantities, even as much as 15 per cent, and such acetone containing alcohols are especially desired in several arts, as they serve for the purpose to which they are put better than pure methyl alcohol. A pure methyl alcohol is now produced in very considerable quantity which is of 100 per cent strength as it leaves the works, but it soon absorbs water on exposure so as to reduce its alcohol strength to 98 or 97 per cent.

[1] Tenth Census of the United States, Manufactures, general folio 1013.

In the Pierce process, as described by Landreth, the charring of the wood is effected in circular, flat-top, brick kilns holding 50 cords of wood each. The wood is charred by the heat produced by gas burned in a brick furnace under the kiln, into and through which the products of combustion pass. The gaseous products of the dry distillation of the wood pass from the kiln to condensers, where the tarry and liquid products are condensed and the gas sent back to the kiln. Thus none of the charcoal produced is burned to carbonize other wood, as in the common pits or ovens. The gas which elsewhere is wasted is here not only sufficient to effect the carbonizing of the wood, but furnishes fuel for the boilers required about the works.

The wood used is as thoroughly seasoned as the conditions of maintaining a year's supply in advance, cost of storage room, and interest on capital invested in stock render economical. If not thoroughly dry when placed in the kilns, the carbonization of the wood is automatically deferred, by the absorption of the heat in the evaporation of the sap and other moisture, until the seasoning process is complete. This seasoning commences at the top of the kilns and proceeds regularly downward, by a definite plane of seasoning. When this plane reaches the bottom and the seasoning is complete, which is indicated by a sudden change in the color of the escaping vapors, the process of charring begins at the top and proceeds downward precisely like the seasoning process.

The watery vapors driven off during seasoning are not preserved, but are allowed to escape through vents temporarily left open around the base of the kilns and through the top of the kiln chimneys, which, during this stage, are open at the top, but which, so soon as the watery vapor has escaped, are connected with a suction main. The time required for the several stages in the cycle of operations in producing a kiln of charcoal is as follows:

	Days.
For charging one kiln with wood	2
For completing the seasoning of the wood	1
For carbonizing the wood	7
For cooling the charcoal	6
For drawing the charcoal	2
Total length of cycle	18

As one 60-ton blast furnace requires 5,000 bushels of charcoal daily, or the output of 2 kilns, the total number of kilns in a plant to furnish a continual supply of fuel must be equal to twice the number of days in a cycle plus a margin for relays, for repairs, and unusual delays; the margin is usually chosen at one-sixth the effective number of kilns, so that the total number of kilns comprising a plant $= 2(18) + \frac{1}{6}(36) = 42$, of which at any one time—

4 kilns are being charged and closed.
2 kilns are being seasoned.
14 kilns are being carbonized.
12 kilns are being cooled.
4 kilns are being drawn.
6 kilns are idle or acting as relays.

42

These 42 kilns are arranged in 2 distinct batteries of 21 kilns each. Each battery has its own condensers and suction main carrying the products of distillation to the condensers, and its own gas main leading the noncondensable gases back to the kiln furnaces.

The condensers are composed of tall wooden tanks, 5 feet square by 20 feet high, through which the products of distillation pass, each inclosing 99 vertical copper pipes, 2 inches in diameter, through which the condensing water flows. The condensed products are trapped out at the bottom of each condenser, of which 10 comprise a battery, and conveyed to cooling tanks, where the tar is separated from the pyroligneous acid liquor by cooling. The tar is used to coat the kilns to render them impervious to air, and for this purpose one coating of tar suffices for four burnings, while the usual coating of lime whitewash has to be repeated after each burning. The circulation of the gaseous products through the system is maintained by exhaust fans, which draw the noncondensed gases through the condensers and force them through the gas main back to the kilns, when they are injected into the furnaces by a steam jet from a one-sixteenth-inch orifice playing in the center of an inch nozzle on the gas pipe. The minimum amount of air necessary to effect the perfect combustion of the gases is admitted through regulating dampers in the front of the furnace.

From the liquor coolers the pyroligneous acid liquor is conveyed to the distilling house, where the acetic acid in the liquor is converted into acetate of lime; the liquor is then sent to the fractional distillation system, which comprises 8 primary stills and condensers, 4 intermediate stills and condensers, and 2 final or shipping stills and condensers. The stills are circular tanks each holding about 2,500 gallons and are heated by steam coils of 2-inch copper pipe. The several stills of each of the 3 series are operated abreast. The distillation is not carried on continuously, but each series is charged and the distillation carried on until all of the alcohol available is evaporated, when the stills are emptied and recharged with new liquor. The degree of concentration attained in each series of stills is as follows:

The liquor entering the primary stills contains 1½ per cent of alcohol.

The distillate from the primary stills contains 15 per cent of alcohol.

The distillate from the intermediate stills contains 42 per cent of alcohol.

The distillate from the final stills contains 82 per cent of alcohol.

The yields of products differ with the different works and with the different processes employed. According to Landreth the yields by the Pierce process with brick kilns are as follows:

DRY WOOD.	Volume per cord of wood.	Mass per cord.	Per cent.
Resulting charcoal	50.6 bush	1,012 lbs	25.30
Resulting methylic alcohol	4.4 gals	30 lbs	0.75
Resulting acetic acid	4.6 gals	40 lbs	1.00
Resulting tarry compounds	16.5 gals	160 lbs	4.00
Resulting water	220.7 gals	1,838 lbs	45.95
Resulting noncondensable gases	11,000.0 cu. ft	920 lbs	23.00
Total		4,000 lbs.	100.00

Though 1 factory reports as high as 12.93 gallons of alcohol per cord of wood, yet the yields from the retort and oven processes average about 10 gallons of alcohol, 200 pounds of acetate of lime, and 50 bushels of charcoal per cord of wood in addition to the gas, tar, and chemical oil, all of which are burned. The yield of brown acetate of lime is about one-third larger than that of gray. As has been said, where retorts are used much of the charcoal is burned. Where coal is used, four-tenths of the charcoal produced is burned under the retorts. Where no coal is used six-tenths of the charcoal produced is thus consumed. In all of the works the whole of the gas, tar, and chemical or red oil is burned by the aid of steam, but it is probable that investigation will show that the tar and red oil are too valuable to be thus consumed.

The methyl alcohol is used for domestic fuel, as a solvent in varnishes, as a solvent in the manufacture of pyroxylin plastics, in the production of formaldehyde, in the making of methylated spirit, and in the manufacture of anilin colors.

The acetate of lime is used for the manufacture of acetic acid, acetone, "red liquor," and, when purified, as a mordant in dyeing.

Acetone is employed in the manufacture of chloroform, iodoform, and sulphonal, for denaturating grain alcohol, in making smokeless powder, and as a solvent in several of the arts.

A complete treatment of the wood distillation industry should include the production of turpentine, rosin, and tar by the distillation of the wood of the long-leaved pine, but this is made the subject of special report No. 126, issued January 11, 1902, entitled "Turpentine and Rosin."

The factories for the production of the crude products of this industry must be located near an abundant supply of hard wood and where there is a sufficient supply of water for cooling the condensers and charging the steam-generating boilers, this steam being employed in distilling the liquors, evaporating the acetate solutions, drying the acetate, and operating the pumps by which the liquors are raised from one level to another. In some cases, however, the acetate pans are placed over the retorts so that the heat radiated from them may be usefully employed. The total amount of wood reported as consumed in this industry for 1900 was 490,939 cords, having a value of $1,241,972, which gives an average value for it of $2.53 per cord as laid down at the works. Assuming one man to average one and one-half cords of wood per day, the cutting of the wood used would give employment to 3,273 men for one hundred days each. Comparing this total quantity of wood reported with the total quantities of crude wood alcohol, acetate of lime, and charcoal the average yields per cord of wood for all processes are found to be 10 gallons of alcohol, 176 pounds of acetate of lime, and 35 bushels of charcoal.

It is alleged in the "trade" that the importations of acetate of lime into the United States before the introduction of the by-product processes amounted to as much as 3,000,000 pounds annually. The only statistics discoverable in the records of the Treasury Department relative to this, is that in 1880 there were 38,000 pounds imported, having a value of $76. On the other hand, the following table, compiled from "The Foreign Commerce and Navigation of the United States for the Year Ending June 30, 1900," shows that the United States is exporting large quantities of both acetate of lime and wood alcohol:

EXPORTS, WOOD ALCOHOL AND ACETATE OF LIME: 1898 TO 1900, INCLUSIVE.

YEAR.	WOOD ALCOHOL.		ACETATE OF LIME.	
	Gallons.	Value.	Pounds.	Value.
Total	1,653,799	$934,411	134,274,564	$2,014,269
1898	385,938	199,230	37,496,288	537,856
1899	727,062	414,875	48,987,511	700,900
1900	540,799	320,306	47,790,765	776,413

From the same source is the following record of imports of charcoal and pyroligneous acid:

IMPORTS, CHARCOAL: 1891 to 1898, INCLUSIVE.

YEAR.	Value.	YEAR.	Value.
1891	$56,020	1895	$20,272
1892	48,029	1896	42,970
1893	51,634	1897	32,106
1894	40,249	1898	2,404

IMPORTS, FOR CONSUMPTION, ACETIC OR PYROLIGNEOUS ACID: 1891 TO 1900, INCLUSIVE.

YEAR.	Pounds.	Value.
1891	10,946	$1,036
1892	12,280	2,302
1893	18,421	2,795
1894	22,244	3,959
1895	92,889	8,938
1896		
1897		
1898	127,949	9,776
1899	202,838	14,467
1900	292,891	19,189

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Group VIII. Fertilizers.

The term "fertilizer," as used in this report, includes all manufactured products which are intended to promote the growth of plants and which can be, and customarily are, so used without needing any further factory treatment. Under this definition raw phosphate rock, even if finely ground, can hardly be included, nor can crude cottonseed, ordinary tankage, nor unground bone. All of these have fertilizing properties, but require further treatment, usually chemical, if the full effect is to be economically obtained. The term "fertilizer works" should, strictly speaking, be confined to establishments producing "finished fertilizers," such as superphosphate, with or without ammoniates; "complete fertilizers," by which is meant a mixture of superphosphate with both potash and ammoniates; and "all other fertilizers," including bone meal and similar substances. But under the principle governing the classification of industries at the census of 1900 there can be included in fertilizer works all factories of which the main product, though not a finished fertilizer, was, nevertheless, a fertilizer material—say, tankage—in a condition of advanced manufacture, such products being included in "all other fertilizers."

The total number of establishments thus classified as fertilizer works, and forming Class A, is 422. In addition there are 18 small establishments, each of which reported a value, for all products, of less than $500, and hence are not included in the regular census tabulations. As the total fertilizer product of the 18 establishments amounted to but 46 tons of complete fertilizer, valued at $1,047, and 213 tons of "all other fertilizers," valued at $3,489, it will be seen that the omission to tabulate establishments under $500 is of small consequence.

Under Class B are included 10 establishments whose main product places them in some one of the 19 groups of "chemical industries," but which made more or less fertilizers as a subordinate, though sometimes very important, part of the product. The total fertilizer product of this class amounted to superphosphate, tons 1,810, value $20,417; complete fertilizer, tons 17,707, value $350,077; and "all other fertilizers," tons 7,983, value $98,510.

Class C includes 28 works, none of which belongs to "chemical industries," yet at which were made a certain amount of fertilizers. The importance of taking this class into consideration, if a full presentation of the industry is desired, is evident, since the total product of this class was superphosphate, tons 12,000, value $100,000; ammoniated superphosphate, tons 750, value $13,500; complete fertilizer, tons 24,391, value $521,825; and "all other fertilizers," tons 27,409, value $443,147.

Class D includes such by-products of "slaughtering and meat packing," "garbage reduction," "glue," and similar industries as were reported as "fertilizers." So far as known, such materials are bones, bone tankage, ammoniates, and the like, utilized in the preparation of ammoniated and complete fertilizers. While included here for the sake of completeness, it must be remembered that the amounts and values of these products, as well as those of Class C, are elsewhere reported in the census tables of their respective industries, and their presence here is a not unnoticed duplication. Of this class, 10 "garbage-reduction" works produced such materials aggregating 17,809 tons, value $256,322, while the report for "slaughtering and meat packing" gives "fertilizers," tons 160,962, value $3,326,119, and "glue" gives tons 15,942, value $331,268, a total of 204,713 tons, and a value of $3,913,709.

Included in "all other fertilizers" is fish scrap, the residue after the oil is pressed out of the fish, amounting to 27,035 tons, of a reported value of $448,602, in addition to which certain establishments made 1,942 tons which were consumed in works in making fertilizers. The fish oil reported from the 25 establishments engaged in this industry amounted to 1,135,264 gallons, valued at $222,929. The returns of scrap and oil per thousand fish, the customary unit of measure, naturally vary considerably, according to the condition of the fish, whether fat or lean, the lean fish yielding little oil in proportion to the scrap. In one case of a large and well-managed factory having good fish, the yield per thousand fish was given as 4.17 gallons of oil and 185 pounds of scrap, while another large works, having very lean fish, reported a yield of only 1.87 gallons of oil and but 140 pounds of scrap. The general average for all reports was, 2.98 gallons of oil and 149.2 pounds of scrap per thousand fish. After the scrap leaves the press in which the oil is expressed, it must be protected from decomposition, as this not only produces a local nuisance but results in serious pecuniary loss. In one case where 500 tons of good scrap were valued at $10,000, 500 tons of decomposed scrap were valued at only $3,000. In order to prevent this decomposition the laws of several states, for example, Massachusetts and Connecticut, require that the daily output of scrap shall be sprinkled with sulphuric acid, as this prevents the lighting of flies upon it and the consequent development of maggots. When acid is so used, finely ground phosphate is often mixed with the scrap before shipment, thus taking up the excess of acid and hindering the rotting of the bags in which the scrap is shipped.

The use of fish as a fertilizer was known to the aborigines of New England before the arrival of the whites, since it is stated in the records of the Plymouth colony that Squantum, a friendly Indian, showed the colonists how to manure their corn by putting a fish into each hill. It would seem, therefore, that the colonists were ignorant of the fertilizing value of fish, which is rather surprising, since the value of barnyard manure has been known since a very early period in the history of agriculture, and marl, a phosphatic lime earth, was used in England, at least, prior to this period. It is possible, however, that the value of marl was considered to lie in its improving the physical condition of the soil rather than as furnishing any plant food, as the advantage of mixing clay with sandy soils or sand with clayey soils was known to the Romans.

As soon as the true action of fertilizers became known, it was seen that the presence of grease or oil in a fertilizer was harmful, as hindering the conversion of the fertilizing ingredients into the soluble forms into which they must pass before they can be assimilated by the plant. Hence by extracting the oil from fish a valuable substance was obtained and the residue of scrap became more quickly efficient. The same thing occurs in the cottonseed industry, the oil and "linters," valuable for other purposes, containing very little fertilizer material, while the cake and hulls are in much better condition for utilization as feed or fertilizer than in their original condition as part of the seed.

Little is known about the beginnings of the fish-oil industry, but it is stated that the Herreshoffs, of Rhode Island, were making fish oil and scrap as early as 1863. The fish generally used for this purpose is the menhaden or mossbunker, which appears on the Atlantic coasts in the summer in large schools and is a very oily fish, in no demand for edible purposes. The number reported as caught during the census year is 458,963,200, and yielded the quantities of oil and scrap noted above.

The most available statistics of this industry are those given by Eugene G. Blackford in One Hundred Years of American Industry, 1895, page 394. These are here presented with the statistics derived from reports classified at the census of 1900 as chemical industries, group "fertilizers," and may therefore not include all of the reports received from this industry. It is believed, however, that the showing is substantially complete, although the figures show an enormous reduction in capital invested and number of men employed, from the figures given for 1894. It is true that in some cases where complete fertilizers are also made, the men reported as employed are those engaged at the factory only, those employed in fishing being represented only by the cost of the fish as covering wages, supplies, and maintenance of vessels. Still the total capital, $497,760, bears a fair relation to total value of product, which is $703,866, made up of oil, $222,929; scrap sold, $448,602; and scrap used in works, 1,942 tons, of a calculated value of $32,237; and the general statistical position of the industry bears out the statements of some of those engaged in the industry to the effect that in 1900 there was little profit in it.

MENHADEN INDUSTRY, SEASONS OF 1874, 1880, 1890, 1894, AND 1900.

YEAR.	Factories.	Sail vessels.	Steamers.	Men employed.	Capital invested.	Number of fish caught.	Gallons of oil made.	Tons of scrap.
1874	64	283	25	2,438	$2,500,000	492,878,000	3,372,847	50,976
1880	79	366	82	3,261	2,550,000	776,000,000	2,035,000	19,195
1890	28	27	52	4,368	1,750,000	553,686,156	2,939,217	21,173
1894	44	30	57	2,560	1,737,000	540,361,900	1,999,505	27,782
1900	25			500	497,760	458,963,200	1,135,264	28,977

"Slaughtering and meat packing" furnishes a large quantity of fertilizer materials, because, in the large packing establishments of the present day nothing utilizable is allowed to go to waste. The blood is carefully collected and dried, making a high-priced ammoniate, and the gelatin, glue, grease, etc., of the horns, hoofs, and other bones and other offal extracted. The residues from this part of the work are sold as bones, tankage (which is meat offal dried and ground), and as "bone tankage" (which is tankage containing bone fragments). Dried blood, tankage, and all of the like materials, which are called "ammoniates," are valuable by-products of the packing industry, and are the most expensive constituents of a complete fertilizer.

The final aggregate of the reported amounts and values of the fertilizer products for 1900 from all sources so far as found, superphosphate and other products made but consumed in the works in the making of mixed fertilizers not being included, is as follows:

FERTILIZER PRODUCTS: KINDS, QUANTITY, AND VALUE, 1900.

	Number of establishments.	SUPERPHOSPHATE.		AMMONIATED SUPERPHOSPHATE.		COMPLETE FERTILIZER.		ALL OTHER FERTILIZERS.	
		Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
Class A	422	923,198	$8,471,943	142,898	$2,349,388	1,436,682	$25,446,046	291,917	$4,178,284
Under $500	18					46	1,047	213	3,489
Class B	10	1,810	20,417			17,707	350,077	7,983	98,510
Class C	28	12,000	100,000	750	13,500	24,391	521,825	27,409	443,147
Total	478	937,008	8,592,360	143,648	2,362,888	1,478,826	26,318,995	327,522	4,723,430
Class D								204,713	3,913,709
Final total	478	937,008	8,592,360	143,648	2,462,888	1,478,826	26,318,995	532,235	8,637,139

The total product, by classes, is as follows:

	Tons.	Value.
Class A	2,794,695	$40,445,661
Under $500	259	4,536
Class B	27,500	469,004
Class C	64,550	1,078,472
Total	2,887,004	42,097,673
Class D	204,713	3,913,709
Final total	3,091,717	46,011,382

The total number of establishments in Classes A, B, and C, the only ones which can properly be denominated fertilizer works, is 476. This shows a considerable increase—392—over the figures for the census of 1890 but falls short of the estimates for 1898 made by the author of "The Fertilizer Industry."[1] The estimated number given by him, is "about 700." It is evident that this figure was too high, because while the business, as a whole, has much increased, the tendency, as in all other branches of manufacture, is to concentrate the industry into the hands of larger companies or combinations, who by reason of greater facilites in, and control of, the market can, if necessary, undersell competitors and work on a closer margin of profit. The author of the interesting bulletin just noted complains of the indifference, even "positive unwillingness of manufacturers to furnish the information desired." The experience of the Census Office with this group has been much more satisfactory. With but one exception, every establishment that was reached, either by the field force or by correspondence, endeavored to give a correct statement of the operations. From the large combinations and firms, reports were often received which were most valuable, and offers of any further information which might be needed. In other cases the reports, owing to the deficiencies of a hastily assembled field force were sometimes unsatisfactory, but correspondence brought the information, if existing. In the case of the positive refusal above mentioned, a little local inquiry enabled us to construct a satisfactory report, because the nature, quantity, and value of the product of the establishment were known, and from correct reports from establishments in the vicinity the quantities of ingredients and their cost could be fairly estimated. Such editing work must be done with great caution if the results are to have real value, and it is satisfactory to be able to state that, owing to the cheerful cooperation of manufacturers, such work has been reduced to a minimum.

"Fertilizers" appears as a special item for the first time in the census report for 1860. The condition of the industry then and its growth since are shown by the following comparison, the percentage of gain for each decade over the preceding one being also given:

[1] Miscellaneous Bulletin No. 13, United States Department of Agriculture, 1898, page 5.

FERTILIZER MANUFACTURE, BY DECADES: 1860 TO 1900.

YEAR.	Number of establishments.	Per cent of increase.	Product (tons).	Per cent of increase.	Value.	Per cent of increase.
1860	47	....	....	....	$891,344	....
1870	126	168	....	....	5,815,118	552
1880	278	120	727,453	....	19,921,400	242
1890	392	41	1,898,806	161	35,519,841	78
1900	478	21	2,887,004	52	41,997,673	18

These figures are fairly in accordance with what is otherwise known of the history of the development of this industry. Of the 422 establishments in Class A only 7 stated that they manufactured fertilizers prior to 1860, 3 of these being in Baltimore, Md., where, so far as is known, the manufacture of fertilizers began. In 1840 Liebig published his classical researches on plant nutrition, in which he asserted that "the food of all vegetation is composed of inorganic or mineral substances." This was contrary to the then prevailing view, which was that the humus of the soil was the support of plant life, the mineral substances, the ash of the plant, being considered of subordinate importance. The researches of Wiegman and Polstorf showed, however, that a luxuriant plant growth could be obtained by planting the seeds in soil which had, by burning, been deprived of the last trace of humus or other organic matter, and then watering them with dilute solutions of the needed inorganic salts. Other investigators continued this line of research, and a rational agriculture was then developed. It was found that a plant derives its carbon from the air directly by means of its leaves, and also, but in a minor degree, through its roots by the absorption of water containing carbonic acid. On the other hand, while the plant can to a small extent supply its demand for nitrogen from the ammonia of the atmosphere by means of its leaves, this supply is quite inadequate for healthy growth. The deficiency, as also the demand for mineral salts, must be supplied through the roots. As these can only take up such substances when dissolved in water, it follows that not only the nitrogen which is taken up by the plant must be in soluble forms which are now considered to be nitrates, which are always soluble, but also the mineral constituents such as phosphoric acid, silica, lime, potash, iron, etc., must be in forms soluble in water to be available for the nourishment of the plant.

The importance of phosphoric acid being early recognized, the manufacture of superphosphate began. According to Kerl the first scientifically planned fertilizer works in Germany were erected in 1850. A letter from Dr. R. W. L. Rasin, of Baltimore, states that—

The manufacture of chemical fertilizers in the United States began about 1850. In that year Dr. P. S. Chappell, and Mr. William Davison, of Baltimore, made some fertilizer in an experimental way. About the same time Professor Mapes was experimenting. Later De Burg utilized the spent bone black derived from the sugar refineries and made quite a quantity of "dissolved bone black" (superphosphate). In 1853 or 1854 Mr. P. S. Chappell commenced the manufacture of fertilizers, as did B. M. Rhodes, both of Baltimore. In 1855 Mr. John Kettlewell, recognizing the fact that Peruvian guano (then becoming quite popular), and containing at that time 18 to 21 per cent of ammonia, was too stimulating and deficient in plant food (phosphates), conceived the idea of manipulating the Mexican guano, containing no ammonia but 50 to 60 per cent of (bone) phosphate of lime, and called his preparation "Kettlewell's manipulated guano."

While in 1856 the sales of Peruvian guano had increased to 50,000 tons and of Mexican guano to some 10,000 tons, there was not at that date 20,000 tons of artificial fertilizers manufactured in the entire country. Baltimore was not only the pioneer but the principal market for fertilizers until some time after the Civil War. The 50,000 tons of Peruvian guano referred to was bought and sold in this market, and there was little demand for that or the Mexican guano in any other market unless the inspection brand of the guano inspector of Baltimore was upon the package. The Peruvian Government agent, who received and disposed of all importations, was located here, and all other markets were supplied from Baltimore. At that time no fertilizers were sold west of Pennsylvania.

Owing to the exhaustion of the sources of supply the importation of guano has almost ceased. In 1900 but 1,150 tons, value $15,543, were imported from Peru, the total amount of guano imported being 4,756 tons, value $56,956. Much of this is, however, practically phosphate rock, requiring chemical treatment before using. The original guano of Peru was produced from the excrements and remains of sea birds deposited upon islands in a very arid region. Its agricultural value was well known to the ancient Peruvians, whose wise laws forbade the killing or molestation of the birds. Owing to the scarcity of rain the ammoniacal salts developed in the deposits remained in the guano, while in less arid regions the soluble salts were leached out, and where the underlying rock was a limestone this became altered to a certain depth, becoming a more or less pure tricalcic phosphate, usually called bone phosphate of lime. The guanos of Sombrero, of Navassa, and of many other places are examples, and all require chemical treatment.

The importation of phosphate rock for 1900 amounted to 110,065 tons, value $504,092, coming mainly from Germany and Spain. The term "phosphorite" is used to cover all of the varieties of phosphate rock which range from the crystallized apatite of Canada to the comparatively amorphous rock of South Carolina, but was originally applied to the fibrous phosphate from Estremadura, Spain, which occurs in large quantities and is extensively exported. The German phosphate from the Lahn region and other places is usually concretionary in appearance. This concretionary structure is very characteristic of phosphorites, as shown in many places in Florida and in the so-called coprolites of England and other localities.

By treating phosphate rock or bones with sulphuric acid, superphosphate or acid phosphate is formed. The works making this, mix more or less of it with ammoniates, or potash or both, producing the various grades of ammoniated superphosphate, superphosphates with potash, or complete fertilizer. The remainder is sold as such, being bought by establishments that make various mixtures to suit local demands, while a very large quantity goes directly into consumption, being bought by farmers, who make their own composts.

Of the 422 fertilizer works belonging to Class A, 76 made sulphuric acid. The total quantity of acid thus made amounted to 642,938 tons of chamber acid of 50° Baumé, of which 571,831 tons were consumed by the works producing it in making superphosphates, while the remainder, 71,107 tons, was sold elsewhere mainly as chamber acid, only 5,360 tons being concentrated to higher strengths before sale. Thirty acid-making works did not make enough for their own demand and supplied the deficiency from other sources. In Classes B and C, 3 works made 12,028 tons of 50° acid and consumed it in making superphosphate, making a total of 583,859 tons thus made and consumed by 79 works.

Of the 478 works producing fertilizers, 76 made superphosphate, but purchased the needed acid, while 208 bought the superphosphate; in each case the final product sold was mixed fertilizers. The remaining works, 115 in number, as well as all of Class D, produced the fertilizer materials above mentioned and placed under "all other fertilizers." In so far as any of these products are purchased by other fertilizer works and used in making mixed fertilizers, the quantities and values of such purchases reappear in the mixed fertilizers, and to that extent there is a duplication. The extent of this duplication can only be estimated, since a considerable quantity of the products included in "all other fertilizers" consists of bone meal and other substances, which are used for composting or put on the land without further treatment. On the other hand, it is certain that "all other fertilizers"—tons 532,235, value $8,637,139—falls far short, both in quantity and value, of the real production of such materials. For example, the establishments under Class A report using 37,868 tons of cottonseed meal, and those in Class C, 3,608 tons, a total of 41,476 tons. These figures evidently represent only a fraction of the amounts actually used for fertilizer purposes, since the total product of cotton seed meal for 1900 was 884,391 tons, value $16,030,576, a very large proportion of which, amounting to 638,638 tons, was used in composting, as shown by the large quantity of superphosphate which goes into consumption as such.

The figures for superphosphate, ammoniated superphosphate, and complete fertilizer are quite close to the truth, as an examination of the complete returns will show. The total quantity of superphosphates reported as made and sold as such by all of the classes A, B, and C is 937,008 tons. The quantity of superphosphate purchased for mixing purposes is, for Class A, 286,918 tons; Class B, 240 tons; Class C, 9,402 tons; a total of 296,560 tons. Deducting this from the total, 937,008 tons, leaves the residue of 640,448 tons which was sold as such to the ultimate consumer. To this amount must be added the superphosphate in the mixed fertilizers to obtain the total quantity produced for the census year. The returns show great variations in the proportions of superphosphate in the products of the various establishments, but comparisons show that ammoniated superphosphate will average 70 per cent of superphosphate and complete fertilizer 50 per cent, giving the following result:

Superphosphate, sold as such, total tons	937,008
Superphosphate, purchased, total tons	296,560
Difference, equals finally consumed as such, tons	640,448
In ammoniated superphosphate, 70 per cent of 143,648 tons	100,553
In complete fertilizer, 50 per cent of 1,478,826 tons	739,413
Total superphosphate produced, tons	1,480,414

The total product of superphosphate may also be ascertained from the amount of sulphuric acid reported as being used in its manufacture. Comparison of the returns at the census of 1900 fully confirms the current statement that in making superphosphate from a standard phosphate such as South Carolina rock the practice is to mix equal weights of phosphate and chamber acid. Reaction at once sets in, the mixture becoming quite hot and giving off vapors consisting of steam and volatile ingredients of the phosphate, such as carbon dioxide, fluorine, and chlorine. This volatilization loss amounts, for South Carolina rock, to 10 per cent of the total weight of the ingredients. Other phosphates, such as high-grade Florida rock, bones, etc., will of course require other proportions of acid and the volatilization loss will also differ, but the general average of all returns shows that every ton, 2,000 pounds, of phosphatic material required 2,000 pounds of chamber acid, lost 10 per cent, 400 pounds, by volatilization, and yielded 3,600 pounds of superphosphate. Taking all of the sulphuric acid reported as consumed in works and that purchased the results are as follows:

	SULPHURIC ACID.	
	Consumed (tons).	Purchased (tons).
Class A	571,831	231,528
Class B	5,028	268
Class C	7,000	200
Total	583,859	231,996
Add total, consumed		583,859
Total acid used		815,855
Add phosphate rock, equal amount		815,855
		1,631,710
Deduct 10 per cent loss		163,171
Total superphosphate produced, tons		1,468,539

Comparing the final quantity with that reported above, namely, 1,480,414 tons, the difference is found to be only 11,875 tons, or 0.80 per cent. This agreement is surprisingly close, since, under the conditions, a much larger difference would have been sufficient to demonstrate the general correctness of the returns.

The quantity of phosphate rock estimated above as used is 815,855 tons. Class A reported the purchase of 806,445 tons; Class B, 4,810 tons, and Class C, 7,700 tons; a total of 818,955 tons, or a difference of only 3,100 tons. This close agreement is, however, only fortuitous. Many of the larger works undoubtedly had more or less phosphate rock in stock at the beginning and end of the census year, and it is not always clear that the quantity reported is the amount actually used or only that which was purchased during the year. A part of the superphosphate estimated above as contained in the mixed fertilizers was made from bones, spent boneblack, and other materials, but how much can not be ascertained, because, although Class A reported the consumption of 96,679 tons of bones, part of this was used to make boneblack, part was disposed of as bone meal, and part mixed with the compounded fertilizers without any special addition of acid. Again, part of the tankage bought by the works is "bone tankage," containing considerable quantities of crushed bone, so that it is impossible to determine how much of the acid used actually went to make bone superphosphate.

Examination of the reports shows that only a comparatively small quantity of "concentrated phosphate" is made, although it would seem that there ought to be a considerable demand for this product which is so largely made in England, France, and Germany. It is made by treating phosphate rock with an amount of sulphuric acid sufficient to entirely decompose it, converting all of the lime into sulphate, allowing this to settle, and drawing off the solution of phosphoric acid. "The solution is then evaporated in lead pans to a density of 45° Baumé, at which strength the solution contains nearly 45 per cent P_2O_5. During this concentration the iron and aluminum phosphates separate and are removed. The strong solution of phosphoric acid is then treated with finely ground phosphate rock to form mono-calcium phosphate, which is dried and disintegrated."[1]

The phosphoric acid solution may be made from any form of phosphate, and low-grade material too poor for the manufacture of superphosphate can be used for this purpose. The phosphate rock added in the second stage of the process should, however, be high grade, if the best results are to be attained. For this reason, the Florida rock which contains up to 80 per cent or more of phosphate is mainly shipped abroad to supply the foreign demand for this purpose, while our own manufacturers, making only ordinary superphosphate, mainly use South Carolina rock containing about 60 per cent phosphate. The manufacture of superphosphate from South Carolina rock is a much simpler process and

[1] Thorp, Outline of Industrial Chemistry, page 144; 1898.

the product is a satisfactory one, although its contents in soluble phosphoric acid is low, ranging from 20 to 24 per cent as compared with concentrated phosphate or "double super," which may contain up to 47 per cent.

The further development of this industry in this country will depend upon transportation conditions as well as upon the advance of agricultural knowledge, but it would seem that there is a field for this work in the phosphate regions where much poor rock occurs for which there is no present demand, but which might be utilized in the local manufacture of "double super."

The use of tetrabasic phosphate, or slag phosphate, appears to have almost completely ceased in the United States, while its use is continually extending in Europe. The reasons assigned for this situation need not be given here, but doubtless in time this valuable material will assume the importance it deserves.

The following table shows the total fertilizer product of the United States, arranged geographically:

	STATES.	Number of establishments.	TOTAL. Tons.	TOTAL. Value.	SUPERPHOSPHATE. Tons.	SUPERPHOSPHATE. Value.	SUPERPHOSPHATE. Per cent of product.	SUPERPHOSPHATE. Per cent of value.	SUPERPHOSPHATE. Value per ton.
1	United States	478	2,887,004	$42,097,673	937,008	$8,592,360	32.5	20.4	$9.17
2	North Atlantic division	155	685,893	11,978,666	139,232	1,316,208	20.3	11.0	9.45
3	Maine	3	1,828	27,902					
4	Massachusetts	10	83,733	2,108,575	1,282	12,820	1.5	0.6	10.00
6	Connecticut	9	11,077	313,610					
6	New York	37	164,266	2,610,435	9,810	105,645	6.0	4.0	10.77
7	New Jersey	30	247,144	3,820,189	105,165	887,470	42.6	23.2	8.44
8	Pennsylvania	66	177,845	3,097,955	22,975	310,273	12.9	10.0	13.59
9	South Atlantic division	198	1,531,688	19,462,816	622,614	5,302,997	40.7	27.3	8.52
10	Delaware	11	49,942	634,213	2,385	28,250	4.8	4.5	11.84
11	Maryland	42	386,133	6,213,925	124,696	1,178,367	32.3	22.6	9.45
12	District of Columbia	7	3,859	76,480					
13	Virginia	42	258,474	3,325,542	120,633	1,024,893	46.7	30.8	8.49
14	North Carolina	20	139,582	1,727,270	60,820	497,397	43.6	28.8	8.17
15	South Carolina	24	388,572	4,657,275	173,183	1,404,569	44.6	30.2	8.12
16	Georgia	45	278,982	3,331,469	131,503	1,075,681	47.1	32.3	8.17
17	Florida	7	26,144	496,642	9,394	93,940	35.9	18.9	10.00
18	North Central division	63	258,726	4,349,157	62,945	814,300	24.3	18.7	12.93
19	Ohio	28	103,814	1,562,638	24,728	285,698	23.8	18.3	11.55
20	Illinois	12	104,120	1,842,300	26,108	313,850	25.1	17.0	12.02
21	Indiana	16	11,668	238,161	365	10,006	3.1	4.2	27.41
22	Missouri	4	8,753	156,115	2,766	44,248	31.6	28.3	16.00
23	Kansas	3	30,371	549,943	8,978	160,498	29.6	29.2	17.11
24	South Central division	39	352,778	5,053,564	110,649	1,140,376	31.4	22.5	10.30
25	Kentucky	4	17,315	295,520					
26	Tennessee	5	93,054	1,464,788	35,959	456,568	38.6	31.2	12.70
27	Alabama	21	139,282	1,944,283	38,246	369,587	27.5	19.0	9.70
28	Mississippi	3	37,704	492,772	7,200	50,400	19.1	10.2	7.00
29	Louisiana	6	65,423	856,201	29,244	263,821	44.7	30.8	9.00
30	Western division	9	22,131	636,687					
31	California	9	22,131	636,687					
32	All other states[1]	14	35,788	616,783	1,568	18,479	4.4	3.0	11.80

[1] Includes establishments distributed as follows: Iowa, 1; Michigan, 1; Minnesota, 1; Nebraska, 1; Oregon, 1; Rhode Island, 1; Texas, 2; Washington, 1; West Virginia, 2.

AMMONIATED SUPERPHOSPHATE.					COMPLETE FERTILIZERS.					ALL OTHER FERTILIZERS.					
Tons.	Value.	Per cent of product.	Per cent of value.	Value per ton.	Tons.	Value.	Per cent of product.	Per cent of value.	Value per ton.	Tons.	Value.	Per cent of product.	Per cent of value.	Value per ton.	
143,648	$2,462,888	5.0	6.9	$17.14	1,478,826	$26,318,996	51.2	62.5	$17.79	327,522	$4,723,430	11.3	11.2	$14.42	1
21,429	574,251	3.1	4.8	26.79	431,521	8,899,684	62.9	74.3	20.62	93,711	1,188,623	13.7	9.9	12.63	2
....	....	....	....	....	828	21,602	45.3	77.4	26.09	1,000	6,300	54.7	22.6	6.30	3
....	....	....	....	....	78,171	1,988,605	93.4	94.3	25.44	4,280	107,150	5.1	5.1	25.03	4
1,000	23,000	9.0	7.3	23.00	7,325	205,931	66.1	65.7	28.11	2,752	84,679	24.9	27.0	30.84	5
10,300	338,400	6.3	13.0	32.85	87,862	1,623,638	53.5	62.2	18.48	56,294	542,752	34.3	20.8	9.64	6
7,283	159,580	3.0	4.2	21.91	126,839	2,629,511	51.0	68.8	20.90	8,857	143,628	3.6	3.8	16.22	7
2,846	53,271	1.6	1.7	18.71	131,496	2,430,297	73.9	78.5	18.48	20,528	304,114	11.5	9.8	14.81	8
71,661	1,056,542	4.7	5.4	14.74	701,361	11,307,083	45.8	58.1	16.26	136,052	1,796,194	8.9	9.2	13.20	9
....	....	....	....	....	17,180	283,873	34.4	60.8	16.52	30,377	322,090	60.8	44.8	10.61	10
48,608	690,671	12.6	13.2	14.21	184,095	2,985,015	47.7	57.3	16.21	28,734	359,872	7.4	6.9	12.52	11
....	....	....	....	....	3,410	69,800	88.4	91.3	20.47	449	6,680	11.6	8.7	14.87	12
4,300	72,100	1.7	2.2	16.72	106,828	1,820,771	41.3	54.8	17.41	26,713	407,778	10.3	12.3	15.26	13
3,400	51,000	2.4	3.0	15.00	61,017	981,669	43.7	56.8	16.08	14,345	197,304	10.3	11.4	13.75	14
....	....	....	....	....	207,875	3,147,202	53.5	67.6	15.14	7,614	105,504	2.0	2.3	14.04	15
15,353	242,771	5.5	7.3	15.81	105,521	1,641,318	37.8	49.3	15.55	26,605	371,799	9.5	11.2	13.98	16
....	....	....	....	....	15,435	377,535	69.0	76.0	24.46	1,315	25,167	5.0	5.1	19.13	17
34,840	565,281	13.5	13.0	16.22	105,358	1,891,260	40.7	43.6	17.95	55,583	1,078,316	21.5	24.8	19.40	18
23,805	380,936	23.0	24.4	16.00	43,351	700,606	41.8	44.8	16.21	11,930	195,398	11.5	12.5	16.39	19
4,150	58,100	4.0	3.2	14.00	43,483	835,335	41.8	45.3	19.21	30,379	635,015	29.2	34.5	20.90	20
27	500	0.2	0.2	14.81	5,750	116,280	49.3	48.8	20.22	5,526	111,375	47.4	46.8	20.16	21
....	....	....	....	....	2,774	39,039	31.7	25.0	14.07	3,213	72,828	36.7	46.7	22.67	22
6,858	125,745	22.6	22.9	18.33	10,000	200,000	33.0	36.4	20.00	4,535	63,700	14.9	11.6	14.05	23
15,037	256,599	4.3	5.1	17.06	199,609	3,242,648	56.6	64.2	16.75	27,483	413,941	7.8	8.2	15.06	24
....	....	....	....	....	17,315	295,520	100.0	100.0	17.07	....	....	....	....	....	25
....	....	....	....	....	36,695	704,220	39.4	48.1	19.22	20,400	304,000	21.9	20.8	14.90	26
2,000	35,000	1.4	1.8	17.50	92,253	1,433,355	66.2	73.7	15.42	6,783	106,341	4.9	5.5	15.70	27
....	....	....	....	....	30,504	442,372	80.9	89.8	14.50	....	....	....	....	....	28
13,037	221,599	20.0	25.9	17.00	22,842	367,181	34.9	42.9	16.07	300	3,600	0.5	0.4	12.00	29
....	....	....	....	....	19,570	591,187	84.4	92.9	32.08	2,561	45,500	11.6	7.2	17.76	30
....	....	....	....	....	19,570	591,187	84.4	92.9	32.08	2,561	45,500	11.6	7.2	17.76	31
681	10,215	1.9	1.7	15.02	21,407	387,233	59.8	62.8	18.08	12,132	200,856	33.9	32.6	16.55	32

The establishments of the above table have been grouped according to the customary census divisions. Of the total product of the United States, 2,887,004 tons, valued at $42,097,673, superphosphate, sold as such, amounted to 32.5 per cent of quantity, and 20.4 per cent of value, the average value per ton being $9.17; ammoniated superphosphate, to 5 per cent quantity, 5.9 per cent value, and $17.14 per ton; complete fertilizer, 51.2 per cent quantity, 62.5 per cent value, and $17.79 per ton; and all other fertilizers, 11.3 per cent quantity, 11.2 per cent value, and $14.42 per ton. It must be remembered that while the quantities given in this table and elsewhere in this report are substantially correct, the values given in the reports are in most cases far below the market prices, since freight and other expenses must be added so that the final price to the consumer is very much higher. Moreover, as already stated, of the 937,008 tons of superphosphate, sold as such, 296,560 tons, or 31.7 per cent, were bought by other works and used for making mixed fertilizers, leaving 640,448 tons, or 68.4 per cent, which went directly into final consumption. At the average value of $9.17 per ton, the 296,560 tons would be worth $2,719,755, and, from one point of view, might be deducted, leaving superphosphate 640,448 tons, valued at $5,872,605, and the total product of the country 2,590,444 tons, valued at $39,377,918. Such a presentation, while possibly nearer the truth as regards ultimate consumption, would, however, be incorrect in a census report of manufactures which deals with capital, labor, materials, and products. The production of the 296,560 tons of superphosphate required capital, labor, and materials, and the figures of these demands are included in the general tables for this industry. The establishments purchasing this material saved the capital and labor required to produce it, so that if the deduction were made from the product, it would be necessary to make a corresponding deduction on the other side, which is plainly impossible.

On examining this table it will be noted that the South Atlantic division leads in quantity and value of product, the North Atlantic division being second. The average fertility of the Atlantic coast states is not high, and rational farming requires the continued application of fertilizer, much of it of high grade. The general status of agriculture in the various states in these two divisions is well shown by the figures. When the size of the average farms is small and most of these devoted to the growth of vegetables, fruit, and such products, as is the case in New England, the fertilizers demanded are high priced, as the requirements of the soil must be carefully studied and supplied if profits are sought. Proceeding southwardly, agriculture is on a larger individual scale and of a simpler character, until, in the cotton states, we find practically only a single market product, requiring a simpler fertilizer, low in price, and to be applied with judgment. Any excess of fertilizer acts injuriously upon the crop by stimulating a growth which can not resist the inevitable drought of the region. Moreover, a too liberally stimulated cotton plant runs to stems and foliage, with but little fruit, as may be seen in plants grown in gardens. For convenience in picking, the cotton plant should not be more than 3 feet high, nor more than an average arm's length to the center. and the bolls should open nearly simultaneously.

When a plant is grown in the rich soil of a garden, as is frequently done, for its beauty, it may reach a height of seven, eight, or more feet, with corresponding diameter, but, while quite beautiful, the yield of cotton is comparatively small, and costly to gather. The possibilities in cotton culture become evident when it is considered that for upland cotton the average yield of lint cotton is from 150 to 250 pounds per acre, while careful cultivation under favorable weather conditions has been known to bring up this yield to 1,000 pounds. Indeed, although a yield of 1,500 pounds has never been attained, it is the goal which many intelligent planters consider can be reached by careful selection of seed, and proper methods of planting, fertilizing, and tending. While it is not feasible, here, to make an extended comparison between the quantities and values of the fertilizers used in the different states in relation to the character of the agriculture and products, such a study will disclose that, while each state can show poor farming, yet in the main, what is done is best suited to local conditions so far as understood. The methods which may enrich a farmer in Massachusetts would impoverish him in South Carolina, while the methods which insure a good cotton crop are quite inapplicable to truck growing.

In comparing the various states it will be noted that South Carolina leads in quantity of product, 388,572 tons, while Maryland leads in value, $5,213,925. In the production of superphosphate, sold as such, South Carolina leads with 173,183 tons, valued at $1,404,569, Georgia being second with 131,503 tons, and Maryland third with 124,696 tons. The Maryland product is, however, valued at $1,178,367, thus exceeding the Georgia valuation of $1,075,581. In the proportion of such superphosphate to the total production of the state, Georgia is first as it disposes of 47.1 per cent of its total product in this form, and is followed by Virginia, Louisiana, South Carolina, North Carolina, New Jersey, and Maryland, in the order given. This large sale of superphosphate in these states is due to the numerous manipulators who mix special brands for local consumption, and also to the demands of farmers for home composting. This latter kind of work is naturally most frequent in the cotton states where the cottonseed and cottonseed cake furnish a large local supply of ammoniates, while the extensive truck farming of New Jersey and Maryland causes a similar demand.

The value of the superphosphate per ton ranged from

$7 in Mississippi to $27.41 in Indiana. The Mississippi valuation is very low, the average for the United States, $9.17, being about the price for superphosphate made from rock. The high value of this product in Indiana and other states of the North Central division is due to its having been made from raw bone and being practically an ammoniated superphosphate. Indeed, this value is higher than that given by any state for its product of "ammoniated super," with the exception of New York, which rates this product at $32.85, the average for the United States being only $17.14. In the production of "ammoniated super," Maryland leads all of the states, with a production of 48,608 tons, valued at $690,671, which is, however, only $14.21 per ton.

In the production of complete fertilizer South Carolina leads both in quantity and value, producing 207,875 tons, valued at $3,147,202, but the value per ton is low, $15.14. Leaving out California, the high valuation of whose fertilizer, $32.08, is due to the high cost of materials, it is found that the North Atlantic division, especially the New England states, makes the most expensive complete fertilizers. Connecticut leads with $28.11 average value per ton, followed by Maine with $26.09, and Massachusetts with $25.44. The Maryland product, next in quantity and value to South Carolina, being 184,095 tons, valued at $2,985,015, is quoted at only $16.21 per ton.

"All other fertilizers" amounts, for the United States, to 327,522 tons, valued at $4,723,430, being 11.3 per cent of the total product, 11.2 per cent of the total value, and averaging $14.42 per ton. As might be expected, New York leads in quantity, with a production of 56,294 tons, of an average value of $9.64 per ton. This low value shows the nature of the product, which is mainly garbage tankage, made by the garbage-reduction works near the large cities. Illinois, next in tonnage, 30,379 tons, is first in value, $635,015, or $20.90 per ton, while Missouri gives a value of $22.67 per ton; the reason in both cases being that the product is largely made from slaughterhouse offal, which yields high-grade products. The "fertilizers" of Class D, 204,713 tons, valued at $3,913,709, show an average value of $19.12 per ton, and belong to this category.

So far as it is possible to show the capital employed, also the labor and other elements of cost in the production of fertilizers, the statistics are given in the special tabulation of Class A for this industry. It is, however, not possible to do this for the other classes, since fertilizers form only a subordinate part of the product, and the capital employed and the costs can not be separated from the general operations of the works.

The importations of fertilizer materials for the census years 1890 and 1900, as given by the United States Treasury Department in "The Foreign Commerce and Navigation of the United States," 1890, pages 1150 to 1151; 1900, page 102, is as follows:

IMPORTS FOR IMMEDIATE CONSUMPTION FOR THE YEARS ENDING JUNE 30, 1890 AND 1900.

YEAR.	PHOSPHATES, CRUDE OR NATIVE.		KIESERITE, KYANITE OR CYANITE, AND KAINITE.		GUANO.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	31,179	$309,764	62,871	$422,225	8,432	$111,811
1900	14,075	86,763	133,244	762,493	4,765	58,474

YEAR.	BONE DUST OR ANIMAL CARBON AND BONE ASH, FIT ONLY FOR FERTILIZING PURPOSES.		APATITE.		ALL OTHER SUBSTANCES NOT ELSEWHERE SPECIFIED.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	3,219	$59,059	126	$1,297	21,277	$333,109
1900	1,968	30,189	333	4,019	99,169	745,724

The literature of the fertilizer industry is very voluminous, and it is difficult to make a selection. The books giving the most useful information are probably The Phosphates of America, by Francis Wyatt, Scientific Publishing Company; Principles and Practice of Agricultural Analysis, Vol. II, Fertilizers, H. W. Wiley, Chemical Publishing Company, 1895; and the articles on Fertilizers in Muspratt—Kerl, Technical Chemistry, Wagner's Technology, and The Mineral Industry, the yearbook published by the Engineering and Mining Journal.

Group IX.—Bleaching Materials.

Although bleaching materials of various kinds have been long in use and bleaching by chlorine or hypochlorites has been in vogue since the latter part of the eighteenth century, no separate returns have been secured for this industry at any previous census. Chlorine production has practically been, until recently, incidental to the manufacture of soda by the Le Blanc process, and as this process has not secured a foothold in the United States, the production of chlorine bleaches has heretofore undoubtedly been insignificant in quantity and value. As pointed out in the treatment of Group X, with the introduction of electricity as an agent in effecting chemical transformations, common salt and other chlorides are being electrolyzed on a commercial scale with the result that the production of chlorine and hypochlorites is assuming importance. The chlorine thus produced is converted into bleaching powder by means of lime, but other hypochlorites, and notably sodium hypochlorite, are made from imported bleaching powder. In addition there are produced and used in bleaching, disinfection, or as a preservative, hydrogen dioxide, sodium dioxide, sulphurous acid, sodium, calcium, and potassium bisulphites, and many special compositions.

In considering this industry in its entirety there must be discussed, not only those bodies specifically reported as bleaching materials produced by the older processes, but also such bleaching agents as have been produced by the aid of electricity, or sent out for use in the compound or liquefied state, and also those which are the subordinate products of establishments whose principal products classify them with other industries. Combining these there were 26 establishments in 7 states, producing 26,794,338 pounds of material having a value of $592,658, and employing a capital of $672,969 and 216 wage-earners. These establishments were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF FACTORIES PRODUCING BLEACHING MATERIAL: 1900.

STATES.	Number of establishments.	Average number of wage-earners.	Capital.	Product.	Per cent of total.
United States	26	216	$672,969	$592,658	100.0
New York	10	126	529,746	407,327	68.7
Pennsylvania	6	4	25,853	15,878	2.7
New Jersey	3	10	14,500	39,171	6.6
Illinois	3	12	15,039	42,399	7.2
Missouri, Michigan, and Ohio	4	64	87,831	87,883	14.8

Among the principal products were 10,979 tons of hypochlorites of a value of $462,949; 588,335 pounds of hydrogen dioxide of a value of $63,754; 350,585 pounds of sulphur dioxide of a value of $4,826, and 1,461 tons of bisulphites of a value of $34,486. There were consumed in this manufacture 15,000 tons of salt brine, equivalent to 1,574 tons of salt, or, together with the other salt consumed, 9,055 tons of salt of a value of $19,105; 158,561 bushels of lime of a value of $20,532; 168 tons of caustic soda of a value of $7,618; 92,600 pounds of metallic sodium; 93,000 pounds of black oxide of manganese of a value of $1,325; 227 tons of muriatic acid of a value of $4,325; 974 tons of soda ash of a value of $23,368; 7 tons of potash of a value of $420; 171 tons of sulphur of a value of $4,000; 74 tons of barium dioxide of a value of $16,540; 74,490 pounds of phosphoric acid of a value of $14,898; and 44 tons of bleaching powder of a value of $1,570.

Sulphur Dioxide (sulphurous acid gas; sulphurous anhydride; SO_2).—This substance has been used as a bleaching agent from ancient times. It results from the burning of sulphur or sulphur-containing bodies in air or oxygen. In the presence of water it bleaches wool, hair, straw, and other tissues; but the bleaching is not permanent. Sulphur dioxide is used also as a disinfectant and germicide; in ice machines as a refrigerating agent; in the preparation of bisulphites; to a small extent in the leather and glucose industries; and as the first product in the manufacture of sulphuric acid. Next to its use in making sulphuric acid, the largest consumption of sulphur dioxide is undoubtedly in the sulphite process for converting wood into wood pulp for the purpose of making paper. As it is made and consumed in the works no returns are available to determine how much of the gas is produced in this industry.

Bisulphites.—There is returned as having been manufactured during the census year bisulphites of sodium, calcium, and potassium. They are manufactured by saturating a solution of sodium carbonate, milk of lime, or potassium carbonate with sulphur dioxide and crystallizing out the salt formed. Or the solution may be used as made. These bodies are employed as antichlors in bleaching to remove the excess of chlorine from the fibers of the goods which have been bleached by hypochlorites, and thus prevent this chlorine from rotting the fiber. They are thus used to treat wood pulp in paper making, and it is probable that much of the material used in this art is not included here. The bisulphites are also employed in chrome tannage, in brewing, in glucose and starch making, and as preservatives.

Hydrogen Dioxide (hydrogen peroxide, H_2O_2).—Hydrogen dioxide is made by treating barium dioxide, or sodium dioxide in suspension or solution in water, with a dilute acid, and keeping the temperature at a low point by means of ice. Hydrochloric, hydrofluoric, sulphuric, nitric, or even carbonic acid may be employed. The hydrogen dioxide is set free as a gas, which dissolves in the water present. This solution is decanted off or filtered, phosphoric acid is added to it, and it is diluted, if necessary, so as to contain 3 per cent of H_2O_2, when it is sent into commerce, and is then known as a 10-volume solution. Hydrogen dioxide is a powerful oxidizing agent, and it is used in bleaching hair, silk, wool, feathers, bone, and ivory. It has been quite extensively used for toilet purposes; also as an antiseptic and disinfectant in surgery; as an antichlor; as a reducing agent in chrome tannage; and as a preservative for milk, beer, wine, and other fermentable liquids. The Oakland Chemical Company began the manufacture of hydrogen peroxide in Brooklyn, N. Y., in 1881.

Sodium Dioxide (sodium peroxide, Na_2O_2).—Sodium dioxide is made by heating metallic sodium in aluminum trays, in a specially contrived furnace, to 300° C. while purified air is being passed over it. It is a yellowish white very hygroscopic powder, and is chiefly used as a bleaching agent, being a very powerful one, as it gives off 20 per cent of its weight of active oxygen. Its solution is too strongly alkaline for silk or wool bleaching, and for this purpose it should be converted into magnesium dioxide, which is easily effected by adding a solution of magnesium sulphate to the solution of sodium peroxide.

Hypochlorites.—There have been returns made for bleaching powder (which, according to Lunge, is a compound containing in the same molecule calcium attached to chlorine and to a hypochlorous acid residue) and sodium hypochlorite. The bleaching powder is made by passing chlorine gas into absorption chambers so as to come into contact with lime which has been so slaked as to contain from 24.5 to 25.5 per cent of water. The lime is exposed to the action of the gas until the test shows that the product contains from 36 to 37 per cent of available chlorine. The yield from 100 pounds of good lime is 150 pounds of bleaching powder. Bleaching powder is but partly soluble in water and when treated with water forms a milk-like fluid. It is an efficient bleaching, deodorizing, and disinfecting agent. To liberate the chlorine for bleaching purposes, an acid should be employed. The carbon dioxide of the atmosphere will effect this result, but in practice a dilute mineral acid is usually employed, the cloth first being saturated in the bath of bleaching-powder emulsion, called the "chemic," and then in the bath of dilute acid, called the "sour." Bleaching liquors may be made by passing chlorine gas into the milk of lime, and it was in this form that it was first used.

The emulsion of bleaching powder reacts with magnesium sulphate to form magnesium hypochlorite, with alum to form aluminum hypochlorite, with zinc sulphate to form zinc hypochlorite, and with sodium carbonate to form sodium hypochlorite. They are all efficient bleaching agents and are especially desirable because they are completely soluble in water. Potassium hypochlorite and sodium hypochlorite have been sold under the respective names of Eau de Javelle and Eau de Labarraque, they having been prepared by passing chlorine gas through a solution of potassium carbonate for the first, and sodium carbonate for the second. Sodium hypochlorite is still used for domestic purposes in removing spots from linen and also, together with oxalic acid, as an ink eradicator.

Bleaching by chlorine was first suggested and applied by Berthollet in 1785, and its adoption revolutionized the textile industry. He employed solutions of chlorine gas in water, but Tennant in 1798 patented a liquid bleach consisting of a solution of calcium or sodium hypochlorite prepared by passing the gas into milk of lime or a solution of caustic soda. This liquid bleach is difficult to transport and keep, and Tennant introduced a marked improvement by the invention of bleaching powder in 1799. Bleaching powder was made in this country at Bridesburg, Pa., by Charles Lennig in 1847. The Mathieson Alkali Works, at Niagara Falls, N. Y., and the Dow Chemical Company, of Midland, Mich., began the manufacture of bleaching powder from electrolytic chlorine in 1898.

Bleaching powder is still imported in very large quantities. The extent is shown in the following table, compiled from Volume II of the Foreign Commerce and Navigation of the United States for the years ending June 30, 1891 to 1900:

IMPORTS OF LIME, CHLORIDE OF, OR BLEACHING POWDER: 1891 TO 1900, INCLUSIVE.

YEAR.	Pounds.	Value.	YEAR.	Pounds.	Value.
1891	107,475,715	$1,429,509	1896	104,053,877	$1,579,358
1892	110,748,289	1,839,640	1897	99,274,138	1,375,560
1893	120,811,918	2,213,121	1898	114,232,578	1,421,920
1894	81,610,463	1,507,076	1899	113,107,250	1,159,271
1895	100,456,774	1,644,835	1900	136,403,151	1,464,019

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GROUP X.—CHEMICAL SUBSTANCES PRODUCED BY THE AID OF ELECTRICITY.

In no prior census has any mention been made of this art. As a fact, as shown in the historical account which follows, this industry has practically been developed since the census of 1890 was taken. Nevertheless, it has already grown to such magnitude in these ten years as to effect serious inroads on the older processes, and it will undoubtedly in the future assume a greater importance. Already it is found that sodium and other metals, caustic soda, bleaching powder and other bleaching agents, bromine and potassium bromide, potassium chlorate, litharge, graphite, calcium carbide, carborundum, carbon disulphide, and phosphorus are reported as being produced on a commercial scale, the total value of the output for 1900 being reported at $2,045,535. It is particularly to be noted that the Le Blanc soda process, which has for a century been a standard process for chemical manufacture, is now endangered not only by the Solvay ammonia process, but that the last prop on which it relied for profit has been thrown down by the development of economic methods for the electrolytic production of bleaching powder. It is to be regretted that statistics of the electrical energy efficiency, and other data which are essential to a full understanding of this art are not at present accessible. But it can be stated that, apart from works producing aluminum (which is not included in the chemical industries), there are 14 establishments in the United States belonging in Group X, and that these employ $9,173,060 of capital and 739 wage-earners. These establishments were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF ELECTRO-CHEMICAL FACTORIES: 1900.

STATES.	Number of establishments.	Average number of wage-earners.	Capital.	Value of products.	Per cent of total.
United States	14	739	$9,173,060	$2,045,535	100.0
New York	10	614	8,311,538	1,836,606	89.8
Maine, Michigan, Connecticut, and New Hampshire	4	125	861,522	208,929	10.2

It is to be observed that the total value of the product given here differs from that given in the tabulation of "Chemicals" under the legend "Electro-chemicals," because caustic soda is classed with Group II, bleaching powder with Group IX, and the like; while there is gathered here the value of everything in all the classes which has been reported as having been produced by the use of the electric current. It is evident that while in the tabulation the value for a substance appears but once, by this method of treatment the value of a given substance will appear each time that it is treated of in a different group, and that therefore the value of that caustic soda which was produced electrolytically will not only appear in the total value given for Group X, now under consideration, but also under Group II, when the caustic-soda industry is considered as a whole. For this reason, as well as because the establishments devoted to the manufacture by electricity of any particular product are too few to be discussed under the rules separately, the statistics will be found combined with other statistics in the treatment of other groups.

Sodium.—The remarkable experiments conducted by Sir Humphry Davy in 1807, which resulted in the isolation of sodium[1] and of potassium, not only added to the list of known chemical elements two of its most interesting and important members, but the method devised by him and used here for the first time, in which an element was isolated by the passage of an electric current through its fused electrolyte and in which also the vessel used to contain the fused electrolyte and in which the fusion was effected was made of conducting material and served simultaneously as a container, and as one pole of the decomposing cell, has been largely applied in recent times, since easily controlled supplies of electrical energy at reasonable cost have been at command. Unfortunately no adequately cheap source of electrical energy was available until the dynamo was invented in 1867.[2] In the meantime, and subsequent to Davy's discovery, Gay-Lussac and Thénard found that sodium could be displaced from fused caustic soda by metallic iron at a high temperature, and later Brunner discovered that this reduction could be effected under these circumstances by carbon also. Upon this discovery, and making use of the condenser of Donny and Maresca, Sainte-Claire Deville based the method of manufacture which he devised, and this was for many years the only one employed in the commercial production of this metal. In practicing this process a mixture of sodium carbonate, lime or chalk, and charcoal were heated in iron retorts, and the displaced sodium distilled off and condensed, the reaction taking place being represented by the equation:

$$Na_2CO_3 + 2\ C = 2\ Na + 3\ CO.$$

Darling says, "Deville —— brought its manufacture to a high degree of perfection, reducing the cost of a kilo from 2,000 francs, in 1855, to 10 francs, in 1859."[3]

About 1886, H. Y. Castner, an American, greatly simplified the manufacture by acting on sodium hydroxide with iron and carbon, or iron carbide, effecting the following reaction:

$$6\ NaOH + FeC_2 = 2\ Na_2CO_3 + Fe + 2\ Na + 3\ H_2$$

by fusing the mass in steel or iron crucibles and passing the vapors into condensers opening under high-test petroleum. According to Mendelèeff,[4] "At present (1897) a kilogram of sodium may be purchased for about the same sum (2 shillings sterling) as a gram cost thirty years ago."

In 1890 Castner devised an electrolytic process which completely superseded the chemical processes for the isolation of sodium, and this has since been, until recently, the only process in use in this country or abroad for the commercial production of this metal. The electrolyte consists of fused caustic soda, which is melted in a cylindrical steel crucible with a contracted neck at the bottom, so set in a flue that as the crucible is heated from the outside the body of it only becomes heated while the neck remains cool, so that the caustic soda which fills the crucible remains solid in the neck and protects the joint between the cathode and the crucible at that point. There is a perforation in the bottom of the crucible at the neck, through which the cathode is passed up vertically and sealed by the solid caustic soda, as described above. The electrodes are of iron, and the anode, which may be cylindrical in form, is inserted from above so as to surround the end of the cathode. Encircling the cathode within the anode, and depending from a collecting pot above, is a cylinder of iron-wire gauze which serves to prevent the sodium, as it is liberated, from passing into the anode compartment. The inverted collecting pot above the cathode is filled with hydrogen, which is one of the products of the electrolysis, and this protects the sodium, as it collects, from chance oxidation. The sodium is baled from the collecting pot as soon as it has accumulated in sufficient quantity. More recently Darling has devised a process by which sodium is obtained from sodium nitrate.

Metallic Sodium and Nitric Acid from Fused Sodium Nitrate.—The Darling process, as carried out in the works of Harrison Bros. & Co., of Philadelphia, Pa., is characterized by the kind of diaphragm used. A cast-iron pot, set in a brick furnace and containing the nitrate to be decomposed, acts as the anode or positive electrode. A 6-inch layer of refractory insulating material is placed in the bottom of the pot and the porous cup rests centrally upon this, leaving a 3-inch space between the cup and the pot. This space is then filled with sodium nitrate and the cup itself nearly filled with melted sodium hydroxide. The cathode, or negative electrode, consisting of a short length of 4-inch wrought-iron pipe, provided with proper elec-

[1] Phil. Trans., vol. 98, page 1. 1808.
[2] Borcher, Electric Smelting and Refining, page 104.
[3] J. Frk. Inst., vol. 153, page 65. 1902.
[4] The Principles of Chemistry, D. Mendelèeff, vol. 1, page 535: London, 1897.

trical connections, is suspended inside the cup, reaching nearly to the bottom, and bridges made of wrought-iron pipe support these cathodes in a row of porous cups. When external heat is applied to the furnace, the electrolytes melt, and, permeating the walls of the cup, allow the passage of the current which, when of suitable strength, causes the decomposition of the sodium nitrate into sodium, nitrogen dioxide, and oxygen. The nitrogen dioxide and oxygen are liberated as gases at the positive electrodes, escape through a hole in the cover provided for that purpose and are utilized.

The positive sodium ions pass through the walls of the cup and on through the molten sodium hydroxide to be ultimately liberated in the metallic state at the cathodes. The first sodium liberated is absorbed by or combined with the sodium hydroxide, hydrogen gas being evolved and sodium monoxide, probably, being formed. After some time, metallic sodium rises to the top of the electrolyte in the cups and at intervals of about one hour is dipped off with a spoon and preserved under mineral oil. This style of porous cup and furnace gives excellent results. The use of two electrolytes of different character, yet having a common base, allows of the sodium being liberated in a neutral medium away from all danger of oxidation by the nitrate from which it is obtained. At first the sheet-metal walls of the porous cup had a very short life, being quickly eaten away by the local action caused by the secondary effects of the current. This trouble was overcome by shunting about 5 per cent of the current directly through the metal walls of the cup, making them positive. This plan reduced the local action and increased the life of the cup about ten times. The material now used for the porous cup is a mixture of ground dead-burnt magnesite and Portland cement, and it makes a very satisfactory diaphragm.

The nitrogen dioxide and oxygen evolved at the positive poles are conducted by means of earthenware pipes to a number of receivers or Woulff bottles connected together and containing water. The nitrogen tetroxide which is produced on coming in contact with the water combines to form nitric acid, $3\,N_2O_4+2\,H_2O=4\,HNO_3+N_2O_2$. The N_2O_2 takes up a molecule of oxygen to again form N_2O_4, and more nitric acid is formed. If it is desired to make a very strong acid for use in the manufacture of high explosives, a system of towers that automatically brings the strength of the acid up to a high degree is used.

Each furnace takes a current of about 400 amperes at an average E.M.F. of 15 volts. External heat is used only when starting up and when changing the cups, which have a life of from 425 to 450 hours; at other times during the operation the heat generated by the resistance to the passage of the current is sufficient to keep the electrolytes melted.

It is interesting to note, in connection with this process, that in December, 1902, the supply of metallic sodium on hand and in storage at these works had become so great that the city authorities, fearing accidents, compelled the operation of the process to cease.[1]

Up to some ten years ago, about the only use for sodium outside of the laboratory was in the isolation of aluminum, and when the electrolytic method for the production of aluminum was developed it looked as if the isolation of sodium on any large scale would cease. It was only when electricity was also applied to the isolation of sodium that it could be obtained cheaply enough to permit of its use in fields that had hitherto been closed to it on the score of cost. Chief among these new uses is the manufacture of alkaline cyanides, which are so largely used in the extraction of gold from low-grade ores and tailings; for "quickening" mercury in gold amalgamation; for electroplating; in photography; and other minor uses. Large amounts are also converted into sodium peroxide to be used in bleaching wool, silk, and feathers, and thereby replacing the more expensive hydrogen peroxide. It is also used in making certain anilin colors and organic compounds, and wherever a powerful reducing agent is needed.

Caustic soda and hypochlorites.—When common salt is electrolyzed it is separated into its constituents, sodium and chlorine, and this electrolysis may be effected by passing a proper current through fused sodium chloride, or through an aqueous solution of the salt; but in the latter case the sodium set free at the cathode immediately reacts with the water present, forming sodium hydroxide and liberating hydrogen. As shown in the discussion in Group II, the soda industry is one of the most important of the chemical industries, and as common salt is used in the Le Blanc, Solvay, and the other established processes of soda manufacture as the raw material of the art, it is not surprising that since, as stated above, common salt is readily electrolyzed, numerous processes and devices have been invented for effecting this on a commercial scale. Among them are the Vautin, Hulin, and the Borchers processes, in which fused sodium chloride is the electrolyte, and the Holland and Richardson, Hargreaves-Bird, Castner or Castner-Kellner, Solvay, Le Sueur, and the Dow, in which an aqueous solution of common salt, which in some instances is native brine, is used as the electrolyte. According to Blount,[2] the Castner-Kellner process is the only one which in 1900 was being worked in England on a large scale and in a profitable manner, but while this process is carried on in the United States, the Le Sueur and Dow processes are also in active operation here.

The difficulties in making the simple electrolysis of common salt a commercial success have been various. In the fused electrolyte processes they have been

[1] Science, vol. 15 (N. S.), page 129, Jan. 24. 1892.
[2] Practical Electro-Chemistry, page 309.

largely due to the corrosive action which fused salt exerts on most materials that can be used for making the vessels in which the electrolysis can be conducted, while, since the melting point of sodium chloride is 800° C., and metallic sodium begins to distill below 900° C., the metal comes off mostly as a vapor, which greatly increases the difficulties of collecting it. In the dissolved electrolyte processes, among other difficulties, trouble has arisen from the evolved chlorine wandering into the cathode compartment and reacting with the previously formed sodium hydroxide, or vice versa, to form hypochlorites and chlorates, while the complete separation of the caustic soda from the sodium chloride was not at first easily effected.

C. L. Parsons,[1] writing in 1898, says:

Ernest A. Le Sueur enjoys the distinction of having invented the first electrolytic process for the commercial decomposition of sodium chloride, which became a regular contributor to the markets of the world. Since February, 1893, caustic soda and bleaching powder have been manufactured at Rumford Falls, Me., on a commercial scale.

It appears that Le Sueur began his experiments in the winter of 1887–1888, and after associating with him Charles N. Waite, who afforded him valuable assistance and some facilities at his chemical works in Newton, Mass., they together ran an experimental cell from October, 1890, to May, 1891, in a paper mill at Bellows Falls, Vt. In 1892 an association was formed, which in August of that year began the erection of a plant at Rumford Falls, and in February, 1893, began the manufacture of caustic soda and bleaching powder, using to generate the required current one 200-kilowatt dynamo of the Thompson-Houston pattern. The success of the venture was such that three more dynamos of the same capacity were installed in the fall of 1894, and the Electro-Chemical Company was organized.

Parsons describes the Le Sueur cell as follows:

The cell as now used is contained in a tank 5 by 9 feet and 1½ feet deep, and made of one-quarter inch boiler steel. Excepting the asbestos, which composes the diaphragm, the wire netting of the cathode, and the materials of the positive electrode, it is built entirely of spruce, red brick, Portland cement, sand, and slate. These substances are so disposed in the cell as to be practically permanent, the wood being exposed to no action except that of the caustic solution, which has little effect upon it. The anodes are introduced from the top of the cell and may be removed singly without interrupting the process. Troublesome joints are closed with a specially prepared plastic cement. The diaphragm is tipped somewhat from the horizontal for the purpose of permitting the easy egress of the hydrogen bubbles. The foundation of the cell within the tank consists of an oblong frame of spruce, 8 feet 4 inches by 4 feet 10 inches, outside measurement, and 8 inches less on both dimensions inside. This frame is 11 inches deep, only the side pieces, however, resting upon the floor of the tank. The end pieces consist of four 4-inch timbers, whose upper surfaces are 10 inches above the floor of the tank and 1 inch below the top surface of the longer side. The frame is divided transversely by a timber, similar to each of the end timbers, which crosses the middle of the frame at the same level as the end pieces. This center beam forms a bridge over which the flat iron ribs supporting the cathode are hung. The cell is thus divided into two equal spaces merely for mechanical convenience. The ribs referred to consist of four parallel pieces of flat iron, three of them being 1½ by three-eighths inch, and the fourth, twice as wide. This wider piece is fastened at both ends to the containing tank, so as to receive from the latter the electric current, which enters through the material of the tank and communicates the current to the cathode, which rests upon these iron ribs. The diaphragm rests directly upon the cathode. The depth of the trough formed by the slanting ribs is 4 inches. There is an adequate arrangement at the ends of the bridge pieces by means of which the hydrogen, finding its way to this higher level, is delivered to exit pipes communicating with the atmosphere, or with any system of piping to which it is desired to deliver it. The inch of space between the tops of the cross timbers and the side pieces is utilized to take a piece of slate 4 feet long by 4 inches wide by 1 inch thick. This presses down upon the diaphragm and the cathode netting and keeps all solid. On top of the sides and ends of the frame there are four courses of common brick laid in clear cement. There is a coating of cement applied to the inside walls of the portion of the cell forming the anode compartment, and this includes not only the brick walls, but the small portion of the wooden sides above the cathode, which would otherwise come in contact with the anode liquid. The ceiling of the cell consists simply of pieces of slate, 2 feet by 1 foot, and suitably supported by transverse strips of slate, 1 inch thick by 4 inches wide. Through the ceiling plates pass the glass tubes to which the anodes are attached.

The anodes which are now used are made from an alloy of iridium and platinum, and are so constructed that a very large anode surface is presented at an almost incredibly small cost, when it is considered that it is not at all of the nature of a plated surface, but is an anode of solid metal. Sixty anodes on an average are used to each cell, and each anode costs 73 cents at the present market price of platinum. They are acted upon chemically but slightly, if at all. If the glass holders break there is no loss of platinum, and a new anode can immediately be put in place. The total cost for the anodes of a plant producing, per month, 200 tons of bleaching powder, is approximately $5,000, or $40 for a cell producing 55 pounds of sodium hydroxide and 50 pounds of chlorine per day; and this allows for a very low cell efficiency. The total cost for the renewal of the platinum, including labor, is less than half the cost of the bare carbon alone, as it was formerly used. Besides, it must be remembered that carbon anodes are certain to give more or less carbon dioxide if hypochlorite be present, while with these iridio-platinum anodes no carbon dioxide can possibly be produced.

At Rumford Falls, the Electro-Chemical Company obtains power at a very low cost, so that it pays to obtain a maximum of work from each cell by using a higher current density in proportion to the anode surface than might be tenable under other conditions. As the cells are now constructed, a current of 1,000 amperes is passed through each cell under a pressure of six and one-half volts. I am aware that this voltage is high, and from a statement in Lunge[2] he would probably, at first thought, condemn the process on this ground alone. But it will readily be understood how this increased voltage can be economically employed when it is considered that at $8 per electrical horsepower per year, which is the cost of power to the company at Rumford Falls, the extra cost per pound of product, on an average efficiency of 80 per cent, is but $0.00015 for each extra volt used. This high voltage is by no means an essential of the process, and each cell can be run on a lower amperage, when of course less pressure would be required. It is simply a fact that at Rumford Falls it is economical to run the cells on this voltage, forcing through them all the current they can take without undue heating. Under these conditions, the renewal of the cell is usually made necessary only on account of the deterioration of the diaphragm. The diaphragms have an average life of seven weeks, and have been used twenty-four consecutive weeks

[1] J. Am. Chem. Soc., vol. 20, page 868. 1898.

[2] Alkali Industry, vol. 3.

without renewal. The cathodes are but little acted upon, and the steel tanks are practically indestructible.

The cells are arranged so that twenty-two are in series, and three series are run in parallel on two dynamos. The hydrogen is used only for working platinum, the larger part being allowed to escape into the atmosphere. The chlorine is conducted by earthenware pipes to lead chambers and absorbed by lime in the usual manner, although at present a part is used for manufacture of potassium chlorate. The caustic solution is concentrated by evaporation in *vacuo*, and is separated from the major part of the undecomposed salt by centrifugals. Any chlorate is now readily removed, and the solution is then boiled down in cast-iron kettles to a first-quality caustic soda, analyzing about 74 per cent sodium oxide. The recovered salt is converted into brine and is used in the cathode compartment of the cells, nothing but fresh brine and some hydrochloric acid ever being added to the anode side. Whole bays of twenty-two cells have shown daily averages of over 90 per cent chlorine efficiency, and weekly averages of 87 per cent. If the anode compartment could be kept constantly acid, as can be done with single cells, a chlorine efficiency approaching very closely to the theoretical may be reached. The efficiency, reckoned upon the sodium hydroxide produced, is not quite so high.

One great field for electrolytic processes is the production of bleaching liquors and caustic solutions for bleacheries, paper mills, and the like. Large economies might be introduced by companies of this kind by making their own solutions electrolytically instead of by the usual method of first transporting the chlorine in the form of bleaching powder and the alkali in the solid state. This is almost self-evident when one considers that the final evaporation of the caustic soda, which is quite costly, is done solely for purposes of transportation; that the absorption of chlorine by milk of lime is a very simple operation, and the bleach liquors so produced are much more efficient per unit of chlorine than bleaching powder; and that the raw material (salt) is easily and cheaply obtained and transported without deterioration, while a small plant can be run almost as economically as a large one. In fact, the Electro-Chemical Company has sold a great deal of chlorine in the form of bleach liquors to pulp mills at reasonable distances from the works, that preferred to take this liquid carrier of chlorine on account of its ready-settled solution, ease of manipulation, and its greater efficiency, although the cost of transportation might be somewhat greater. In works which do not require caustic soda, the process would also be highly economical, for under such conditions the cathode liquor can be directly used to absorb the chlorine, in excellent condition for bleaching purposes, thus doing away entirely with the cost and use of lime. I do not hesitate to predict that we shall yet see many Le Sueur plants established in connection with mills now using bleaching powder. In fact, one of our largest American sulphite pulp mills has already made arrangements for a trial of the Le Sueur plant, with a view of bleaching to a very large extent.

Parsons points out that the chief difficulty of the process from the outset has been to keep the sodium hydroxide in its proper compartment, for with the best of diaphragms a limited amount of diffusion into the anode compartment goes on, and sodium hypochlorite is formed, which is oxidized to sodium chlorate either before diffusion into the outer space or during evaporation of the cathode solution, and is eventually recovered as a by-product in the form of potassium chlorate. In addition, the diffusing sodium hydroxide is partly electrolyzed, and, if carbon anodes are used, the oxygen liberated will attack them, forming carbon dioxide. The sodium hypochlorite may also be electrolyzed, giving rise to nascent oxygen and increasing the amount of carbon dioxide produced, and this formation of carbon dioxide is a very serious matter, for unless removed from the chlorine gas, it renders the manufacture of a standard grade of bleaching powder impossible. Le Sueur has overcome many of these difficulties, first, by having the liquid in the anode compartment at a higher level than that of the cathode, thus diminishing the entrance of sodium hydroxide by diffusion; second, by using platinum-iridium anodes; and third, by adding hydrochloric acid to the anode compartment so as to keep the solution slightly acid. This acid, so added, at once decomposes any hypochlorite, and is itself oxidized so that all of its chlorine is regained in the form of that gas. No chlorine is lost by this operation, for the chlorine obtained as bleaching powder is greater than the equivalent of the sodium hydroxide by the amount of chlorine in the added hydrochloric acid. This use of hydrochloric acid is a matter of some expense, for an equivalent of chlorine at Rumford Falls costs more in the form of hydrochloric acid than it is worth as bleaching powder, but in other localities, and especially near the Le Blanc soda factories, such use of hydrochloric acid may prove a positive advantage from the standpoint of economy. Parsons points out that while in 1892, when the Rumford Falls plant was built, bleaching powder sold in Boston for $45 per ton and caustic soda for $74 per ton, in 1898 the prices were $30 and $36, respectively.

According to Chandler,[1] all the difficulties enumerated above were completely overcome by the Castner process, in which the usual porous diaphragm is avoided, and a moving cathode of quicksilver is used in its place which absorbs the metallic sodium as fast as it is produced and removes it at once from the decomposing cell to a neighboring one, where the sodium is withdrawn electrolytically and converted into sodium hydroxide. The operation is accomplished in what is known as the "tipping cell," which is so arranged that once a minute it is rocked upon its support just enough to cause the mercury cathode in the bottom to flow back and forth under the partition to and from the neighboring cell, where the sodium hydroxide is produced free from chlorine. The metallic sodium never exceeds more than 0.2 per cent of the mercury, and consequently there is very little loss from the recombination of sodium and chlorine in the decomposing cell.

An important adjunct to the tipping cell is Castner's graphitized anode. With the ordinary carbon anodes, such as have been previously employed, it was found that the combined action of the chlorine and other substances resulting from the electrolysis of sodium chloride, together with the chemical reactions which occurred at or near the surface, disintegrated them rapidly. By converting the anodes after they have been shaped and baked into the graphitic form, they are of much greater durability, and the graphitizing process

[1] The Mineral Industry, vol. 9, page 765. 1901.

has been regularly employed on a large scale for this purpose. Other modifications and improvements in the details of construction of the tipping cells have been made which facilitate the production and have increased the efficiency of the process. The Castner process yields pure caustic soda and pure chlorine, and has been in successful operation for several years in England, on the Continent, and at Niagara Falls, N. Y. At the last-named locality the company now using it is extending its plant.

According to Blount,[1] the Castner-Kellner process is at work in England, at Weston Point, in Lancashire, where a plant of about 1,000 horsepower is in use and where a second plant of equal size is now being put down. Another plant of 2,000 horsepower (also about to be doubled), belonging to the Mathieson Alkali Company, is running at Niagara, using current supplied by the Niagara Falls Power Company. The output of this company is stated to be 10 tons of caustic soda and 24 tons of bleaching powder per day of twenty-four hours; the current efficiency, from 85 to 90 per cent; the pressure required, 3.5 volts—i. e., the energy efficiency is from 55.6 to 58.9 per cent. These statements are found to be concordant if we assume that the joint efficiency of the transformers and dynamos is 80 per cent.

This is not an unreasonable loss, inasmuch as the current has not only to be let down in voltage, but has to be transformed from an alternating to a direct current. The current comes from the power house at a pressure of 2,200 volts; it is transformed down in stationary transformers to a pressure of 120 volts. At this pressure the current, (which is, of course, still alternating,) passes to motor transformers, which transform it to a direct current delivered at a pressure of 200 volts, this being a convenient voltage for working a group of electrolytic cells.

The anodes used are ordinary "squirted" carbons; they are subjected to a "special treatment," designed to render them more refractory, and are said to last a year. Connection is made with them by means of a lead cap cast on one end. The caustic soda solution obtained is fairly concentrated, e. g., about 20 per cent strength. Much is sent in liquid form in tank wagons to soapmakers in Buffalo, about 20 miles from Niagara. Some is boiled down and sold in the solid state to the Electro-Chemical Company, whose works are close to those of the Mathieson Alkali Company.

The Dow process, as set forth in United States patent No. 621908, of March 28, 1899, has for its object the production of the chlorine and sodium hydroxide from common brine, consisting of sodium chloride, calcium chloride, and magnesium chloride in aqueous solution, and the invention is in the peculiar kind of diaphragm employed and its method of formation. To form this diaphragm a quantity of metallic iron is introduced into the brine in the neighborhood of the anode. On the electric current being passed through the solution the first actions that take place are the decomposition of the electrolytic solution near the anode and cathode, free chlorine being formed at or near the anode, and free sodium, calcium, and magnesium being formed at the cathode. These latter in turn react with the water of the electrolyte to form sodium, magnesium, and calcium hydroxides, this formation also taking place near the cathode, thus $2Na+2H_2O=2NaOH+H_2$. Part of the chlorine at the anode combines with the iron and forms iron chloride ($3Cl_2+2Fe=2FeCl_3$). The sodium, calcium, and magnesium hydroxides and the iron chloride diffuse toward the middle of the cell and meet between the electrodes. On such meeting the iron is precipitated as iron hydroxide, which forms part of the diaphragm,

$$3NaOH+FeCl_3=Fe(OH)_3+3NaCl,$$
$$3Ca(OH)_2+2FeCl_3=2Fe(OH)_3+3CaCl_2,$$
$$3Mg(OH)_2+2FeCl_3=2Fe(OH)_3+3MgCl_2.$$

Calcium and magnesium hydroxides are precipitated by the sodium hydroxide from the calcium and magnesium chlorides,

$$2NaOH+CaCl_2=Ca(OH)_2+2NaCl,$$
$$2NaOH+MgCl_2=Mg(OH)_2+2NaCl.$$

The diaphragm begins to form and build up from these precipitates, consisting of iron, calcium, and magnesium hydroxides. The chlorine diffusing toward the cathode on passing into the diaphragm, is absorbed by the calcium and magnesium hydroxides, forming calcium and magnesium hypochlorites, thus preventing the contamination of the cathode solution by the chlorine. These hypochlorites, whose formulæ are not positively known, decompose very rapidly, probably into chloride and oxygen. In actual working these hypochlorites are not found present. The iron hydroxide being inert so far as the chlorine is concerned, is not disturbed, so that eventually the side of the diaphragm near the anode is almost completely depleted of calcium and magnesium hydroxide by the action of the chlorine, and only iron hydroxide is left, while the cathode side consists mainly of calcium and magnesium hydroxides. The iron hydroxide prevents to a great extent the chlorine of the anode compartment from being consumed by the parts of the diaphragm with which it will combine. As the pores of the diaphragm contain iron, calcium, and magnesium chlorides, the sodium hydroxide of the cathode side upon entering the diaphragm is absorbed by these chlorides before it can diffuse to the anode side, so that the sodium hydroxide can not contaminate the anode solution.

Thus the products of electrolysis are effectually prevented from passing into and contaminating the opposite solutions. The precipitation and formation of the diaphragm will take place most rapidly where the diffusion is the greatest, and should any portion become

[1] Practical Electro-Chemistry, pages 313–314.

detached or mutilated diffusion will be greater at the mutilated point, and the consequent greater precipitation at this point will mend the break. It is thus seen that the diaphragm will thicken evenly. While one or more sheets of porous material—such as paper, cloth, asbestus, and the like—might be placed as a nucleus upon which the two essential layers of the diaphragm would be precipitated in the practical working of the cell, such a procedure has not been found necessary or advantageous, the diaphragm being readily produced in the proper place without such foundation. The physical qualities of the mixed hydroxides when made into a diaphragm in this manner are such that they form a coherent and self-supporting mass offering very little resistance to the passage of the electric current, but at the same time they offer a high resistance to the diffusion of the products of electrolysis and the electrolyte.

In the Dow process carbon electrodes are used. In all the processes bleaching powder is produced by absorbing the chlorine in dry slaked lime kept at a temperature below 46° C. The yield of bleaching powder from 100 pounds of good lime is 150 pounds.

Chlorates.—Chlorates have heretofore been prepared by passing chlorine into alkaline solutions maintained at a temperature at or above 100° C. In making potassium chlorate, which is the salt most largely used, the chlorine was first passed into a hot milk of lime, and after this had become saturated with chlorine and had acquired a density of 25° to 30° Twaddle, the solution was run off to settle. When clear, potassium chloride in calculated quantity was added, which, by reacting with the calcium chlorate, gave rise to calcium chloride and potassium chlorate.

As noted above, sodium chlorate may be obtained as a secondary product in the Le Sueur and other processes of electrolyzing common salt, and by metathesis with potassium chloride the potassium chlorate results. Since potassium chloride occurs native, and is mined at Stassfurt, it would appear to be a simple matter to electrolyze a hot solution of this salt directly to the chlorate, using a vessel without any diaphragm, but this is found feasible only up to a small concentration. Kellner has proposed to add to a saturated potassium chloride solution about 3 per cent of a sparingly soluble hydroxide, such as slaked lime or magnesia, and to keep the whole in agitation as the current is passed. The lime or magnesia assists in the formation of the chloric acid and serves to bring about the transfer of the potassium from its combination as a chloride to that as a chlorate. By concentration of the solution the potassium chlorate formed crystallizes out. As shown by United States patent 493023, of March 7, 1893, Gibbs and Franchot make use of a cathode of copper oxide in electrolyzing the potassium chloride. The theoretical yield of potassium chlorate is 164 parts for every 100 parts of potassium chloride used.

Potassium chlorate is used in manufacturing explosives, fireworks, fuse compositions, safety and parlor matches, and as an oxidizing agent in color works, in dyeing, and in other arts.

Lead Oxides.—Under Salom's process these are produced by the oxidation of spongy metallic lead, which is obtained by the electrolytic reduction of galena. Dilute sulphuric acid is used as the electrolyte, and sheets of lead are employed for electrodes. As neither the galena nor the lead reduced from it is soluble in the electrolyte, there is no ionization of the lead compounds or conveyance of the lead, but the latter is left as a porous mass, having the form of the original mass from which it was obtained, while the sulphur is evolved as hydrogen sulphide, and in this regard this process differs from all other electrolytic processes in use or proposed for use. The porous lead heats up on exposure to air, and is readily converted to oxides, or may be employed in the Dutch process of making white lead, where its porous condition constitutes an advantage in promoting the speed of corrosion. The lead may also be directly compressed into grids for secondary batteries.

Graphite.—Graphite is distinguished by being the first substance existing in nature as a mineral which has been commercially produced in the electric furnace. Its existence as a mineral under the names plumbago and black lead has long been known, and its employment in pencils is described in a work written by Conrad Gessner in 1565, but it was not until 1779 that its identity was established by Scheele and it became recognized as one of the allotropic forms of carbon. Several methods for the artificial production of graphite have been discovered, and that it is obtained from other forms of carbon by exposure to high temperatures, such as obtain in the electric furnace, has long been known, but the discovery that this is brought about through the formation first of carbon compounds, such as silicon carbide, and their subsequent decomposition is due to E. G. Acheson, and he has reduced this discovery to practice, producing graphite in quantity. An interesting feature of his discovery is that the phenomenon of the conversion is a progressive one and that a small portion of the other constituent of the carbide acts, as he says, "by catalysis" to convert a large mass of the amorphous carbon into graphite. This conversion is effected in a similar furnace to that used in the manufacture of carborundum, and the methods employed are similar.

The factory for working this process and making graphite from coke, bituminous coal, or other amorphous forms of carbon was established at Niagara Falls in 1899, and is to-day the only factory in the world, and the material has been here produced in several forms. One is an intimate mixture of pure amorphous carbon and graphite in fine powder for use as paint and for foundry facings. Another consists of articles previously molded from amorphous carbon which contains the catalytic agent. Among them are electrodes for use in alkali processes, like the Castner process, and carbon plates for use as brushes in dynamos and motors; and the life as well as the efficiency of these articles is much increased by being graphitized. It is expected that this process may utilize much of the fine refuse from the coke ovens.

Graphite is used in the manufacture of pencils, crucibles, stove polish, foundry facing, paint, motor and dynamo brushes, antifriction compounds, electrodes for metallurgical work, conducting surfaces in electrotyping and for glazing powder grains.

As pointed out, the chief source of graphite is from mines, and the extent of its production from this source in the United States will be shown when the census of the mining industry is taken. The amount imported is, however, very large, as shown by the following table, compiled from Vol. II of the Foreign Commerce and Navigation of the United States, for the year ending June 30, 1900:

IMPORTS OF PLUMBAGO, 1891 TO 1900, INCLUSIVE.

YEAR.	Tons.	Value.	YEAR.	Tons.	Value.
1891	10,135	$509,809	1896	11,891	$384,554
1892	13,511	726,648	1897	12,459	321,355
1893	14,207	866,309	1898	11,154	472,401
1894	7,935	410,819	1899	15,970	1,081,859
1895	7,051	208,935	1900	20,597	2,345,294

Calcium Carbide, CaC_2, was prepared in 1862 by Woehler, by heating an alloy of zinc and calcium with an excess of carbon, and in 1893, by Travers, by heating a mixture of calcium chloride, carbon, and sodium. Its commercial production began in the United States at Spray, N. C., in 1894, when Thomas L. Willson produced it by heating lime and coke together in an electric furnace, and out of this has grown the large industry which exists to-day. The furnace employed by Willson was of the simplest kind, as it consisted merely of a rectangular fire-brick box lined with carbon, to serve as one electrode, into which a stout carbon rod or bundle of rods dipped vertically to serve as the other electrode. The charge of mixed lime and coke was piled about the vertical electrode, which, after making contact to establish the arc, was raised as the mass was caused to react. Since the reaction is effected solely by the high temperature attained in the electric furnace, and not through electrolysis, either an alternating or a direct current can be employed, and as the former can be brought from a distance at a high voltage and transformed on the spot where it is to be used, by a stationary transformer, it is generally to be preferred.

As carried on at Spray, the operation was a discontinuous one, since, when the movable electrode had been raised to its greatest height and a prismatic mass of the carbide had been formed between the electrodes, the current had to be cut off, the furnace cooled, and the carbide removed, before a fresh charge could be put in. Besides, a very large part of the charge of coke and lime failed to be heated to the reaction temperature, and yet its presence was necessary to protect the walls of the furnace from the high temperature of the arc.

Through the invention of Charles S. Bradley, this process has now been made continuous. He prefers to employ a rotary wheel or annulus, into which projects at one side an electrode; the wheel being provided with means for preventing the material from spilling; with means for supplying fresh material to be acted upon by the current; and with facilities for removing the product; the whole being so arranged that the operation may be carried on in an uninterrupted manner, as the furnace is constantly forming fresh additions to the product and permitting the latter to be removed as frequently as may be necessary. The wheel is preferably turned by power-driven machinery, and is provided with a hollow periphery, to which (over an arc covering the lower part of the wheel) buckets are attached, forming throughout the arc a closed receptacle for the material to be operated upon. These buckets are arranged to be withdrawn or opened when they reach the discharge-end of the wheel-arc. The material, in the form of powder or granules, is supplied to the side of the wheel which contains the electrode or electrodes. The electric arc, or the limits of the space within which the electric action on the material takes place, is wholly within the mass of pulverized material, so that a wall of unchanged or unconverted material will surround the product of the furnace, and the motion of the wheel is in such direction as to keep the converted material surrounded by a body of unconverted material, and thus to exclude air until the converted mass has become sufficiently cool to permit of its removal and further treatment for packing for shipment or storage.

In the formation of the calcium carbide, the intimate mixture of ground lime and ground carbon is supplied to that side of the wheel-arc into which the current is introduced and is here fused and forms a pool of liquid carbide within the wheel rim, the pool being surrounded by a mass of the uncombined mixed carbon and lime which acts as an efficient heat insulator and keeps the walls of the receptacle comparatively cool. As the wheel turns, the pool is withdrawn from the neighborhood of the arc, or region of electrical activity, so that the liquid carbide cools and solidifies under a superincumbent and surrounding mass of material, which prevents access of air and thus prevents wasteful consumption of carbon by combustion. Thus a core of solid calcium carbide is formed within a granular or pulverized mass of material, the core growing in length as the receptacle recedes from the electrode until it emerges from the other end of the wheel-arc, when the removable sections of the wheel rim may be taken off one at a time, which permits the pulverized material to fall away from the solid core of carbide, so that the latter may be broken off or otherwise removed periodically. Thus the formation of carbide goes on continuously without any necessary interruption for recharging or removal of the product.

The wheel used is formed in sections which are bolted together, and it has a horizontal axis mounted in boxes at or near the floor level. The rim of the wheel is concave in cross section and is provided at intervals with pivoted latches to engage studs on semi-cylindrical sections of plate iron and thereby support them on the wheel. Auxiliary plates of thin sheet iron may be bent around the joint between the sections on the inside of the wheel rim, to prevent the pulverized material from sifting through the cracks at the joints. The wheel may with advantage be made about 15 feet in diameter, and the rim and plate-iron sections of such proportions as to form a circular receptacle of 36 inches in diameter. The inner wall of the wheel rim is provided with holes at intervals to receive copper plugs connecting with the several plates of a commutator on which bears a brush, connecting with one pole of an electric generator. The other pole of the generator connects with a carbon electrode about 4 inches in diameter, mounted in a sleeve and provided with a screw thread on the outside, which engages an internally threaded sleeve secured to a bevel gear, on the axis of which is a crank for adjusting the electrode. The electrode and its regulating mechanism are mounted on a framework adjacent to the wheel pit, so that the electrode may be fed into the receptacle formed by the wheel rim and the rim sections when partly consumed.

A feed hopper is provided with a spout projecting into the wheel rim and a gate for regulating the supply of mixed material to be acted upon. The wheel pit is preferably provided with sloping sides, so that any powdered material which drops from the wheel at its discharging end or elsewhere may slide by gravity to a conveyor, the buckets of which return it to the feed hopper, to again pass through the furnace.

The wheel is preferably connected with an electric motor by speed-reducing gearing. The motor shaft carries a worm, acting on a spur gear, on the shaft of which is secured another worm, meshing with another gear, on the shaft of which is a third worm, meshing with a gear on the wheel shaft. By this mechanism, a very slow speed of the wheel may be maintained, a complete revolution being made once in five days. In using the apparatus, the rim sections are latched over the wheel rim above an arc covering the lower part of the wheel, and the gate of the feed hopper is opened. A charge of intimately mixed carbon and lime, in proper proportions to form calcium carbide, falls into the receptacle around the wheel rim and accumulates until the top of the electrode is immersed therein. The circuit of the electric machine may then be closed and the electric motor thrown into operation. As the charge is moved away from the electrode, intense heat is created and the refractory material fuses. As the wheel turns, the pool gradually recedes from the electrode and slowly cools while inclosed within walls of refractory, uncombined material on all sides, and the cool product forms a bottom for the liquid compound. Thus a continuous core of the product is formed, new rim sections being added by the workman at intervals of a few hours.

The electrode, at starting, should project well into the receptacle, and, as the wheel turns, the electrode rises relatively to the charge, and when it reaches a point near the top of the rim section, a new rim section is hung on the wheel by means of the next set of supports, and a strip of sheet iron is bent around the joint between the rim sections. The gate of the hopper is then opened and the rim filled, or partly filled, with material. As this material in its powdered state is a very poor conductor of electricity as well as of heat, the immersion of the electrode does not interfere with the heating action. When a new rim section is added on the electrode side of the wheel, one is removed at the other side. Thus the process continues until the solid core of the furnace product appears at the discharge end of the wheel, when a rim section is taken off and the powdered material falls into the pit, leaving a pillar of solid product projecting vertically, which may be broken off or otherwise removed. Solid calcium carbide is a conductor of electricity, and the copper plugs make a good contact with it, thereby constituting the carbide itself one of the electrodes. The action of the commutator leads the current to a point of the carbide core close to the electrode, and prevents unnecessary resistance, which would intervene if the plugs were more widely spaced. The conducting plugs which are remote from the arc help to carry the current, and thus the heating of any one contact with the carbide core is reduced.

Calcium carbide is used in generating acetylene gas, the reaction taking place when it is brought in contact with water at the ordinary temperature. As the manufacture of calcium carbide is a fairly efficient process, and as it may be produced wherever a head of water is available, as the energy is stored in it in a compact form, and as this energy may be readily made available again by generating the acetylene and burning it, calcium carbide is looked upon as a material by means of which the energy of remote waterfalls that is now going to waste may be made useful to man.

Carborundum (Silicon carbide, SiC), the production of which is covered by E. G. Acheson in United States patent No. 492767, of February 28, 1893, is made in the United States only, and is made by heating a mixture of 34.2 per cent of coke, 54.2 per cent of sand, 9.9 per cent of sawdust, and 1.7 per cent of common salt in an electric furnace. The furnace is built up of bricks put together without any binding material, because of the necessity of permitting the gases generated during the process to freely escape, and because the furnace must be pulled down at the end of each run. At each end of the bin-shaped furnace, which is about 15 feet long, 7 feet high, and 7 feet wide, is a heavy bronze casting to which the leads are attached, which carries, on its inner surface, a bundle of sixty 3-inch carbon rods, each of which is 2 feet in length. These electrodes project into the furnace and are discontinuously connected by a cylindrical mass of coarsely powdered coke which forms a core about 9 feet long by 2 feet in diameter in the center of the furnace. The charge of the above-described mixture, weighing about 10 tons, is packed all about this core.

When the current is turned on, heating proceeds slowly until, after about two hours, carbon monoxide is evolved at all the openings in the brickwork and from the upper surface of the charge, where it burns with a blue flame. After some twelve hours the outside of the charge becomes red hot, and after twelve hours more the reaction has proceeded as far as practicable. After cooling, the furnace walls are pulled down, when the charge is now found to be separated into several layers, viz.; an outer one consisting of about 11 per cent salt, 56 per cent silica, and 33 per cent of carbon, which represents the portion of the charge which has not been heated sufficiently high to be converted into carbide. Within this outer layer is a layer of greenish-colored material, concentric with the core and consisting of amorphous silicon carbide, mixed with raw materials. It is not hard enough for use as carborundum, and is reworked in the next charge. The third layer, which is about 10 inches in thickness, consists of crystallized silicon carbide, the crystals being small on the outside and increasing in size toward the core. This is the carborundum. Within this layer is the portion about or within the core, which has been converted into graphite. The 10-ton charge yields about 2 tons of carborundum, though the theoretical yield of a charge of this size, consisting of silica and carbon mixed in equivalent proportions is about 4.2 tons. The energy used is about 1,000 horsepower.

Although pure silicon carbide is colorless, the crystals obtained in the commercial manufacture are blue, black, or dark brown, and are iridescent; and as they possess an almost adamantine luster, they are very beautiful. They are hard enough to scratch ruby and very permanent. Carborundum is largely used as an abrasive, the crystals being crushed in edge runners, washed with water and acid, dried, and graded by sieving. In this condition it is molded in a great variety of forms. It is also employed in the manufacture of steel as a substitute for ferro-silicon, and in the manufacture of graphite.

Carbon Disulphide.—One of the most ingenious as well as one of the most recent chemical applications of electricity is in the manufacture of carbon disulphide (carbon bisulphide; bisulphide of carbon; CS_2), a substance which was discovered by Lampadius in 1796, and which has been heretofore manufactured by passing the vapors of sulphur over coke or charcoal which has been heated to a "cherry red" in retorts made of cast iron or glazed earthenware. The further steps in the process are for the purpose of purifying the carbon disulphide by removing uncombined sulphur, hydrogen sulphide, sulphur dioxide, and other foreign bodies which may be present, and this is accomplished by condensation in towers, washing in water, treatment with chemicals, such as lead acetate, caustic soda, milk of lime or anhydrous copper sulphate, mercury or mercuric chloride, and redistillation. For certain uses the presence of certain of the impurities adds to the efficiency of the material, and in such cases the methods of purification alluded to are dispensed with. Owing to the corrosive action of the heated sulphur vapors and their products, but few materials can be employed in the construction of retorts, and those which have been used have been short lived, so that the manufacture has not only been conducted in a discontinuous manner, but the renewal account has been large.

In the electric process of Edward R. Taylor, which was put into operation in 1900 at Torrey, N. Y., several sets of carbon electrodes are introduced into the base of a stack furnace and connected by a bridge consisting of broken coke or other conductive carbon, while the body of the stack is filled with charcoal. Sulphur is fed in by suitable ports so as to cover the electrode faces when, as the current is passed through, it becomes melted and vaporized. At the same time the charcoal is heated above the electrodes, and reaction with the sulphur occurs. From the construction of the furnace, the heat radiated through the walls of the stack is utilized in heating the sulphur to the melting point, and the heat resident in the carbon disulphide vapors is largely utilized in heating up the charcoal as the latter descends the stack. The process is a continuous one, and the current may be regulated either by the amount of conductive carbon introduced into the furnace or by reducing the working surfaces of the electrodes by partly submerging them in the molten sulphur.

Carbon disulphide is extensively used as a solvent and extractive agent, as it dissolves sulphur, phosphorus, iodine, rubber, camphor, wax, tar, resins, and nearly all oils and fats. It is a germicide and insecticide and is very largely used by transportation and storage companies for the destruction of weevils in wheat, and other insect pests, and by farmers for exterminating mice, rats, prairie dogs, gophers, and other subterranean animals that damage the crops. It is employed in the manufacture of thiocyanates, carbon tetra-chloride, sulpho-carbonates, viscose, rubber cement, and in organic preparation work, and for prisms.

Phosphorus.—Heretofore phosphorus has been produced from burnt bone or mineral phosphates by treating them with sufficient sulphuric acid to convert part or all of the calcium present into calcium sulphate and the phosphorus contents into calcium metaphosphate or eventually into phosphoric acid, and reducing these products by charcoal.

Quite long ago Wöhler suggested that the manufacture be carried out by heating the calcium phosphate, such as exists in burned bones or rock phosphates, with sand and carbon, by which a reaction of the following nature may be realized:

$$2Ca_3(PO_4)_2+6SiO_2+10C=6CaSiO_3+10CO+P_4;$$

but until recently it has been impracticable to use this simple process on account of the high temperature required. This difficulty is now met in the electric furnace, and at present the electric production of phosphorus is on a profitable basis. In the continuous process of Readman, Parker, and Robinson, 100 parts of calcium phosphate, 50 parts of sand, and 50 parts of coke are intimately mixed and heated in a tightly covered electric furnace provided with an outlet pipe leading to a condenser and a tap hole. The phosphorus volatilizes as it is liberated, and, together with the carbon monoxide, passes to the condenser, where the phosphorus condenses and is collected in water. The residue of calcium silicate and foreign bodies fuses to a slag and is tapped off at intervals, fresh charges of the phosphate mixture being introduced into the furnace without interrupting the electric current.

The phosphorus as first produced is contaminated with sand, carbon, clay, and other impurities, and this crude phosphorus is purified by melting under warm water and straining through canvas, or by redistillation from iron retorts. For final purification it is treated, when molten, with a mixture of potassium dichromate and sulphuric acid, or by sodium hypobromite. Theoretically, 100 parts of $Ca_3(PO_4)_2$ should yield 20 parts of phosphorus, but in practice with the electric furnace only about 17 parts are recovered. This is, however, much more than the yield given by the older process, in which part of the phosphate was converted into calcium metaphosphate; there the maximum yield on the original phosphate was but 11 parts in 100.

Phosphorus is used in the manufacture of friction matches and fuse compositions; for making rat poison; and as a source of phosphoric acid and other phosphorus containing compounds that are used in medicine and in the arts. As phosphorus is a very active reducing agent, it has found some application in the precipitation of the precious metals and in electrotyping.

Other Products.—As an evidence of what may be expected in the future, attention is called to the fact that hydrogen sulphide (which may be burned to produce sulphuric acid), white lead, chromic acid from chromium sulphate, and lampblack from acetylene are being made by the aid of electricity. Especial activity is to be looked for in the field of organic chemistry. So long ago as 1849 Kolbe[1] electrolyzed alkaline salts of fatty acids, obtaining hydrocarbons, and since then halogen derivatives of the hydrocarbons have been made from organic salts or alcohols and haloid compounds; chloral from alcohol and potassium chloride; mono and dichloracetones and monobrom acetone from acetone and hydrochloric or hydrobromic acid; azoxybenzene, azobenzene, hydrazobenzene, benzidine, and anilin from the reduction of nitrobenzene; piperidine by the reduction of pyridine in acid solutions; and vanillin and heliotropine from the ozonization of eugenol or oil of cloves; and many other laboratory reactions. According to Swan[2] the manufacture of iodoform, vanillin, chloral, azo and hydrazo compounds, oxidation products of fusel oil, dyestuffs of the triphenylmethane type, anilin blue, anilin black, Hofmann's violet, alizarin, Congo red, oxidation products of the alcohols, sulphonic acids, piperidine, dihydroquinone, benzidine, and amidophenol have already been produced abroad by electrochemical means, and that at least the first five are being so produced on a commercial scale.

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Group XI.—Dyestuffs.

Under the classification "dyestuffs and extracts" reports have been rendered for the two previous censuses. As the sources of much of the natural raw materials of the two industries and the methods for their treatment are in many respects similar, both dyestuffs and tanning materials were embraced in this

[1] Liebig's Annalen, vol. 69, page 259. 1849.

[2] J. Chem. Soc., vol. 20, page 668; 1901.

classification. Combining the returns of the census of 1900 in the same manner we have the following comparison:

COMPARISON OF DYESTUFF AND EXTRACT FACTORIES: 1880 TO 1900.

YEAR.	Number of establishments.	Capital.	Wage-earners.	Value of product.
1880	41	$2,363,700	992	$5,253,038
1890	62	8,645,458	2,302	9,292,514
1900	77	7,839,034	2,094	7,350,748

This comparison shows a gain of 76.9 per cent in the value of the product for 1890 over that for 1880, and a loss of 20.9 per cent in the value of the product for 1900 as compared with that of 1890. Considering the general character of trade conditions in 1900 and the activity of the dyeing and tanning industries, it is believed that this falling off is not real, but that it is due to a difference in rulings as to the category in which certain of the products reported should be put. For instance, the chromium compounds are used in dyeing, in tanning, for paints, and as chemicals in many arts. Where shall they be classified? Again, citric, lactic, tartaric, and other acids are used in calico printing and in other arts. Shall they be classified under acids or under dyestuffs? Questions like these continually arise, and they will necessarily be settled, to a certain extent, in different ways in the different censuses. The endeavor in the present report has been to classify substances as chemicals in the categories of acids, sodas, potashes, alums, cyanides, and fine or heavy chemicals unless they very distinctively belonged in one of the other categories in the scheme of classification.

Another cause might arise from an extension of the work and an increase in the output of an establishment, if that increase took place in another industry, for the return would be classified under the principal product. Thus, if in 1890 an establishment were grinding sumac leaves part of the time and wheat part of the time, and the value of the ground sumac in 1890 exceeded that of the flour, the establishment would in that year have been classified under "dyestuffs and extracts;" but if in 1900 the value of the flour exceeded that of the sumac, the returns would be classified under "food and kindred products." As a rule these variations tend to balance one another and to give a result that is a close approximation to the true one, but in certain instances this may not be the case, though in each census they all appear in the final summation.

Taking the returns thus assembled, the geographical distribution of the dyestuff and extract industry is presented in the following table:

GEOGRAPHICAL DISTRIBUTION OF DYESTUFF AND EXTRACT FACTORIES: 1900.

STATES.	Number of establishments.	Capital.	Wage-earners.	Value of product.	Per cent of value.
United States	77	$7,839,034	2,094	$7,350,748	100.0
New York	19	2,548,136	562	2,111,811	28.7
Massachusetts	10	592,510	56	1,320,881	18.0
Pennsylvania	12	1,778,173	361	1,269,246	17.3
New Jersey	10	591,916	172	502,798	6.9
Virginia	8	385,904	271	479,372	6.5
West Virginia	5	272,192	98	245,754	3.3
California, Connecticut, Florida, Illinois, Kentucky, Maine, Michigan, Rhode Island, and Tennessee	13	1,670,203	574	1,420,886	19.3

A clearer idea of the dyestuffs industry may be obtained by separating the statistics for this industry from those rendered for tanning materials and by combining with them the data from those schedules in which dyestuffs have appeared as a minor product and which have therefore been sunk in another classification. There have been 72 establishments found in which such manufacture is carried on and the product is shown in the following table:

TOTAL PRODUCTION OF DYESTUFFS IN THE UNITED STATES: 1900.

CHARACTER OF PRODUCT.	Number of establishments.	Quantity (pounds).	Value.
Total	72	61,209,231	$5,868,006
Natural dyestuffs	21	48,245,628	3,435,808
Artificial dyestuffs	32	7,698,435	2,280,899
Mordants	6	734,000	85,466
Iron liquor	5	3,344,568	32,065
Red liquor	5	707,040	7,340
Other products	3	479,560	26,428

There were consumed in the manufacture 51,955 tons of logwood, of a value of $1,084,746; of fustic 3,104 tons, of a value of $51,586; of cutch 798,508 pounds, of a value of $61,697; of indigo 109,034 pounds, of a value of $125,069; of yellow oak bark 4,907 tons, of a value of $29,451; of anilin dyes 1,734,717 pounds, of a value of $840,229; of alizarine and other coal tar colors 1,417,325 pounds, of a value of $333,317; of logwood extract 2,364,792 pounds, of a value of $163,408; and of wood for the manufacture of iron liquor 2,838 cords, of a value of $9,629; besides small amounts of nicwood, quercitron, turmeric, quassia, persian berries, myrabolans, gambier, sumac, nutgalls, quill-bark and oils, and other materials for assistants and mordants.

Coloring matter obtained from vegetable or animal substances have been used in coloring textiles from prehistoric times, and as they were supposed to exist ready formed in the organism, they became known as natural dyestuffs. Prominent among natural dyestuffs is the coloring matter obtained from logwood and known as "hæmatein." The color-forming substance (or chromogen), hæmatoxylin, exists in the logwood partly free and partly as a glucoside. When pure, hæmatoxylin forms nearly colorless crystals, but on oxidation, especially in the presence of an alkali, it is converted into the coloring matter hæmatein, which forms colored lakes with metallic bases, yielding violets, blues, and blacks with various mordants. Logwood comes into commerce in the form of logs, chips, and extracts. The chips are moistened with water and exposed in heaps so as to induce fermentation, alkalies and oxidizing agents being added to promote the "curing" or oxidation. When complete and the chips have assumed a deep reddish-brown color, the decoction is made which is employed in dyeing. The extract offers convenience in transportation, storage, and use. It is now usually made from logwood chips that have not been cured. The chips are treated in an extractor, pressure often being used, but a pressure above 15 pounds to the square inch is to be avoided, as it may cause a decrease in the coloring power of the product. The liquor is settled to remove fibers and resin, and evaporated in a vacuum pan to a density of about 50° Tw., or it may be continued until a solid extract is obtained on cooling. The yield of solid extract produced with pressure is about 20 per cent and without pressure about 16 per cent. The extract is sometimes adulterated with chestnut, hemlock, and quercitron extracts, and with glucose or molasses. Reynolds & Innis made "dyestuffs" at Poughkeepsie, N. Y., in 1816. Browning and Brothers made extracts in Philadelphia in 1834.

Fustic is the heart wood of certain species of trees indigenous to the West Indies and tropical South America. It is sold as chips and extract, yields a coloring principle which forms lemon-yellow lakes with alumina, and is chiefly used in dyeing wool. Young fustic is the heart wood of a sumac native to the shores of the Mediterranean, which yields an orange-colored lake with alumina and tin salts.

Cutch, or catechu, is obtained from the wood and pods of the *Acacia catechu*, and from the betel nut, both being native in India. Cutch appears in commerce in dark brown lumps, which form a dark brown solution with water. It contains catechu-tannic acid, as tannin and catechin, and is extensively used in weighting black silks, as a mordant for certain basic coal-tar dyes, as a brown dye on cotton, and for calico printing.

Indigo, which is obtained from the glucoside indican existing in the indigo plant and in woad, is probably one of the oldest known dyestuffs. It is obtained from the plant by a process of fermentation and oxidation, the yield being from 0.2 to 0.3 per cent of the weight of the plant. Indigo appears in commerce in dark blue cubical cakes, varying very much in composition as they often contain indigo red, and indigo brown (which affect the color produced by the dye), besides moisture, mineral matters, and glutinous substances. Thus Java[1] indigo contains from 70 to 80 per cent of the pure color; Bengal, 60 to 70 per cent; and Kurpah, 30 to 55 per cent. It has been found that "lots" of natural indigo sold as one quality varied in themselves, and that samples drawn from the same chest and identical, so far as appearances went, differed as much as 7 to 8 per cent in their contents of pure indigo. Powdered indigo dissolves in concentrated fuming sulphuric acid, forming monosulphonic and disulphonic acids. On neutralizing these solutions with sodium carbonate and precipitating the indigo carmine with common salt there is obtained the indigo extract, soluble indigo, and indigo carmine of commerce. True indigo carmine is the sodium salt of the disulphonic acid, and when sold dry it is called "indigotine." Alexander Cochrane made extract of indigo at Lowell, Mass., in 1849.

One of the most important of the recent achievements of chemistry is the synthetic production of indigo on a commercial scale. For some years approaches have been made, as in the case of what was known as "propiolic paste," containing about 25 per cent of o-nitrophenylpropiolic acid, which was used for a time in calico printing, but abandoned because of the unpleasant odor which was developed in the process, and which persistently adhered to the goods, and because the blue color produced was slightly gray in shade, and in the case of Kalle's artificial indigo prepared from o-nitrobenzene chloride. The synthetic indigo now made by the Badische Anilin und Soda Fabrik is manufactured by the Heumann[2] process (D. R. P. 91202). Starting with naphthalene, the cheapest and most abundant of the coal-tar products, by treatment with highly concentrated sulphuric acid, phthalic acid is obtained. This phthalic acid is converted into phthalimide by the use of ammonia; the phthalimide is converted to anthranilic acid by means of sodium hypochlorite; the anthranilic acid is united with chloracetic acid to form phenylglycocollorthocarboxylic acid; by fusing this last mentioned acid with caustic soda, indoxyl or indoxylic acid is formed, according to the existing conditions, and when these are oxidized by air, in the presence of alkalies, they pass into indigo. In this manufacture 10,000 tons of naphthalene, over 1,200,000 pounds of ammonia, 4,500,000 pounds of glacial acetic acid, and 10,000,000 pounds of salt are consumed. The recovery of the 40,000 tons of sulphur dioxide, which occurs as a by-product in the treatment of the naphthalene with sulphuric acid (which is the first step in the process of making indigo) is an important matter, and the recently perfected contact process for its conversion into sulphuric acid for reuse comes in most opportunely.

[1] J. Frk. Inst., vol. 153, page 50. 1902.
[2] J. Am. Chem. Soc., vol. 23, page 911. 1901.

Lachman says:[1]

The present annual production of synthetic indigo has not been given to the public, but from the data obtainable it can not be far from 3,000,000 pounds, about one-fourth of the world's supply. It is going to be a question of business rather than of manufacture when the indigo factories will have supplanted the indigo fields. Some of the above calculations will give a faint idea of the purely commercial side of this stupendous undertaking. The 'Badische' has already invested over $4,500,000 in the plant and the preliminary experiments.

Although mineral dyes such as prussian blue, chrome yellow, orange and green, and iron buff, or nankin yellow, have long been used, artificial dyestuffs assumed preponderating importance with the discovery of the lilac color *mauve* by Perkin in 1856, and *fuchsine* or magenta by Verguin in 1859, for with each succeeding year other colors have been discovered, until at the present time there are several thousand artificial organic dyes or colors on the market. Since the first of these were prepared from anilin or its derivatives the colors were known as "anilin dyes," but as a large number are now prepared from other constituents of coal-tar than anilin they are better called "coal-tar dyestuffs." There are many schemes of classification. Benedikt-Knecht[2] divides them into I, aniline or amine dyes; II, phenol dyes; III, azo dyes; IV, quinoline and acridine derivatives; V, anthracene dyes; and VI, artificial indigo.

Of the anthracene dyes, the alizarin is the most important, since this is the coloring principle of the madder. The synthesis of alizarin from anthracene was effected by Gräbe and Liebermann in 1868, but a commercial process for its production was not developed until some years later, when it was worked out by the above-named chemists in conjunction with Caro, though the process was discovered simultaneously by Perkin. Schorlemmer[3] said in 1894: "Gräbe and Liebermann's discovery produced a complete revolution in calico printing, turkey-red dyeing, and in the manufacture of madder preparations sooner than was expected. Madder finds to-day only a very limited application in the dyeing of wool. Twenty years ago the annual yield of madder was about 5,000,000 tons, of which one-half was grown in France, while ten years ago the whole export from Avignon was only 500 tons."

It is to be observed that the quantities of substances like indigo, coal-tar dyes, alizarin, and the like reported as consumed in the United States in the further manufacture of dyestuffs are less than the amount of these articles that is imported; but this follows naturally from the fact that a large, and in some instances the largest, part of this material goes directly to the dye works and print works, while there is recorded here only such as is the subject of further manufacture before being offered for sale. As much of the material is made up in the dye and print works into other compositions of matter before being used, a complete summary of the dyestuff manufacture of the country would embrace also the manufacture at this point of consumption, but such data are not at command.

In textile dyeing and printing, substances called mordants are largely used, either to fix or to develop the color on the fiber. Substances of mineral origin, such as salts of aluminum, chromium, iron, copper, antimony, and tin, principally, and many others to a less extent, and of organic origin, like acetic, oxalic, citric, tartaric, and lactic acid, sulphonated oils, and tannins are employed as mordants. In all technologies and treatises on dyeing and printing the mordants are regarded as of equal importance with the coloring matters, and from this standpoint they are properly included in a census of the dyestuffs industry; but in the larger scheme of the chemical industries, such as is now under consideration, the point of view will necessarily be different, and therefore when a substance like alum or copperas or tannic acid is a distinctively chemical substance and is applied to other uses than in dyeing or printing, it is classified in its proper category under acids, bases, or salts, but when a substance is a composition of matter and is used exclusively or principally as a mordant it is embodied under that heading in the table given above.

Iron liquor, known as black liquor or pyrolignite of iron, is made by dissolving scrap iron in pyroligneous acid. It is sold as a dirty olive-brown or black liquid, having a density of about 25 Tw. (1.12 sp. gr.) and consists mainly of ferrous acetate with some ferric acetate and tarry matters. It is used as a mordant in dyeing silks and cotton and in calico printing. It was manufactured by James Ward, at North Adams, Mass., in 1830.

Red liquor is a solution of aluminum acetate in acetic acid, and is produced by acting on calcium or lead acetate solutions with aluminum sulphate or the double alums, the supernatant liquid forming the red liquor. The red liquor of the trade is often the sulpho-acetate of alumina resulting when the quantity of calcium or lead acetate is insufficient to completely decompose the aluminum salt. Ordinarily the solutions have a dark-brown color and a strong pyroligneous odor. It is called red liquor because it was first used in dyeing reds. It is employed as a mordant by the cotton dyer and largely by the printer.

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[1] Loc. cit.
[2] Chemistry of Coal-tar Colors.
[3] Rise and Development of Organic Chemistry, page 248.

IMPORTS FOR CONSUMPTION DURING THE YEARS ENDING JUNE 30, 1891-1900.

YEAR.	LOGWOOD.		EXTRACTS AND DECOCTIONS OF LOGWOOD AND OTHER DYEWOODS.		CAMWOOD.		FUSTIC.		ALL OTHER DYEWOODS.		CUDBEAR.	
	Tons.	Value.	Pounds.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Pounds.	Value.
1891	84,381	$1,842,954	3,282,227	$275,802	3	$220	9,100	$132,841	1,002	$28,969	402,241	$37,889
1892	60,297	1,233,592	4,227,017	325,576	29	3,339	8,490	125,067	2,527	50,131	276,690	24,597
1893	56,404	1,218,934	3,757,259	287,723	26	3,745	10,293	165,807	479	8,978	320,348	25,317
1894	53,709	1,313,376	2,817,451	196,397	70	5,770	7,765	126,309	347	4,426	151,121	12,666
1895	60,683	1,478,618	3,565,277	261,762	23	1,676	6,299	89,696	553	12,386	148,024	13,129
1896	66,074	1,522,069	4,910,176	287,120	50	3,748	6,832	90,389	1,165	18,583	118,517	9,256
1897	33,462	611,010	5,459,302	277,798	....	....	7,918	102,472	639	8,327	66,804	4,902
1898	46,977	744,135	3,664,623	232,986	....	....	9,923	137,666	2,726	33,475	66,795	4,795
1899	37,518	547,334	3,113,658	207,406	....	....	9,198	121,665	8,834	103,276	36,487	2,919
1900	48,190	628,464	3,420,276	227,527	1	161	4,440	60,886	20,967	205,351	61,305	3,944

YEAR.	GAMBIER OR TERRA JAPONICA.		CRUDE INDIGO.		INDIGO CARMINE.		EXTRACTS OR PASTES OF INDIGO.		SUBSTITUTE INDIGO.	MADDER AND MUNJECT, OR INDIAN MADDER, GROUND OR PREPARED.		ORCHIL OR ORCHIL LIQUID.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Value.	Pounds.	Value.	Value.
1891	27,610,594	$1,343,604	2,089,500	$1,600,865	28,175	$33,145	881,969	$58,288	$416	673,260	$39,806	$81,974
1892	25,808,495	1,069,043	2,460,635	1,772,506	23,600	28,636	826,887	58,845	....	518,786	52,063	68,779
1893	35,762,646	1,305,468	3,226,314	3,137,511	29,687	35,304	1,317,835	101,347	2,793	653,779	61,720	64,928
1894	26,408,458	981,328	1,717,635	1,218,580	12,504	16,907	829,380	68,474	1,587	262,663	17,576	43,235
1895	29,022,603	963,255	3,411,539	1,940,250	26,173	33,405	605,750	57,317	187	329,477	18,541	59,317
1896	32,343,256	1,108,611	2,707,928	1,571,018	34,967	42,369	590,664	55,361	....	318,313	15,746	62,831
1897	31,349,555	959,501	3,010,005	1,586,309	52,192	59,182	469,729	51,153	....	292,462	12,963	38,965
1898	42,333,486	1,021,288	3,058,787	1,807,336	26,671	26,642	396,760	59,001	....	246,218	11,816	56,755
1899	38,123,478	754,497	3,127,182	1,698,583	17,505	17,172	254,531	23,324	....	280,081	12,298	45,494
1900	38,857,515	906,282	2,747,043	1,446,490	18,204	15,767	251,538	20,094	....	120,736	5,869	47,134

YEAR.	SAFFLOWER AND EXTRACT OF, SAFFRON AND SAFFRON CAKE.	COCHINEAL.		OIL OF ANILINE.		SALTS OF ANILINE.	ALIZARIN, NATURAL OR ARTIFICIAL AND DYES COMMERCIALLY KNOWN AS ALIZARIN YELLOW, ORANGE, GREEN, BLUE, BROWN, AND BLACK, INCLUDING EXTRACT OF MADDER.		COAL-TAR COLORS OR DYES NOT SPECIALLY PROVIDED FOR.	ALIZARIN ASSISTANT OR SOLUBLE OIL, OR OLEATE OF SODA, OR TURKEY-RED OIL.		ALIZARIN ASSISTANT, ETC., ALL OTHER.	
	Value only.	Pounds.	Value.	Pounds.	Value.	Value only.	Pounds.	Value.	Value only.	Gallons.	Value.	Pounds.	Value.
1891	$44,598	86,797	$19,935	1,489,908	$299,662	$713,732	3,443,167	$674,101	$1,632,642	653	$437	1,325	$717
1892	55,391	230,039	55,883	1,428,070	253,248	536,477	4,838,220	1,029,122	1,640,024	....	....	3,997	2,262
1893	27,697	215,512	52,572	1,211,818	163,539	432,134	5,729,221	1,125,506	2,322,258	....	....	2,901	1,157
1894	24,341	104,284	28,124	951,671	115,141	395,575	3,960,079	722,919	1,429,101	....	....	1,153	577
1895	16,462	130,205	37,285	1,315,934	143,426	548,110	5,287,720	870,383	2,739,933	92,158	25,735	....	....
1896	33,765	160,422	50,988	1,364,674	164,238	662,459	6,154,156	994,395	2,918,332	82,376	24,626	....	....
1897	38,022	137,261	41,943	....	....	812,884	6,169,018	1,023,425	3,163,182	....	....	....	....
1898	52,482	158,055	45,762	....	....	1,087,704	5,871,962	886,349	3,723,388	....	....	....	....
1899	32,477	97,563	23,207	....	....	743,130	5,226,452	700,786	3,900,099	....	....	....	....
1900	44,502	158,911	31,408	....	....	537,812	6,009,552	771,336	4,792,103	....	....	....	....

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GROUP XII.—TANNING MATERIALS.

The making of leather is one of the older arts. From the best records attainable, according to Robert H. Foerderer,[1] it appears that the first tannery in this country was operated about the year 1630 in Virginia. A year or two later the first tannery in New England was established in the village of Swampscott, Lynn, Mass., by Francis Ingalls, and the vats used by him remained until 1825. With the establishment of the tanning industry necessarily came the gathering of the tanning materials from forest and field, and subsequently their preparation for use, but the first mention of this industry in census reports appears under the head of "sumac" in the report for 1850, and from this time, except in 1880, separate returns for tanning materials have been made in each census report, though the methods of statement have been so varied as to make comparison, except in certain items, almost impossible. Thus in 1850, 1860, and 1870 there are the classifications "sumac," "sumac bark and prepared sumac," and "ground sumac;" in 1860 and 1870 also, "ground

[1] One Hundred Years of American Commerce, Vol. II, page 495.

bark;" in 1870, also "hemlock-bark extract;" in 1890, "dyeing and tanning extract," and "chipped wood and other products of this group."

In this report for the census of 1900 there are included, under "tanning materials," the ground, chipped, and other comminuted materials, and the extracts obtained from oak bark and wood, hemlock, sumac, and palmetto root, together with the chrome solutions that are employed in tanning. Under this classification, and taking into account establishments not in the chemical classification of the census, but which produce tanning materials in addition to other products, like drugs or leather, 39 establishments were reported, employing $2,107,040 of capital and 700 wage-earners, and producing $1,899,220 of product. They were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF FACTORIES PRODUCING TANNING MATERIALS: 1900.

STATES.	Number of establishments.	Capital.	Wage-earners.	Value of product.	Per cent of total.
United States	39	$2,107,040	700	$1,899,220	100.00
Virginia	8	385,904	271	479,372	25.33
Pennsylvania	8	566,869	103	357,462	18.82
New York	4	341,870	90	295,356	15.55
West Virginia	4	270,192	90	232,365	12.23
New Jersey	6	94,762	27	181,800	9.57
Massachusetts, Maryland, Florida, Tennessee, Kentucky, Illinois, Michigan, and California	9	447,443	119	352,865	18.50

There were 23 establishments employing $1,055,665 of capital and 351 wage-earners in the manufacture of tanning materials from the oak. There were used of oak and chestnut oak 36,897 cords of bark, of a value of $265,557, and 34,871 cords of wood, of a value of $92,252, and there were produced of ground bark 29,948,237 pounds, having a value of $186,381, and of extract, 34,673,997 pounds, having a value of $661,119.

There were 10 establishments employing $586,681 of capital and 156 wage-earners engaged in the manufacture of tanning materials from the hemlock. There were used of hemlock bark 43,566 cords, having a value of $210,930, and there were produced 35,591,329 pounds of extract, of a value of $572,882, whereas in 1870 (the only previous record at command) 2 establishments were reported employing $85,000 of capital and 37 wage-earners, and having a product valued at $185,300.

There were reported 11 establishments employing $333,648 of capital and 105 wage-earners engaged in the manufacture of tanning materials from sumac. There were used of sumac leaves 11,538 tons, having a value of $214,353, and there were produced 9,528,800 pounds of ground sumac, valued at $114,660, and 8,102,742 pounds of sumac extract, valued at $215,677. This output is compared with data accessible in previous census reports in the following table:

PRODUCTION OF SUMAC, BY DECADES: 1850, 1860, 1870, AND 1900.

YEAR	Number of establishments.	Capital.	Wage-earners.	Value of product.
1850	9	$15,550	25	$36,731
1860	4	11,700	12	16,850
1870	19	167,450	85	267,180
1900	11	333,648	105	330,337

There was produced of chrome tannage solution, as reported, 1,837,134 pounds, of a value of $52,516, but it is probable that much of this material produced and consumed in tanneries is not accounted for. Besides these materials there was a quantity of tannic acid from nutgalls and other sources reported, but this is more properly classified and treated of under acids.

The sources of tannin in nature are very numerous. Bernadin, in his book,[1] treats of 350 different vegetable sources. Mineral salts have also been employed as tanning agents, while more recently still the electric current and organic compounds, such as formaldehyde, have been employed to convert hides or skins into leather. The tannin which exists in or is produced from vegetation varies with the genus and the species, and even, it is believed, with the part of the plant from which it is obtained. Trimble[2] classifies the tannins as follows: Group *a*, gallo-tannic acid; chestnut-wood tannin; chestnut-bark tannin; pomegranate-bark tannin; sumac tannin. Group *b*, oak-bark tannin; mangrove tannin; canaigre tannin; rhatany tannin; kino tannin; cetechu tannin; tormentil tannin. According to the prevailing views, tannin is a glucoside and the tannic acid obtained from it is digallic acid. Gallnuts are the richest in tannin contents of any vegetable source, amounting to upward of 50 per cent, but the sources of tanning materials reported as used in tanning in the United States are oak and hemlock barks, oak wood, sumac leaves, and palmetto root.

Oak and Hemlock.—The bark and the wood are chipped fine and sold in this form for making the tan liquor, or they are treated to extract the tannin and other principles, and this extract is put upon the market. For maki g leather it has been found essential that the aqueous extract shall contain sugars, gums, resins, and coloring matters as well as tannin, since the above-mentioned substances play an important part in the conversion of the hides into leather. According to Hough,[3] the yield of bark is 3 cords per acre, and 4 to 6 trees yield a cord of bark.

Sumac.—The sumac stands next in importance to the hemlock as a source of tanning material in the United States. It is obtained from several species of the *Rhus*, but chiefly from the *R. glabra* and *R. tyhina.*

[1] See Literature at the end of this group.
[2] The Tannins, Vol. II, page 132.
[3] Report upon Forestry, page 145.

The sumac best suited for tanning and dyeing purposes grows wild in a belt of country extending from Maryland down through the Atlantic states to Georgia, Alabama, Mississippi, Louisiana, and Texas, and in portions of Kentucky and Tennessee. The northern climate appears too cool for developing the tanning properties of this plant to the best advantage, although in the past large quantities of the leaves gathered in Pennsylvania and New York have been sold to tanners of goatskins, who put them in vats to strengthen and keep the sewed skins from leaking, and they have been used by many tanners to brighten the color of their leather.

According to Hough,[1] in 1877 the state of Virginia led in the production of sumac, and the business of collecting, grinding, and packing was carried on at Richmond, Fredericksburg, Alexandria, Culpeper, Winchester, and perhaps other places. According to Bernadin,[2] in 1880, 6,000 tons of American sumac were annually brought into the market, principally from Alabama, Tennessee, Kentucky, and, above all, Virginia. Sumac leaves contain 24 per cent of tannin, but a sample of *Rhus glabra* from Georgetown, D. C., went as high as 26.10 per cent in tannin contents.

The season for picking sumac begins about the first of July and ends the last of September, or with the first frost, for when the leaves turn red in the autumn they are no longer of value. The tanning properties of the sumac reside in the leaves, and only these should be gathered. The differences existing in various samples of sumac is found often to be due to the care with which the leaves were gathered and dried. The blossoms and berries, as well as the stems, should be thrown out and the leaves should be dried in the shade. When cured, the sumac is ground in mills under heavy wooden wheels, revolving in circles, at the ends of axles attached horizontally to a vertical shaft. These grinding wheels are inclosed in a tight covering to prevent the escape of the dust, which arises quite abundantly. John G. Hurkamp began grinding sumac at Fredericksburg, Va., in 1847.

Palmetto Root.—The palmetto root is a source of tannin which has attracted attention in recent years in the South. It is found abundantly in Florida, and grows in Alabama, Louisiana, and Tennessee. It shows 10 per cent of tannin and the root can be cut up like bark. The tannin from this source produces tough grain and strong, durable leather. It tans rapidly, giving a pleasing light color, toughness, and pliability, and is a good filler of leather. There was but one factory reporting palmetto extract at the census of 1900. The extract is put up in barrels containing 52 gallons, and a gallon weighs about 10½ pounds.

Tanning Extracts.[3]—"The use of extracts in tanning has grown to large proportions during the past fifteen years. There are many advantages in the use of such extracts. The liquids are always under perfect control; that is, by putting in so much extract the quantity of tanning material is known. It does away with the storing of large quantities of bark, as 1 barrel of extract is equivalent to about 1 cord of bark—128 cord feet. Where space costs money, this is quite an item, and it also saves interest and insurance on the bark.

"There is no difference in the fiber produced by bark liquors and pure tanning extracts, as properly prepared extract is nothing more than concentrated liquor. Tanning extracts in common use in the United States are made from chestnut oak bark, chestnut oak wood, chestnut wood, hemlock bark, quercitron bark, canaigre, and sumac. Black oak bark extract is used to give a bloom to leather, and coloring or dyeing extracts are made from logwood, fustic, and from a large number of other materials.

"The chestnut tree, after it is felled is peeled of the bark, which is objectionable on account of the coloring matter which it contains. The chestnut oak tree is used as it comes from the stump. The chestnut tree and the chestnut oak tree are cut into suitable lengths, say about 4 feet long, in the forest. These pieces are then carried to the factory, where they are further reduced by 'chipping' by a machine built especially for the purpose. This machine is a cast-steel disk 4 feet in diameter, revolving rapidly, and carrying a suitable arrangement of knives, which cut the wood into small chips. These chips are carried to the leaches and leached or extracted as is usual in tanneries. No chemicals should be used in the leaches. The liquor is then run into settling tanks, and next passed through 10 wire-cloth strainers of the finest meshes to clarify it, after which the liquor goes to the vacuum pan and is concentrated under diminished pressure at a temperature of between 120° and 140° F.

"The above-described method of settling and straining is the one in common use in the United States, and it produces a liquor which is pure and transparent enough to be made into an extract suitable for tanneries.

"When the degree of heat has been carried too high in the leaches, such liquor can only be clarified sufficiently by first lowering the temperature below the coagulating point of blood and adding blood; second, raising the temperature of the liquor sufficiently high to coagulate the blood, which gathers up the fine suspended matter and settles to the bottom of the vat or tank, and is then still further strained. It is then concentrated as usual.

"Extract, however, made from a liquor which has been produced at too high a degree of heat, although clarified by blood albumen, will not produce a satisfactory article; that is, such an extract is not, strictly speaking, a concentrated liquor.

[1] Report upon Forestry, page 153.
[2] Classification de 350 matieres tannantes, page 23.
[3] The Manufacture of Leather, by Charles T. Davis, pages 74–77.

"The extract maker, it is true, obtains a larger yield or number of pounds of finished extract from his material, but it is at the expense of the tanner. The excessive degree of heat in the leaches extracts not only nontanning substances, which are objectionable, but destroys also certain bodies which act favorably in the production of leather.

"In the concentration of the liquor in the vacuum pan, extreme caution must be observed as to the degree of heat. A temperature of over 140° F. or thereabouts produces a change in the tanning substances and in its allied nontanning substances which is very objectionable, and which produces an undesirable leather, not only in color but in quality. In other words, a liquor, although carefully made, when subjected in the pan to a degree of heat in excess of 140° F., or thereabouts, yields an extract which, when diluted with water, is not what it was before concentration It is on this account that the multiple vacuum pans—that is, more than one pan—can not successfully be used in the concentration of liquors or the making of extracts.

"In the use of extracts the tanner should always be on the lookout for only the pure article, free from adulterations of any kind. Extract is now being extensively used for sole, upper, belting, harness, union, enameled, and patent leather, and in nearly all the cases which have fallen under our observation giving good results in both tannage and weight.

"There are various methods followed in the preparation of hemlock extract, but that used by a prominent extract company in Pennsylvania is a good one. The bark is ground in the old-fashioned mill and is very carefully leached in the old-fashioned way and boiled down in the vacuum pan under the least degree of heat that can be employed. No chemicals whatever are used. They do not press or crush their bark to get from it a larger yield, but are doing their best to give a pure article which will produce a pure, strong, old-fashioned liquor. They take a good, fresh 10° barkometer liquor and boil it down to 27½° Baumé in vacuum. There is no other description than this, for this is all they do.

"The manufacture of tanning extracts now closely resembles the process for extracting sugar; the sliced wood is exhausted by diffusion in autoclaves under slight pressure, and the liquor is filter-pressed and evaporated in some cases in triple-effect apparatus which differs from those used at the sugar works merely in being constructed entirely of copper and bronze, to the exclusion of iron, and in being worked at a higher vacuum than sugar pans are. Most manufacturers decolorize the liquor before concentration, either by the addition of some metallic salt or with albumen and bisulphite of soda. In the former case the acid of the salt remains in the extract, and in the latter, sulphate of soda and noncoagulable albuminoids are retained, whilst in both cases tannin is necessarily precipitated. The presence of salts in tanning extracts is much to be deprecated, since they accumulate in the tan pits to the detriment of the leather.

"Roy has shown that the so-called decolorizing processes are beneficial to the extract, not because they eliminate coloring matters, for they do this in a very minor degree, the color of the liquor after treatment being but slightly diminished if estimated on the basis of equality of tannin content, but because they precipitate together with the first portions of tannin, certain earthy and metallic bases, such as lime, magnesia, manganese, iron, and copper, derived from the wood and from the apparatus. It is these foreign matters combined with tannin, which are taken up, by the leather, imparting bad color and harsh and brittle grain. By substituting an aqueous solution of potassium ferrocyanide for the precipitate previously used, Roy has succeeded in removing these metallic compounds without appreciably decolorizing the extract, and finds that the leather produced by the treated extract is in every way comparable with that prepared with oak-bark liquor made in the tanyard.

"It follows that tanning extracts must be examined for salts of the alkalies and the alkaline earths and for metallic compounds, and valued in accordance with their content of these, as well as with their content of tannin."

John H. Heald & Co. began the manufacture of hemlock-bark extracts at Baltimore, Md., in 1860; at Elmira, N. Y., in 1862; and at Lynchburg, Va., in 1869.

Chrome Solution.—As far back as 1856 the system of tanning, or tawing, by the use of chromium compounds was discovered by a German chemist,[1] but all the early experiments failed because the tannage could not be made permanent. A remedy was finally found in the subsequent use of hyposulphite of soda by which the tannage was made lasting. The discovery of the remedy and its successful application were made in Philadelphia, and the use of hyposulphite of soda for this purpose is covered by United States letters patent of June 28, 1888, granted to William Zahn. According to Foerderer[2] the consequence of this invention was the creation in Philadelphia of what is to-day the largest and best equipped leather factory in the world. In carrying out the process, the skin is first dipped in a solution of a chromium salt, such as potassium dichromate, acidified with hydrochloric acid, and subsequently in a solution of sodium thiosulphate or a bisulphite acidified with hydrochloric or sulphuric acid. It appears that for 100 pounds of skins 4 to 5 pounds of potassium dichromate, 2.5 to 4.5 pounds of hydrochloric acid, 8 to 10 pounds of sodium "hyposulphite," and 0 to 1.5 pounds of sulphuric acid are consumed. Of course any equivalent chromium salt may be used, and latterly the use of other metallic radicals as coagulants has been tried.

Considering leather as a chemical product (and it is always treated as such in the full chemical technologies) a notable example of the application of electricity is found in its use in the tanning of hides and skins to con-

[1] One Hundred Years of American Commerce, Vol. II, page 497.
[2] Ibid.

vert them into leather. There have been many such electric processes invented, some employing tannin solutions, but most of them referring to the use of mineral tannage, with chromium, aluminum, tin, and other metallic salts, on light skins, such as calf, goat, and sheep. One of these electric processes, "the Groth system of rapid tannage by electricity," has, according to Davis,[1] "so far been demonstrated in the United States at Kansas City, Mo., where good results are claimed for it." Further on, in discussing electric and other rapid tannage systems, Davis[2] says:

> The bark methods of tanning are passing away with great rapidity, extracts and chrome are taking their place, and in the larger establishments the chemist has become an invaluable part of the personnel of the tannery, and he is kept busy making investigations and suggestions.

The foreign commerce in tanning materials is set forth in the following tables, compiled from the publications of the Bureau of Statistics of the United States Treasury Department.

[1] The Manufacture of Leather, page 526.
[2] Ibid., page 530.

IMPORTS FOR CONSUMPTION DURING THE YEARS ENDING JUNE 30, 1891 TO 1900.

YEAR.	SUMAC, EXTRACT OF.		SUMAC, GROUND.		SUMAC, UNMANUFACTURED.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891	2,399,028	$77,152	11,412,297	$235,729	2,953,202	$65,802
1892	1,902,089	68,853	10,822,614	225,891	2,841,200	60,657
1893	2,880,210	108,447	14,363,922	289,953	3,817,568	70,152
1894	1,277,609	54,535	8,315,551	191,333	970,207	21,427
1895	1,604,024	53,260	12,242,216	236,541	2,203,645	40,021
1896	2,472,923	78,504	13,349,233	231,324	1,027,824	24,861
1897	2,907,521	84,150	18,530,104	245,992	2,117,439	30,554
1898	1,266,542	48,399	8,336,117	121,461	3,754,307	62,553
1899	1,133,662	38,709	14,156,344	202,605	3,011,810	42,297
1900	1,419,827	50,295	10,644,001	233,846	1,048,955	20,800

IMPORTS OF TANNING MATERIALS FOR CONSUMPTION DURING THE YEARS ENDING JUNE 30, 1891 TO 1896.

YEAR.	HEMLOCK BARK.		HEMLOCK EXTRACTS.		OTHER THAN HEMLOCK.		Hemlock and other, value.	Other articles in crude state used in tanning not specially provided for, value.
	Cords.	Value.	Pounds.	Value.	Pounds.	Value.		
1891	57,254	$274,426	768,710	$14,958	3,310	$229	....	$2,603
1892	53,018	256,346	....	....	12,973	408	....	1,918
1893	50,688	241,244	....	....	672	71	....	8,361
1894	46,173	212,350	....	....	....	....	....	10,630
1895	47,286	230,943	....	....	....	....	$3,470	16,629
1896	43,964	214,891	....	....	....	....	19,045	23,499

DOMESTIC EXPORTS OF BARK AND EXTRACTS FOR TANNING DURING THE YEARS ENDING JUNE 30, 1891 TO 1900.

YEAR.	Value.	YEAR.	Value.
1891	$241,382	1896	$354,007
1892	239,708	1897	241,979
1893	232,269	1898	329,994
1894	271,236	1899	369,693
1895	290,362	1900	376,742

LITERATURE.

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Classification de 350 matieres tannantes, by M. Bernadin: Paris, 1880.

The Tannins, by Henry Trimble, Philadelphia, Vol. I, 1892; Vol. II, 1894.

One Hundred Years of American Commerce; Hides and Leather, by Robert H. Foerderer, Vol. II, pages 494–497: New York, 1895.

The Manufacture of Leather, by Charles Thomas Davis: Philadelphia, 1897.

Organic Chemistry, V. Von Richter, Philadelphia, Vol. I, 1899; Vol. II, 1900.

Group XIII.—Paints (Including Varnishes, and Bone, Ivory, and Lamp black).

Although paints (including pigments), varnishes, and bone, ivory, and lampblack have been separately tabulated, a large proportion of the establishments of the first two classes make both classes of products, and the product of the last class belongs entirely to pigments; hence it is advisable to consider them together in this special treatment.

The following table gives a summary of the principal totals of the three tabulations, with a final column giving the value of that portion of the products which really belongs to this group, the remainder belonging to other groups and being there considered. To the total of this column is added the value of the paint and varnish products from other groups, Class B, and also from other categories, Class C, so far as known, the values of these last being of course reported elsewhere under their respective classes, although usually not separately.

CLASS.	Number of establishments.	Capital.	SALARIED OFFICERS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials.	Value of products.	Products belonging to this group.
			Number.	Salaries.	Average number.	Wages.				
Total	615	$60,834,921	3,731	$5,040,301	9,782	$4,971,697	$5,122,381	$44,844,229	$69,922,022	$67,376,641
Paints	419	42,501,782	2,512	3,077,318	8,151	3,929,787	3,430,061	33,799,386	50,874,995	48,440,780
Bone, ivory, and lampblack	15	782,247	21	23,650	85	46,107	75,678	105,712	359,787	359,787
Varnish	181	17,550,892	1,198	1,939,333	1,546	995,803	1,616,642	10,939,131	18,687,240	18,576,074
Total	647									71,313,392
Class B	10									541,892
Class C	22									3,394,859

The importance of considering, in this connection, the products of Class C is shown by the following list of their kinds, quantities, and values:

KIND.	Quantity.	Value.
White lead, dry, pounds	6,968,000	$289,897
Oxides of lead, pounds	11,626,033	312,403
Oxide of zinc, pounds	60,235,154	2,212,787
Dry colors, pounds	1,394,595	55,450
Paints in oil, in paste, pounds	2,594,824	255,566
Paints, ready mixed, gallons	[1] 479,998	268,756
Total		3,394,859

[1] Quantities not always given; in such cases, calculated from the average value of product.

There were 23 establishments of Class A and 2 establishments of Class C reported as making white lead and oxides of lead. Including the figures of Class C, the total quantity of white lead reported as having been sold dry was 123,070,316 pounds, valued at $4,501,078, in addition to which 131,621,628 pounds were reported as having been consumed in the manufacture of other paint products, making a total of 254,691,944 pounds. The total quantity of oxides of lead reported as sold as such is 62,385,656 pounds, valued at $2,862,743, in addition to which 2,080,374 pounds were reported as being consumed, making a total of 64,466,030 pounds. The entire paint and varnish products, sold as such, from all sources are as follows:

KIND.	Quantity.	Value.
White lead, pounds	123,070,316	$4,501,078
Oxides of lead, pounds	62,385,656	2,862,743
Oxide of zinc, pounds	60,235,154	2,212,787
Lamp black, pouods	7,519,345	420,037
Fine colors, pounds	4,080,902	1,028,754
Iron oxides and other earth colors, pounds	33,772,256	324,902
Dry colors, pounds	169,128,836	4,483,478
Pulp colors, sold moist, pounds	20,060,935	861,531
Paints in oil, in paste, pounds	310,072,689	17,858,693
Paints, ready mixed, gallons	17,380,348	15,139,431
Varnishes—		
Oil and turpentine, gallons	14,286,758	14,337,461
Alcohol, gallons	563,212	943,069
Pyroxylin, gallons	204,069	237,012
Liquid dryers, etc., gallons	6,564,370	3,085,254
Putty, pounds	17,287,323	238,427
All other products		2,778,725
Total		71,313,392

While it is not possible to give an equally complete list of materials, since the reports frequently give merely an aggregate of "all other materials" or report only one or two constituents separately, the following list may be of interest:

KIND.	Quantity.	Value.
Gums, pounds	36,533,632	$3,470,695
Alcohol, grain, gallons	78,309	175,907
Alcohol, wood, gallons	310,059	285,510
Dry colors, pounds[1]		7,002,913
White lead, pounds	39,689,235	1,970,614
Whiting, pounds	10,690,441	55,157
Linseed oil, gallons	16,157,117	7,495,196
Turpentine, gallons	6,519,408	2,965,051
Benzine, gallons	10,081,945	1,045,488
Total		24,466,531

[1] Dry colors includes zinc oxide, barytes, earth colors, and other dry paint materials not otherwise specified.

The growth of this industry as shown by previous census reports is as follows, the same chemicals being included for each census as far as comparable, although the Census Report for 1850 has some remarkable figures. This report gives 51 establishments making white lead with 1,508 employes, combined capital of $3,124,800, and a total product valued at $5,242,213, while only 4 paint works and 3 varnish works are reported, with a total force of 26 employees, capital $14,550, and product valued at $92,375. These figures seem to be erroneous, unless the "white-lead works" were really paint works, although each may have corroded lead for its own use, but this too is doubtful. This view seems to be borne out by the figures of the next census, that of 1860, which gives white lead 36 establishments with 994 employees, capital $2,453,147, product $5,380,347; paints 50 establishments; varnish 48; total employees 991; and capital $3,711,450; product $286,675. Included in paints for 1860 is an establishment reported as making zinc paints, with a capital of $1,000,000, employing 100 people, the product being valued at $250,000. Also 4 establishments making zinc oxide, with a combined capital of $1,228,000, employing 141 people, the total product amounting to only $226,860. These remarkable cases show that even at that early date overcapitalization was not unknown, at least in the zinc industry, unless, as is probable, the entire capitalization of the New Jersey zinc-mining companies, which were then the sole producers, was entered as being employed in the manufacture of this by-product.

PAINT AND VARNISH: 1850 TO 1900.

YEAR.	Number of establishments.	Capital.	Wage-earners.	Value of products.
1850	68	$3,217,100	1,579	$5,466,052
1860	164	7,402,697	2,216	11,107,342
1870	224	13,949,740	3,504	22,512,860
1880	325	17,333,392	5,056	29,111,941
1890	522	45,318,146	10,588	54,238,681
1900	615	60,834,921	13,513	67,376,641

In order to make the figures for 1900 fairly comparable with those of the preceding censuses, only the establishments of Class A are taken into account, the capital, value of products, and total number of employees, office force as well as factory workers, being given. The table at the beginning of this special group report gives the true statistical position of this industry, but so far as can be learned no attempt was made in any former census to separate the products there given under Classes B and C.

The paint and varnish industry in this country had its beginning in the early part of the last century. In 1804 Samuel Wetherill & Son began the manufacture of white lead in Philadelphia, followed in 1806 by Mr. John Harrison, the founder of the present firm of Harrison Brothers & Co., of Philadelphia. At that time all of the white lead used in this country was imported, but was greatly adulterated and very high priced. A letter from Mr. W. H. Wetherill, of Wetherill & Brother, the successors of Samuel Wetherill & Son, states that the American manufacture of white lead was much opposed by the agents of the foreign manufacturers and that the factory started in 1804 was shortly after destroyed by fire and that "evidence was not wanting" that this was done "by an incendiary sent to this country for this purpose." In 1808 operations were again started against heavy foreign competition, which lasted until the War of 1812 which enabled the domestic manufacturers to get a solid footing. From that time the business rapidly increased.

According to an article by W. P. Thompson in One Hundred Years of American Commerce, 1895, page 436, by 1830 there were 12 establishments in the country, of which 8 were east of the Alleghenies. This author gives the white-lead production of the country by decades as follows:

WHITE-LEAD PRODUCTION: 1810 TO 1890.

YEAR.	Tons.	YEAR.	Tons.
1810	369	1860	15,000
1820	....	1870	35,000
1830	3,000	1880	50,000
1840	5,000	1887	65,000
1850	9,000	1890	75,000

The manufacture of oxides of lead appears to have begun at about the same time as that of white lead, since by 1812 there were at least three establishments in Philadelphia. Both processes were very simple, litharge and red lead being made from the metal by regulated heating in a reverberatory furnace, while the white lead was made by the so-called Dutch process, which is still the favorite, the product being considered to be superior in quality to that made by any other process. While, as in everything else, skill is required to make a good grade of product in an economical manner, the process itself is so simple that the large number of white lead works reported for the census of 1850 may be explained by the development of the lead regions of Missouri and Illinois during the forties, as furnishing cheaper material, together with the idea, then probably prevalent, that anyone could make it, since it appeared to require only pots, lead, a little vinegar, and some spent tan bark.

The mixing of paints for sale naturally preceded the making of white lead, but there is no information available as to the beginning of such work. The first varnish factory, according to an article by D. F. Tiemann,[1] was founded by P. B. Smith, in New York in 1828, another early manufacturer being Christian Schrack, of Philadelphia, who began business as a maker of paints in 1816. The quality of the American varnishes proved so satisfactory that as early as in 1836 an export trade began. In 1857 D. F. Tiemann & Co. began making carmine from cochineal, and in 1860 soluble laundry blue and quicksilver vermilion, these products not having previously been made here. At present, American paint and varnish products enjoy a large and increasing foreign demand, and although the census returns for 1900 show that the great increase in the cost of materials during the census year has decreased profits, still the general condition seems to be a satisfactory one.

The foreign commerce in paints and varnishes for the United States is exhibited in the following tables, compiled from "The Foreign Commerce and Navigation of the United States," for the years ending June 30, 1891–1900.

[1] One Hundred Years of American Commerce, 1895, Vol. II, page 621.

PAINTS, PIGMENTS, AND COLORS: IMPORTS AND DOMESTIC EXPORTS, FOR THE YEARS ENDING JUNE 30, 1891–1900.

YEAR.	Imports, value.	Exports,[1] value.	YEAR.	Imports, value.	Exports,[1] value.
1891	$1,439,127	$690,698	1896	$1,309,041	$880,841
1892	1,372,052	709,857	1897	1,387,353	944,536
1893	1,466,761	700,308	1898	1,065,088	689,797
1894	980,715	825,987	1899	1,207,440	938,736
1895	1,246,924	729,706	1900	1,535,461	1,213,512

[1] Includes carbon black, gas black, lamp black, and oxide of zinc, prior to 1898

VARNISHES, SPIRITS, AND ALL OTHER, IMPORTS AND DOMESTIC EXPORTS FOR THE YEARS ENDING JUNE 30, 1891-1900.

YEAR.	IMPORTS.		EXPORTS.	
	Gallons.	Value.	Gallons.	Value.
1891	35,073	$97,298	153,365	$203,285
1892	38,737	101,692	215,266	293,059
1893	41,216	111,675	210,067	258,400
1894	20,337	54,746	226,760	282,278
1895	39,095	106,927	256,890	303,959
1896	40,644	105,551	335,979	362,975
1897	62,665	159,024	409,569	431,761
1898	32,848	79,702	398,841	422,693
1899	33,227	79,461	436,817	463,547
1900	43,743	103,985	588,545	620,104

Group XIV.—Explosives.

This industry, which, as measured by the value of the output, is the fifth in importance among the industries classified under chemical products, has shown a most promising growth during the last decade, as presented by the returns of the Census of 1900, for 97 regular establishments in 21 different states were engaged in the production of explosives. These establishments employed $19,465,846 of capital and 4,502 wage-earners, and produced 215,590,719 pounds, having a value of $16,950,976. They were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF EXPLOSIVES FACTORIES: 1900.

STATES.	Number of establishments.	Value of products.	Per cent of total.
United States	97	$16,950,976	100.0
Maine, Massachusetts, Connecticut, and Vermont	5	654,862	3.9
New York, New Jersey, Pennsylvania, Delaware, Virginia, and West Virginia	54	6,846,212	40.4
Alabama, Tennessee, Missouri, and Kansas	6	1,447,100	8.5
Iowa, Indiana, Illinois, Ohio, Michigan, and Wisconsin	25	3,728,249	22.0
California	7	4,274,553	25.2

These factories were most numerous in the sections where mining or engineering operations were carried on most extensively. Though Pennsylvania had 36 factories and the largest output was in the Middle Atlantic states, yet California alone manufactured over one-fourth of the entire annual output, and was much the largest producer in the United States. In addition to these establishments 5 were reported idle, 1 in operation with less than $500 in value of products, and 2 belonging to the United States Government that were in active operation during the census year, making 80,000 pounds of explosives, having a value of $60,506.

The growth of this industry may be shown by a comparison of the returns at the various censuses for which reports have been recorded. In compiling this data it was observed that the different methods of collecting and reporting the statistics would not permit of a comparison in every detail, yet so far as it can be made it is very instructive. It was also borne in mind that while up to 1860 the data of the explosives industry were for gunpowder alone, in that year blasting powder was included, in 1870 nitroglycerine, in 1880 dynamite, in 1900 smokeless powder, and for several of these decades, variable small amounts of guncotton, fulminate of mercury, and perhaps other explosives. The returns for seven decades are as follows:

TOTAL PRODUCTION AND VALUE OF EXPLOSIVES, BY DECADES: 1840 TO 1900.

YEAR.	Number of establishments.	Capital.	Average number of wage-earners.	PRODUCTS.	
				Pounds.	Value.
1840	137	$875,875	496	8,977,348	....
1850	54	1,179,223	579	....	$1,590,332
1860	58	2,305,700	747	....	3,223,090
1870	36	4,099,900	973	....	4,237,539
1880	54	6,585,185	1,340	....	5,802,029
1890	69	13,539,478	2,353	98,645,912	10,993,131
1900	97	19,465,846	4,502	215,980,719	[1] 16,950,976

[1] This value is for the explosive substances only. When materials of all kinds produced in these establishments are included the value is $17,125,418.

A better idea of the industry may be had by the discussion of each of the products so far as the statistics will permit. This is done for gunpowder (blasting powder being included in this term) in the following table:

PRODUCTION AND VALUE OF GUNPOWDER, BY DECADES: 1840 TO 1900.

YEAR.	Number of establishments.	Capital.	Average number of wage-earners.	PRODUCT.	
				Pounds.	Value.
1840	137	$875,875	496	8,977,348	....
1850	54	1,179,223	579	....	$1,590,332
1860	58	2,305,700	747	....	3,223,090
1870	33	4,060,400	939	....	4,011,839
1880	33	4,983,560	1,011	....	3,348,941
1890	37	9,609,975	1,622	95,019,174	6,740,099
1900	47	8,297,773	1,708	123,314,103	5,310,351

Gunpowder.—Although since the Eleventh Census smokeless powder has come to be used for military and sporting purposes, 1 pound, speaking roughly, replacing 3 pounds of black gunpowder, yet the amount of black gunpowder produced and consumed is still large, and it bids fair to be so for some years to come. This is due to several causes, among which are the following: First, because in ordnance it is necessary to use a priming charge of black gunpowder with which to fire the smokeless powder. Second, because smokeless powder can not be efficiently substituted for black gunpowder in the older forms of small arms that are widely scattered over the country. Third, because black powder is most suitable for use in fuses and in pyrotechnics. Fourth, because smokeless powder is too expensive, and in no way superior to black gunpowder for saluting purposes. From the returns it is found that in the census year there were 10 establishments in 9 different states making black gunpowder, and that they employed $3,397,288 of capital, and 556 wage-earners, and produced 25,638,804 pounds of powder, having a value of $1,452,377. In making this there were consumed 8,614 tons of potassium nitrate (India saltpeter), 174,810 bushels of charcoal, and 1,282 tons of refined sulphur. About 6,800 tons of the potassium nitrate were made by conversion of sodium nitrate with potassium chloride, consuming 5,700 tons of sodium nitrate (Chile saltpeter). The wood employed for the making of the charcoal was willow, alder, or dogwood, and the yield of charcoal was about 25 per cent by weight of the air-dried wood.

While the composition of gunpowder may vary somewhat, the formula usually followed for black gunpowder is 75 per cent of potassium nitrate, 15 per cent of black charcoal, and 10 per cent of sulphur. In recent years brown prismatic powder has been used in heavy ordnance of the general composition of 78 per cent of potassium nitrate, 20 per cent of charcoal, and 3 per cent of sulphur, in which the "charcoal" was underburned charcoal from peat or rye straw, or in which carbohydrates were used, but such gunpowder has been almost, if not completely, displaced.

The manufacture of gunpowder is a very old one, this material having been used as a propellant in cannon at the battle of Crecy in 1346. It was manufactured in the United States prior to and during the Revolutionary War by means of stamp mills which consisted of mortars and pestles of wood and bronze by which the ingredients were pulverized and mixed, the damp material being grained by rubbing through sieves. This method produced not only a very coarsely made and irregularly acting powder but it was very dangerous, as, for instance, according to Chaptal, in France about one-sixth of the total stamps at work blew up annually. In 1787, Cossigny introduced at the Isle de France the practice of pulverizing and mixing the ingredients in wheel mills. In 1791, Carny devised the method of pulverizing in drums, wheel mills being used for incorporating the mass. During the latter part of the Eighteenth century the manufacture of gunpowder was brought to a high degree of perfection in France by the eminent chemist Lavoisier, who had supervision of the Government powder works.

The modern methods of manufacture in the United States began with the founding of the works at Wilmington, Del., in 1802, by Eleuthére Irenée du Pont de Nemours, who had learned powder making from Lavoisier, and who obtained from France the most approved machinery; and these works, constantly growing, have been in regular operation up to the present time, and the methods and kinds of machinery employed have been introduced into the mills subsequently erected elsewhere in this country.

The more recent improvements have been in the introduction of retorts for burning the charcoal, the manufacture of the saltpeter by conversion, and the devising of various forms of press mills. The method of manufacturing potassium nitrate from sodium nitrate by metathesis with potassium chloride was suggested by Longchamps, Anthon, and Kuhlmann in 1859, and was adopted at the Dupont works about 1868. With the large deposits of sodium nitrate available in Chile and potassium chloride accessible at Stassfurt, in Germany, this artificial source for saltpeter successfully competed with the native sources in India, where the supply is limited. This method of manufacture of potassium nitrate has also so reduced the cost of the article as to remove all temptation to continue the vicious system of niter plantations, which robbed the soil of one of its most valuable plant foods.

Blasting powder.—This industry, which is a development of the last century, was pursued during the last census year in 37 different establishments, located in 13 different states, the state of Pennsylvania alone having 19 separate works. There was employed $4,900,485 of capital, and 1,153 wage-earners, and the product amounted to 97,744,237 pounds of powder, having a value of $3,880,910. In the manufacture of this powder there were consumed 38,000 tons of sodium nitrate (Chile saltpeter), 746,000 bushels of charcoal, and 5,100 tons of sulphur.

Between 1802 and 1840 two large gunpowder factories, as well as a few smaller ones, were established in the United States. The active construction of canals and the exploitation of mines caused a considerable and growing demand for gunpowder for use in blasting, which eventually became so marked that to meet it the powder makers placed a "blasting powder" upon the market, which contained the same ingredients as black gunpowder except that they were not so carefully purified and the powder was less carefully made. In 1856 the material now commonly known as blasting powder was made, and it differs from the older blasting powder chiefly in the fact that the expensive potassium nitrate (India saltpeter) of the latter is replaced by the cheap sodium nitrate (Chile saltpeter). For some years prior to the above date, the idea of using sodium nitrate had obtained, but the fact that it was a deliquescent substance had proved an obstacle; yet the difficulties which were supposed to be insurmountable were overcome, and in 1856 its manufacture was begun on a large scale by the leading powder makers. A patent for a gunpowder containing sodium nitrate was granted to L. Dupont in 1857, and upon this an enormous industry, not only in the United States but throughout the world, has been built, and through it an additional impetus has been given to engineering and mining operations. Furthermore, this increased consumption of Chile saltpeter led to an increased development of the enormous deposits of this salt in the desert of Tarapaca, which so cheapened the nitrate as to benefit and stimulate the nitric acid, fertilizer, and many other industries in which this material is used.

The proportions of the ingredients in blasting powder may vary widely. Thus the census returns for 1900 showed gunpowders composed of 67.3 per cent of sodium nitrate, 22.9 per cent of carbon, and 9.4 per cent of sulphur, up to powder composed of 77.1 per cent of sodium nitrate, 8.6 per cent of carbon, and 14.3 per cent of sulphur. Guttman, in his "Manufacture of Explosives," gives a powder consisting of 60.19 per cent of sodium nitrate, 21.36 per cent of charcoal, and 18.45 per cent of sulphur. From a large number of returns we find the average composition to be 74 per cent of sodium nitrate, 16 per cent of charcoal, and 10 per cent of sulphur.

Blasting powder is usually put upon the market in corrugated iron kegs, holding 25 pounds each.

Nitroglycerin.—Nitroglycerin appeared for the first time among the chemical products of the United States in the census returns for 1870, but in 1890 it disappeared under the legend "high explosives," which term usually includes dynamite, gun cotton, nitrosubstitution explosives, and fulminates. While the larger part of the nitroglycerin made is subsequently consumed in the manufacture of dynamite, blasting gelatine, and smokeless powder, there is still a quantity made and sold as such. For the census year 1900 there were 22 establishments located in 6 different states, employing $293,881 of capital and 105 wage-earners. The product amounted to 3,618,692 pounds and had a value of $783,299. There were consumed in its manufacture 1,897,448 pounds of glycerin and 12,134,869 pounds of mixed acids.

In addition to the nitroglycerin produced and sold as such, 31,661,806 pounds were made and consumed, and there were required to make it 15,043,483 pounds of glycerine and 96,092,451 pounds of mixed acids. The total production of nitroglycerin, therefore, for the census year was 35,482,947 pounds, and there were used as materials 16,983,918 pounds of glycerin and 108,227,320 pounds of mixed acids. Although all but two of the factories purchased their sulphuric acid originally, many of them regained their spent acids and some of them manufactured their nitric acid. The quantity of acid reported as regained was 15,916,907 pounds, and of nitric acid manufactured, 26,058,779 pounds. There were consumed in the manufacture of this nitric acid 19,817 tons of nitrate of soda and 28,177,000 pounds of 66° sulphuric acid, but much of the latter was regained acid.

The production of nitroglycerin for 1900 as compared with that reported in previous decades is set forth in the following table:

PRODUCTION OF NITROGLYCERIN FOR THREE DECADES, 1870, 1880, AND 1900.

YEAR.	Number of establishments.	Capital.	Average number of wage-earners.	PRODUCT.	
				Pounds.	Value.
1870	3	$39,500	34	....	$225,700
1880	19	1,601,625	329	3,039,722	1,830,417
1900	22	293,881	105	3,618,692	783,299

Nitroglycerin was discovered by Ascanio Sobrero in Turin, Italy, in 1847, and it is interesting to note that upwards of 7 ounces of the first nitroglycerin made by Sobrero are still kept at the Nobel dynamite factory at Avigliana, in Italy, and are tested every year. Its commercial manufacture seems to have been begun by Alfred Nobel, in Sweden, in 1862, and in 1863 he received his first patent in this art for a mixture of ordinary gunpowder with nitroglycerin, he having at first employed gunpowder as a means of exploding the nitroglycerin. In 1863, however, he discovered that nitroglycerin could not only be exploded with certainty by means of a copper capsule containing mercuric fulminate (now known as a blasting cap or detonator), but that the power developed by the nitroglycerin was enormously greater than could be obtained from it by any other means, and this discovery marked an epoch, not only in the history of nitroglycerin, but in that of all high explosives, since it revealed the method of inducing explosion by detonation.

So near as can be ascertained, the manufacture of nitroglycerin in the United States began at the Giant Powder Company's works in California, in 1867, using Nobel's methods. In 1867 George M. Mowbray also began the manufacture, by independent methods, at North Adams, Mass. Mr. Dupont says:[1]

> There are two engineering works which indicate very well the era of the introduction of high explosives in this country. In the year 1870 the Nesquehoning tunnel, near Wilkesbarre, was excavated in very hard rock by the use of black powder only. The engineers in charge were unwilling to introduce the then new and untried explosive. The work was, however, completed in good form and very quickly, owing largely to the extensive use of compressed air drills. About the same time the Hoosac tunnel was completed, nitroglycerin alone being used in the work. This explosive was principally manufactured upon the ground, and was much used in the liquid state. This work was a greater one than the tunnel first mentioned, but the two serve to mark the transition period in the practical use of explosives. One of the greatest of modern engineering works, the Chicago drainage canal, is now (1895) being carried on largely by high explosives. It is an example of the magnitude of the work that is attempted with explosives.

Nitroglycerin is manufactured by mixing glycerin with a mixture of nitric acid and sulphuric acid. Each of the materials used is the most concentrated that can be made, and the demand for large quantities of nitric and sulphuric acids and glycerin of the highest grades which has been created by the high-explosives industry has had a marked effect on the development of the acid and glycerine industries. The acids are usually mixed in the proportion of 3 parts by weight of sulphuric acid to 2 parts by weight of nitric acid, and they should contain 61.9 per cent of H_2SO_4 and 34.5 per cent of HNO_3, with not more than 0.7 per cent of N_2O_3. These previously mixed acids are sent out from the acid works in iron drums holding about 1,500 pounds, and this weight of mixed acids makes a convenient charge for one run in the nitroglycerin converter, from 210 to 230 pounds of glycerin being there mixed with it.

[1] One hundred years of American Commerce, Vol. I, page 192.

The reaction goes on between the glycerin and the nitric acid, the sulphuric acid present serving chiefly to take up and retain the water which is one of the products of the reaction. When the reaction is completed the materials are run into a tank, where they rest until, owing to their differences in specific gravity, the nitroglycerin and spent acids form into separate layers; then the nitroglycerin is run off into washing and purifying tanks, and the acids are run off to be reworked. The dilute nitric acid thus obtained is sometimes used in the manufacture of ammonium nitrate for use in dynamite dopes. The diluted sulphuric acid is sometimes used in the manufacture of nitric acid, but it is more often concentrated in iron pans, and, after being mixed with strong nitric acid, again used in making nitroglycerin. This spent acid averages in composition 72 per cent of sulphuric acid, 10 per cent of nitric acid, and 18 per cent of water. Theoretically, 100 parts by weight of glycerin should yield 246 parts of nitroglycerin, but in practice the yields are from 200 to 220 parts.

Nitroglycerin is used directly in torpedoes, which are cylinders holding 20 quarts each, for "shooting" oil wells. It also is used in medicine as a heart stimulant. The principal use of nitroglycerin is in making dynamite and blasting gelatin.

Gun Cotton or Pyroxylin.—By the returns for the census of 1900 there were 10 establishments in 3 different states engaged in the manufacture and sale of cellulose nitrates, for various uses and they employed $255,343 of capital and 163 wage-earners. There were produced 922,799 pounds of the various cellulose nitrates, having a value of $486,773, and there were consumed 691,115 pounds of cotton and 8,247,668 pounds of mixed acids. Besides these there were produced and consumed in other establishments 2,739,834 pounds of cellulose nitrates, making a total product for the year of 3,662,633 pounds.

Gun cotton, or pyroxylin, is the name given to various cellulose nitrates which were discovered by Schönbein in 1846, and which result from the reaction between nitric acid and cellulose. There is a considerable number of cellulose nitrates; authorities differ as to their number. In fact, there is still doubt as to the real constitution of cellulose, and therefore nothing can be pronounced with certainty as to the constitution of the nitrates produced from it. However, it is generally accepted that the formula of cellulose is some multiple of $C_6H_{10}O_5$, and that the nitrates are produced by replacing one or more atoms of the hydrogen present by NO_2. It is also accepted, following Vieille, that, taking the formula as $C_{24}H_{40}O_{20}$, there may be at least 8 different cellulose nitrates in which from 4 to 11 groups of NO_2 have been introduced into the molecule. In the following table these different nitrates are so named as to indicate the number of NO_2 groups present, and there is also shown the per cent of N present in each.

CELLULOSE NITRATES.	Per cent of nitrogen.	Weight obtained from 100 parts of cellulose.
Cellulose endecanitrate	13.47	176.4
Cellulose decanitrate	12.75	169.4
Cellulose enneanitrate	11.96	162.5
Cellulose octonitrate	11.11	155.7
Cellulose heptanitrate	10.18	148.6
Cellulose hexanitrate	9.15	141.7
Cellulose pentanitrate	8.02	134.7
Cellulose tetranitrate	6.76	127.8

In addition to these nitrates containing different per cents of nitrogen, there are undoubtedly isomers of many of them. According to their difference in nitrogen contents, or in intermolecular arrangement, these nitrates exhibit different degrees of solubility toward organic solvents, and are in consequence put to different commercial uses. Thus the higher ones are, under ordinary conditions, insoluble in a mixture of 2 parts of strong ethyl ether and 1 part of strong ethyl alcohol, and such cellulose nitrate is called gun cotton. On the other hand, the lower nitrates are soluble in the mixed solvent named under these conditions, and these cellulose nitrates are called pyroxylin. It should be said that later researches tend to show that, according to the conditions under which they are nitrated or the conditions under which they are exposed to the solvent, the higher nitrations are acted upon by the ether-alcohol solvent.

Cellulose nitrates are prepared by immersing purified cotton in mixtures of nitric and sulphuric acid. In making gun cotton, the acid mixture consists of 1 part, by weight, of nitric acid of 1.5 specific gravity to 3 parts, by weight, of sulphuric acid of 1.845 specific gravity, and 1 pound of steam-dried cotton is immersed in and digested for twenty-four hours with 12 pounds of this acid mixture. The acid is then wrung out and the gun cotton is pulped, washed, and compressed into blocks for use. The spent acids which are thrown out in the wringing have been found to contain 79.91 per cent of H_2SO_4, 9.52 per cent of HNO_3, 1.04 per cent of N_2O_4, and 9.65 per cent of water, and they are reworked to be used again. In making the lower cellulose nitrates weaker acids are used, the strength being determined by the use to which the nitrate is to be put. Examples of such acid mixtures are given under smokeless powder and under pyroxylin plastics.

Cellulose nitrates are used for many purposes in the arts. Finely pulped, compressed material, consisting principally of the highest nitration, is known as gun cotton and is used in military mines and torpedoes, and for destructive purposes generally in military operations. Owing to the discovery by E. O. Brown, of Woolwich, in 1868, that it can be detonated when wet, it is now stored and used while saturated with water. In 1847 or 1848 Doctor Maynard, of Boston, discovered that pyroxylin was soluble in ether-alcohol and that the liquid, called "collodion," could be used as a vehicle for medicine and as a substitute for sticking plaster. In 1851 Frederick Scott Archer invented the process of coating photographic plates with collodion. In 1869 John W. Hyatt, Jr., and Isaiah S. Hyatt, of Albany, N. Y., invented the process for manufacturing "celluloid" from cellulose nitrate. Still later, Frederick Crane invented pyroxylin varnishes, and Chardennot invented a process for making artificial silk from pyroxylin. A large use for cellulose nitrates is in the manufacture of smokeless powder, explosive gelatine, and gelatine dynamite. By the use of pyroxylin solutions a form of artificial leather is obtained.

Dynamite.—This explosive first appears in the report of the census of 1880, and then amounted in value to but one-third of that for the nitroglycerin produced. According to the census of 1900, there were 31 different establishments, located in 8 different states, employing $7,551,121 of capital, and 1,758 wage-earners engaged in the manufacture of dynamite. There were produced 85,846,456 pounds, having a value of $8,247,223, and there were consumed in making it, 31,661,806 pounds of nitroglycerin, 20,090 tons of sodium nitrate, 9,934,360 pounds of wood pulp, 82,558 pounds of pyroxylin, and 483,975 pounds of ammonium nitrate.

The production and value of dynamite for 1900, compared with that reported in previous decades, is set forth in the following table:

PRODUCTION OF DYNAMITE, BY DECADES: 1880 to 1900.

YEAR.	Number of establishments.	Capital.	Average number of wage-earners.	PRODUCT.	
				Pounds.	Value.
1880	2				$622,671
1890	32	$3,929,503	731	30,626,738	4,253,032
1900	31	7,551,121	1,758	85,846,456	8,247,223

Dynamite was invented by Alfred Nobel in 1866, and its manufacture began shortly after at the various works established by him. In his testimony before the select committee on explosive substances of the British Parliament, in 1874, Nobel testified that there were then 13 factories, in which he was interested, engaged in this manufacture, 2 of them being in America, while there were many independent works in addition. The returns for dynamite were not so rendered in the prior census reports that the growth of this important industry can be readily ascertained, but some general idea of its growth may be gained from the following table, given by George McRobert, setting forth the annual sales of dynamite for each of sixteen years, from the factories with which Nobel was associated.

McROBERT'S TABLE.

YEAR.	Sales, tons.	YEAR.	Sales, tons.
1867	11	1875	3,500
1868	78	1876	4,300
1869	184	1877	5,500
1870	424	1878	6,200
1871	785	1879	7,000
1872	1,350	1880	7,500
1873	2,050	1881	8,500
1874	3,120	1882	9,500

Dynamite is a material of most variable composition. It consists of a solid porous absorbent which holds the liquid nitroglycerin, and its invention was a necessity, since so many frightful accidents due to the liquid state of nitroglycerin led to legislation in Europe which forbade the transportation and use of the latter explosive. Kieselguhr (known as infusorial silica) was largely used at first, and is still much used in Europe, as the absorbent, but this "dope," as the absorbent base is called, is almost entirely replaced in this country by an explosive dope, which is most frequently a mixture of wood pulp and sodium nitrate, with a very small percentage of calcium or sodium carbonate to act as a neutralizer to any acid present. Such a dynamite is known as a straight dynamite, but there are others which contain a dope of coarsely made gunpowder or of resinous compositions. In 1875 Nobel invented an explosive made by dissolving pyroxylin or soluble cellulose nitrate in nitroglycerin until, when the mixture was cool, it set to a jelly-like mass which is known as explosive or blasting gelatin. This is often mixed with wood meal or wood pulp, and then gelatin dynamite is produced. As may be inferred, dynamites vary greatly in their nitroglycerin contents, and they may be found on the market containing from 5 per cent, as in a bank blasting powder, up to 94 per cent, as in a blasting gelatin. The grade which is probably the most extensively used is that known as 40 per cent dynamite, and analysis has shown a straight dynamite of this grade to contain of nitroglycerin 39.8 per cent, sodium nitrate 46.1 per cent, wood pulp 11.5 per cent, calcium carbonate, 0.7 per cent, moisture 1.9 per cent. It can be safely assumed that 40 per cent is the average nitroglycerin content of the dynamites of all kinds put on the market.

Dynamite as sold is usually loaded into paraffined paper cases, thus making it into "sticks" or "cartridges." These sticks may vary much in size, but the average stick will be 8 inches in length by 1½ inches in diameter, and they are packed in sawdust in boxes holding 50 pounds each.

Smokeless Powder.—At the time the Eleventh Census was taken no smokeless powder was reported, nor was there then any factory in operation for its regular production, while for the census year 1900 there was an output of 3,053,126 pounds of powder having a value at the works of $1,716,101. This industry, which is wholly a growth of the last ten years, embraced 9 factories, having $2,153,958 of capital, gave employment to 730 wage-earners, and consumed 14,000,000 pounds of mixed acids, 1,600,000 pounds of cotton, 2,600,000 pounds of alcohol, 1,400,000 pounds of ether, 143,000 pounds of acetone, and 88,000 pounds of nitroglycerin. There is little doubt that the growth will be much more rapid in the immediate future, as smokeless powder is rapidly supplanting black gunpowder for military and sporting purposes, and, as a large part of the time during the last ten years has been spent in the invention of machinery for handling the materials, in planning works so as to secure the maximum of safety with the maximum of speed and economy in manufacture and in the devising of means for the recovery and renewal of the spent acids and solvents.

The very earliest manufacture of smokeless powder in the United States was carried on by Charles Lennig, at Philadelphia, Pa., about 1850. His small-arm charges were made of long staple, fibrous gun cotton, and, as elsewhere, they were found to be so dangerous that their use was soon abandoned. The next factory to be started was erected by Carl Dittmar, at Quincy, Mass., about 1870, where a soft, granulated powder was made, but this was also abandoned.

The first of the factories erected for the manufacture of modern smokeless powder was planned, erected, and operated at the United States Naval Torpedo Station at Newport, R. I., in 1890, by Charles E. Munroe, under the direction of Commander Theodore F. Jewell, United States Navy, inspector of ordnance, in charge of the station, and it is to-day in regular operation, having been much enlarged. Following this, 4 factories were erected in 1891, 1 in 1895, 1 in 1898, and 2 in 1900, all of which were producing during at least a part of the census year. These factories were scattered through 7 states, 3 of them being in New Jersey and 2 of them being factories belonging to and operated by the United States Government. The Government factories produced military powder only, 4 of the private factories produced sporting powder only, while the remaining private works, though manufacturing largely for military purposes, produced some sporting powder also.

The earliest recorded attempt to use a smokeless explosive as a propellant is found in the experiments of Howard, who in 1800 attempted to use mercury fulminate in place of gunpowder in a firearm, with the result that he burst the piece. Immediately after the discovery of gun cotton by Schönbein in 1846, extensive trials of it as a propellant were made in Germany, France, England, and the United States, but as it was then used in the ordinary fluffy or thread-like condition of cotton it proved too violent. In 1866 Frederick A. Abel devised a method for granulating gun cotton by introducing pulped nitrocellulose containing water and a small quantity of a binding material into a vessel to which a vibrating motion was imparted, thereby producing soft grains, but this does not seem to have come into vogue.

The first person to realize any considerable degree of success was Captain Schultze of the German army, who, in 1862, made a soft-grained powder from well-purified and partly nitrated wood. The first nitrocellulose powder to approach modern requirements was the E. C. powder, invented by Reid and Johnson in 1882, in which the soft grains, produced by rolling pulped nitrocellulose containing water in barrels were superficially hardened or waterproofed after granulation. The first successful military smokeless powder was made in France by Vieille, and it consisted of a hard, dense-grained flake, or fagot powder, made from nitrocelluloses mixed with a nitrate, like barium nitrate, and with or without picric acid. This was followed in 1888 by the ballistite of Nobel, and in 1889 by the cordite of Abel and Dewar, each of which was composed of mixtures of nitrocelluloses with nitroglycerine and a restrainer of some kind. The whole was worked, by admixture with suitable solvents and by use of the proper machinery, into grains which were hardened throughout. In 1889 Richard Von Freeden discovered that gelatinized nitrocellulose, still containing the solution employed for its gelatinization, on being exposed to certain liquids, or the vapors thereof, undergoes a kind of coagulation and division into small lumps, which latter is promoted by stirring, and upon this he based a method of manufacture by which small-grained powders that are hardened throughout could be produced, and the method is now quite extensively followed.

Up to this time all gunpowders throughout the world, both black and smokeless, were made of mixtures of various ingredients, even the smokeless powders, which were made from nitrocellulose only, being made from mixtures of cellulose nitrates of different degrees of nitration; but in 1889 Charles E. Munroe proposed that smokeless powders be made of a single chemical substance in a state of chemical purity, and he pointed out that cellulose nitrate, of uniform nitration, then offered the best material from which to produce such a powder, and this is the principle which to-day governs the manufacture of military smokeless powders, at least in the United States.

Although up to 1898 the United States Army proposed to use smokeless powder composed of nitrocelluloses and nitroglycerin, the United States Navy adopted in 1890 a cellulose powder of uniform nitrogen contents, and the Army followed in 1898. As made to-day, the nitrocellulose used contains from 12.45 to 12.80 per cent of nitrogen. Such cellulose nitrate is made by dipping 1 pound of cotton (free from oil and mechanical impurities and containing about 57 per cent of moisture) in 19 pounds of "mixed acids," containing about 57 per cent of H_2SO_4, 28.2 per cent of HNO_3, and not more than 2 per cent of N_2O_4. The acid has an initial temperature of 25° C., and the crock containing the mixed acids and cotton is heated to 36° C., the cotton being exposed at this temperature, with one turning over of the cotton, for sixty minutes. After purification by wringing, washing, and steaming to remove the acid, the nitrocellulose is freed from the water remaining in it by extraction with alcohol, and it is converted into a gelatinous mass by kneading or stirring in a Werner and Pfleiderer mixing machine with a mixture of ethyl ether and ethyl alcohol, 2 parts by weight of ether and 1 part by weight of alcohol being used for every 3 parts by weight of nitrocellulose. The subsequent processes have for their object the more intimate mixing of the material and straining off of the unconverted portions, the shaping of the mass into grains, and the drying of the grains. The finished grains still contain some of the solvent, particularly alcohol, the amount varying with the thickness of the walls of the grains. In the very smallest grains this amounts to about one-half of 1 per cent, while in the larger grains there may be as much as 4 per cent of solvent present.

It is not easy to check the data in this manufacture, and for this reason round numbers are given. It may be said, however, that 100 pounds of perfectly dry cotton will yield 169 pounds of this nitrocellulose, but the cotton as used may contain as much as 7 per cent of moisture, while the final product may contain from one-half of 1 per cent to 2 per cent of solvents. The quantities of acids can not well be checked, because the spent acid is "rebuilt" and used again. The difficulty is even greater with the solvents, since most of the works manufacture the ether used from part of the alcohol purchased or supplied to them besides reusing the recovered solvents. An additional complication in comparing costs arises from the fact that, when the powder is being made in private works for the United States Government, the manufacturer is permitted to use tax-free alcohol, while if he be making such powder for other parties he must use tax-paid alcohol. Where the Government supplies the alcohol, the weight of alcohol allowed is 1.4 times the weight of the finished powder.

The foregoing description is for military powder, and though picrates and metallic salts, such as nitrates and bichromates, are used to some extent in sporting powders, yet they are to so large an extent composed of nitrocellulose that they may be regarded for purposes of census classification as composed wholly of this material. The methods of manufacture are as a rule quite different from those employed in the making of military powders, and the gelatinizing agents used are ethyl acetate, amyl acetate, and the like, in place of ether-alcohol. It is to be noted that a small portion of the smokeless powder reported for the census year was a nitrocellulose-nitroglycerin powder which had been gelatinized by acetone. Smokeless powder is usually sold in metal canisters holding 1 bulk pound each.

Fulminates.—Although charges of dynamite and other high explosives are invariably fired by detonators or blasting caps charged with mercuric fulminate, and, although percussion caps, friction primers, and fixed ammunition are also charged with this explosive, yet the amount of this most important and essential explosive which is returned as manufactured in the United States was quite insignificant. On the other hand, as shown by the following table, compiled from the records of the Bureau of Statistics of the United States Treasury Department, the importation of fulminate is assuming greater and greater importance as our home industry in other explosives grows, and this is shown even more markedly if to the values for the fulminates there be added those for the blasting caps, percussion caps, and cartridges that are also imported:

IMPORTS, FOR CONSUMPTION, OF FULMINATES, FULMINATING POWDERS, AND LIKE ARTICLES: 1884 TO 1900, INCLUSIVE.

YEAR.	Value.	YEAR.	Value.
1884	$487	1893	$48,509
1885	5,577	1894	42,567
1886	10,647	1895	65,891
1887	10,099	1896	77,197
1888	20,984	1897	76,515
1889	10,717	1898	46,703
1890	19,460	1899	108,741
1891	44,403	1900	105,999
1892	36,278		

The fact that, notwithstanding the dangers attendant on the transportation of this violent explosive substance, its home manufacture has been almost completely superseded by the foreign product, is explained on stating that it is manufactured from grain alcohol, mercury, and nitric acid; that for every 12 parts by weight of mercury fulminate produced 110 parts by weight of 95 per cent alcohol are consumed; and that the tax levied in the United States on alcohol makes the foreign commerce in this article a very profitable one, and home competition practically impossible.

Wage-earners and wages.—There were employed in the entire explosives industry 4,349 men, 117 women, and 36 children under 16 years of age. The wages for the men varied from $365 per annum in New Jersey to $790 per annum in California, the average for the whole country being $539 per annum. The average wage for women was $263 per annum, and for children $169 per annum.

Power.—The total horsepower reported as being employed in these factories was 22,920 horsepower, of which 5,674 horsepower was supplied by 190 water wheels, 13,242 horsepower by 315 steam engines, 2,885 horsepower by 177 electric motors, and 279 horsepower from other sources. The returns are chiefly interesting in marking changes in methods, for, formerly, in erecting black gunpowder works especial care was taken to secure a location for the works where there was an abundant water supply and plenty of wood for charcoal making; whereas, in the manufacture of the modern explosives, while a sufficient isolation to obtain security for the works and limit the damage resulting from accidental explosions is sought, yet readiness and convenience in transportation of the materials used and the goods manufactured are regarded as of the first importance. The improvements in the methods for generating, conveying, and transforming the energy in steam or electricity have now rendered it relatively safe to employ these sources of energy.

Imports and Exports.—A more nearly correct idea of the condition of this industry may be obtained if there be added to the census statistics those for the imports and exports of explosives. The imports of fulminates have already been considered, and attention is now called to the statistics for the foreign commerce in all explosives as compiled from "The Foreign Commerce and Navigation of the United States for the year ending June 30, 1900," Vol. II.

IMPORTS OF GUNPOWDER, FULMINATES, AND ALL LIKE ARTICLES: 1891 TO 1900, INCLUSIVE.

YEAR.	GUNPOWDER.		All other explosives, fulminates, etc., value.	Total value.
	Pounds.	Value.		
1891	34,312	$19,148	$124,528	$143,676
1892	31,111	29,533	100,977	130,510
1893	78,306	68,974	124,661	193,635
1894	85,481	71,285	67,342	138,627
1895	104,990	84,882	96,940	181,822
1896	68,993	49,857	77,192	127,049
1897	87,921	63,722	98,727	162,449
1898	98,708	79,992	65,123	145,115
1899	44,405	29,824	160,620	190,444
1900	31,212	15,835	169,073	184,908

DOMESTIC EXPORTS OF GUNPOWDER AND OTHER EXPLOSIVES: 1891 TO 1900, INCLUSIVE.

YEAR.	GUNPOWDER.		All other explosives, value.	Total value.
	Pounds.	Value.		
1891	733,834	$88,676	$906,870	$995,546
1892	903,077	108,276	752,079	860,355
1893	885,263	105,547	755,966	861,513
1894	495,566	66,839	935,287	1,002,126
1895	972,271	102,885	1,174,396	1,277,281
1896	1,159,935	124,823	1,256,279	1,381,102
1897	1,086,465	118,001	1,437,317	1,555,318
1898	1,202,971	139,644	1,255,762	1,395,406
1899	1,504,624	181,642	1,350,247	1,531,889
1900	1,612,822	197,438	1,694,166	1,891,604

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Group XV.—Plastics.

During the census year 8 establishments manufactured cellulose plastics and also engaged in the further manufacture of these plastics into articles of various sorts. The value of the plastics produced was $2,099,400. The total value of the plastics and of the finished articles was $3,063,673. There were employed a capital of $7,558,720, and 1,221 wage-earners. The growth of the industry can be shown only for the pyroxylin plastics, including the finished article as displayed in the following table:

PRODUCTION OF PYROXYLIN PLASTICS, BY DECADES, 1880 TO 1900, INCLUSIVE.

YEAR.	Number of establishments.	Capital.	Number of employees.[1]	Value of products.
1880	6	$1,214,000	736	$1,261,540
1890	12	3,158,487	1,023	2,575,736
1900	7	7,210,548	1,176	2,864,044

[1] For 1900 this means wage-earners only.

Pyroxylin Plastics.—The best known of all the pyroxylin plastics is "celluloid." The art of making pyroxylin plastics was begun in England when Alexander Parkes discovered, in 1855, that a solution of pyroxylin, mixed with other substances, could, after the solvent was evaporated, be made into a substance having the qualities of horn or ivory, and could then be easily molded or worked or colored as desired. He entered vigorously upon the manufacture of this substance, which he called "parkesine," and put on exhibition various articles made from it, but the enterprise did not succeed and was abandoned in 1867. About this time Daniel Spill began the making of what he styled "zylonite" from pyroxylin or zyloidin by treatment with solvents and admixture with other materials, but owing to the fact that quite fluid solutions were employed, and to the difficulty of getting rid of the excess of the solvents, the operations were not commercially practicable.

In 1869, John W. Hyatt, Jr., and Isaiah S. Hyatt, of Albany, N. Y., made the important discovery that camphor by itself is a solvent for pyroxylin, if, after the camphor has been mixed with the pyroxylin, the mixture be heated to from 150° to 200° F. and subjected at the same time to a heavy pressure, and that the product can be worked like rubber. To this discovery, for which United States Patent No. 105338, July 12, 1870, and its reissues were granted, to the process which those inventors based on it, and to the knowledge and skill which were developed by its practice, is due the present commercial success of pyroxylin plastics.

The Hyatt Brothers began the manufacture of celluloid in a small way at Albany, N. Y., in 1869, but capital was soon interested in the venture, and in 1870 the business was removed to Newark, N. J., where the Celluloid Manufacturing Company has since remained in active operation. It had so expanded in 1896 that the floor space occupied at the factory was nearly eight acres in extent, and it is claimed that over 6,000 persons throughout the country were employed, either in producing the celluloid, or shaping the product of this factory into various articles.

The manufacturing operations at the factory involve the production of the pyroxylin, its conversion into celluloid, and the manufacture of part of the product into wearing apparel and toilet and fancy articles. According to Field, the pyroxylin is made by dipping cotton or tissue paper into a mixture of sulphuric acid 66 parts, nitric acid 17 parts, and water 17 parts, 100 pounds of the acid mixture being used for 1 pound of the paper, and the immersion being continued from twenty to thirty minutes at 30° C. The pyroxylin used in this art is of low nitration, containing about 10.18 per cent of nitrogen.[1] The purified pyroxylin is mixed with camphor by sprinkling it with a solution of camphor in wood alcohol, and incorporating the mass with other desired ingredients on steam-heated maxillating rolls. The solid celluloid which is thus obtained, and which is a composition of pyroxylin with camphor, an ant-acid, and coloring matter, is then shaped by cutting into sheets, stuffing through die plates, molding under pressure while hot, turning, and the like, into various objects.

Celluloid is used in making collars and cuffs; piano and organ keys; billiard balls; paper cutters; combs; backs for brushes and hand mirrors; handles for canes, umbrellas, whips, and cutlery; mouthpieces for pipes, cigarette and cigar holders; chessmen; dolls' heads and other toys; electrotype plates, and a great variety of other articles of adornment and use.

Viscose.—This body represents the most recent development in the production of plastic bodies from cellulose, and was invented by C. F. Cross, E. J. Bevan, and C. Beadle, to whom United States Patent No. 520770, of June 5, 1894, was issued. In the manufacture, purified cotton is treated with an excess of a 15 per cent solution of sodium hydroxide and squeezed until it retains about three times its weight of the solution. It is then placed in a vessel with carbon disulphide, the quantity used being about 40 per cent of the weight of the cotton. After digestion for about three hours at the ordinary temperature, sufficient water to cover the mass is added and digestion allowed to proceed overnight, when, on stirring, a homogeneous liquid is obtained, which is a solution of cellulose thiocarbonate, or xanthate, and from which a jelly or coagulum of cellulose is produced by spontaneous decomposition, by precipitation with dehydrating agents, or by heating the solution. By incorporating viscose with mineral matters, hydrocarbons, and like substances, solid aggregates are produced which may be cast or molded into convenient forms, and after purification and sufficient aging made available for various structural uses. More recently these investigators have found the cellulose tetracetate to be especially suitable for the formation of viscose.

[1] See Explosives: Gun Cotton or Pyroxylin, ante, page 73.

Other Plastics.—Many plastic substances are now made from caoutchouc, gutta-percha, casein, fibrin, gluten, and like bodies which act as gelatinizing or cementing agents, by which the zinc oxide, antimony sulphide, kaolin, and other fillers are held in solid aggregations which may be molded or shaped with lathes and other tools as desired.

The foreign commerce in the pyroxylin plastics, as compiled from the Foreign Commerce and Navigation of the United States for the year ending June 30, 1900, Vol. II, is set forth in the following table:

IMPORTS AND EXPORTS OF PYROXYLIN PLASTICS, 1891 TO 1900, INCLUSIVE.

YEAR.	Imports, value.	Exports, value.
1891	$10,595	....
1892	43,353	$39,004
1893	57,062	36,597
1894	96,977	85,234
1895	371,873	72,926
1896	337,862	146,354
1897	262,675	149,631
1898	160,836	155,444
1899	249,619	173,771
1900	378,583	174,310

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Group XVI.—Essential Oils.

Though one of the less important, as measured by the value of the product, this is one of the oldest of the chemical industries, and it received recognition as a distinct industry in census statistics so long ago as 1860. It appears, however, that there have been varying views at the several censuses as to what substances should properly be placed under this classification. For the census of 1900, there are included in this report, under this title, all those bodies reported as having been manufactured in the United States during the census year, that are usually included in the text-books and treatises under the legends "volatile oils" or "essential oils," except vanillin, and oil or spirits of turpentine, which was made the subject of a special census report, while in addition witch-hazel is included. In this classification, then, there are, for the year ending June 1, 1900, 100 establishments in 14 states, engaged wholly or chiefly in the production or refining of these oils. Of these, 30 establishments produced a product of less than

$500 in value. These 100 establishments employed $622,385 of capital and 201 wage-earners, and the value of their products was $850,133. In addition, there were 3 establishments which produced $9,268 of essential oils as a subordinate product. As pointed out, there is included here the refined natural oils and the crude natural oils, and in addition the artificial oils. These last named are manufactured by 4 establishments, employing $33,720 of capital and 13 wage-earners, and they reported $54,450 in value of products. The vanillin industry, which is classified with "fine chemicals," returned 124,874 ounces of the product, having a value of $113,050. This was manufactured in 4 establishments, and gave employment to 26 wage-earners and $65,689 of capital. The product of refined natural oils for 1900 amounted in value to $370,500. The establishments for the production of the crude natural oils were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF CRUDE ESSENTIAL OIL FACTORIES: 1900.

STATES.	Number of establishments.	Average number of wage-earners.	Capital.	Product.	Per cent of total.
United States	97	167	$426,892	$434,451	100.0
Connecticut	5	8	65,500	45,530	10.5
New York	11	15	183,675	249,150	57.3
Virginia	15	31	15,149	38,165	8.9
Indiana	10	14	20,050	14,893	3.4
Michigan	28	91	107,509	70,126	16.1
New Hampshire, Vermont, Massachusetts, Pennsylvania, North Carolina, Florida, Tennessee, Illinois, Wisconsin, and California	28	8	35,009	16,587	3.8

This tabular view shows that though this industry was widely distributed, it did not attain to any magnitude except in the states of New York, Michigan, Connecticut, and Virginia, and that in these states, as elsewhere, it was carried on by a large number of persons in a very small way. In fact it is usually carried on as an employment accessory to farming, the farmers taking advantage of the idle time between seasons to gather roots, herbs, bark, and leaves, and by means of a simple and often portable still (which is frequently erected for the time being in the woods near where the material is gathered) extracting their essential oils. This accounts for the small number of wage-earners in proportion to the number of establishments reported, as the farmer, in a large number of instances, carries out all the operations without hired labor. The character of the industry and the methods employed are especially illustrated by the great variety of products reported, for there are, among others, returned and combined in the values given in the table, the natural oils of peppermint, spearmint, erigeron (fleabane), pennyroyal, wormwood, tansy, fireweed, golden rod, wintergreen, black birch, sassafras, spruce, cedar, juniper, and witch-hazel.

The peppermint-oil industry was confined principally to Michigan, Indiana, and New York, there having been 95,000 pounds produced in these three states; the sassafras-oil industry was located principally in Virginia, where 104,931 pounds of this oil were produced; the wintergreen-oil industry was located chiefly in Pennsylvania, where 2,075 pounds were reported as having been produced; and the witch-hazel industry was located chiefly in Connecticut and New York, where 110,260 gallons of this substance, having a value of $54,649, were produced.

As previously stated, the methods of classifying this industry, as well as the methods used for collecting the statistics, have varied somewhat in the different censuses, but they have been sufficiently consistent for the last three decades to admit of the comparison made in the following table:

TOTAL PRODUCTION OF ESSENTIAL OILS (CRUDE) BY DECADES, 1880 TO 1890, INCLUSIVE.

YEAR.	Number of establishments.	Capital.	Average number of wage-earners.	Value of product.
1880	124	$67,755	278	$248,858
1890	67	102,223	191	255,847
1900	97	426,892	167	434,451

The increase in the value of the product for 1890 over the value for 1880 was but 2.8 per cent, while the increase for 1900 over 1890 was 69.8 per cent. It is not possible to state how great a part of this increase for 1900 is due to a more complete collection of the returns for this rural industry. There is an apparent falling off in the number of wage-earners, but if, since these operations are usually conducted by the owner of the establishment, there were added one man for each establishment to the number of wage-earners, there would be a total of 264, which is probably not far from the truth. Another method of reckoning the number of wage-earners would be to take into account those engaged in the cultivation of the herbs, like mint, which are grown for the production of essential oils, and it is probable that at the census of 1870, where the number of hands employed is reported as 2,365, a method such as this has been followed. It is necessary to recall that the essential-oil distilleries would, as a rule, be in operation but a part of each year.

The *essential oils* are those volatile oils which exist ready formed in animal and vegetable organisms, and they are called essential because they possess, in a concentrated form, certain of the characteristic properties of the plants from which they are derived. They are also known as the *volatile oils*, because they are easily evaporated, and as *distilled oils*, from the method by which a number of them are usually extracted from the plant. They exist in all odoriferous vegetation, sometimes pervading the plant, and in other cases being confined to a single part of the plant. In some instances the oil is contained in distinct cells, where it is preserved after desiccation of the part, while in others, as in flowers, it is secreted on or near the surface, and exhaled so soon as formed. Occasionally two or more different oils are formed in different parts of the same plant, as in the orange tree, which contains one kind of oil in its leaves, another in its flowers, and a third in the rind of its fruit. Some essential oils are formed during distillation from substances of a different nature preëxisting in the plant, as in the case of oil of bitter almonds, which is produced by the action of water on the amygdalin which exists in the bitter almond. These oils are compound substances, or mixtures of compound substances, consisting of carbon and hydrogen alone, or of these elements combined with oxygen, sulphur, or nitrogen. These compounds are found among the derivatives of both the acyclic and cyclic series, and in addition to the various hydrocarbons there have been found among them alcohols, aldehydes, acids, esters, ketones, phenols, phenol-ethers, lactones, quinones, oxides, sulphides, nitrils, and isothiocyanates. In the mixed oils the oxygenated bodies are often of greater importance than the hydrocarbons because they are usually the possessors of the characteristic odor of the oil in which they are contained. Latterly these oils have been concentrated for sale by the removal of the nonfragrant hydrocarbons, this concentrate representing from 2 to 30 volumes of the original oil. Thus, 1 volume of the concentrated oil represents 2 volumes of the oils of anise, cassia, fennel, gingergrass, *mentha crispa*, *mentha piperita*, cloves, sassafras, and star anise; 2½ volumes of the oils of bergamot, caraway, and lavender; 4 volumes of cumin and rosemary; 5 volumes of thyme; 6 volumes of coriander; 8 volumes of calamus; 10 volumes of absinthe (wormwood); 20 volumes of juniper; 30 volumes of angelica, lemon, and orange. It is asserted that these concentrated oils are more permanent, more soluble in alcohol and water, have a finer odor, and a more nearly constant composition than the original oils. They are undoubtedly superior to the ordinary essential oils both in odor and strength, and they are now offered in the market under the name of "terpeneless volatile oils."

The natural essential oils as ordinarily obtained are of a thin, oily consistency at ordinary temperatures. They partly rise in vapor at ordinary temperatures, diffusing their peculiar odors, and are wholly volatile at higher temperatures; they have a characteristic and generally pungent odor; they are sparingly soluble in water, but readily soluble in alcohol and ether, and most of them are optically active. In the later works, solid camphor-like bodies and vanillin are included with the essential oils.

The essential oils are recovered by several different processes, depending upon the nature of the plant in which the oil exists and the nature of the oil. Thus, oils such as those of peppermint, sassafras, wintergreen, and the like, are obtained by distillation; oils, such as those from the orange and lemon peel may be recovered by expression; and oils, such as those existing in blossoms and constituting their perfumes, may be obtained by the process of enfleurage.

The process of distillation is well described in a circular issued by Albert M. Todd, of Kalamazoo, Mich., entitled "The Essential Oil Industry of Michigan," of which the following is an abstract:

The essential-oil industry of Michigan was inaugurated in St. Joseph county in 1835, being confined for many years to the production of oil of peppermint by the crude and primitive apparatus brought from the East, consisting of a copper kettle containing water in which the plants were placed, to which heat was directly applied, this being connected with a rude form of worm for condensation of the distillate.

As the area under cultivation increased, the need for better appliances was felt, and Michigan's genius gave to the world the greatest invention of the century in the distillation of essential-oil plants—the *steam distillery*—by which the rate of distillation was increased from about 15 pounds to over 100 pounds of essential oil per day. The increased rapidity of distillation now secured was unfortunately not followed by a corresponding advance in quality, for no true system of tests was known by which the quality of the oil could be established, and weedy, resinous, or adulterated oil continued to be the rule. Beginning in 1868, Mr. Todd labored to advance the standard, the result being that a system of tests was established, and a process of steam rectification, with elaborate appliances, was perfected for bringing the crude oil to a uniform state of purity and excellence.

The manufacturing system is as follows: The plants having been carefully cultivated are cut when in full bloom, usually during the months of August and September, and after being partially dried are placed in large wooden vats having a capacity of from 2,000 to 3,000 pounds dried plants each, which, after being filled, are closed with steam-tight covers. A pipe from the steam-generating boiler is connected with the distilling vats, entering them at the bottom under the plants. As the steam enters it is diffused evenly and forced upward through the plants. The heat of the steam expands the globules of oil, which are contained in the minute cells of the leaves, causing them to burst, and the oil being thus freed is carried off in the current of steam. This steam, now charged with the essential oil, having passed through the mass of plants to the top of the vat, escapes through a "changing valve" to the primary condenser, which consists of a series of tin-coated pipes about 6 inches in diameter and 12 feet long, over which a large supply of cold water is made to flow evenly through a perforated trough from above.

The steam of the distillate, consisting of oil and water, is condensed in a primary condenser, but, for the purpose of reducing to a uniform temperature, it is conveyed to a large block-tin worm, supplied constantly with cold water. The distillate, after traversing this worm, falls into the receiver, a vessel about 3 feet in height and 10 inches in diameter, having an exterior pipe leading from the bottom to a height nearly equal to that of the receiver. As the distillate flows into the receiver, the water, being heavier than the oil of peppermint, sinks to the bottom of the vessel, and is forced from thence upward and out through the pipe mentioned. The essential oil collects upon the top of the receiver and is dipped off. The same separation occurs with spearmint, wormwood, tansy, and the other oils lighter than water. With wintergreen and sassafras, which are heavier, the system is reversed; the water rising to the top and being returned from thence to the boiler, while the oil sinks to the bottom. As the water of the distillate does not throw off the entire amount of essential oil contained, it is returned to the boiler and reconverted into steam and continuously used. Many of the distillers, however, allow this water to run to waste, and the amount wasted in America (which in England was formerly bottled and sold) amounted, until recently, to not far from 5,000,000 pounds. The vats in the largest distilleries in the United States require about 3,000 pounds of the dried plants for a charge. If the plants are properly dried, and an adequate supply of steam is at command, the oil may be distilled from the charge in forty-five minutes. As thus distilled from the plants the product obtained is the *natural oil*, which, even though pure plants are used, always contains an insoluble resin, and it is in this form that oil is usually sold.

For the purpose of rendering the oil of absolute purity and the highest possible concentration, aroma, solubility, and therapeutic value, and freeing it from any foreign substances contained therein, it is placed in special refining stills, by means of which fresh steam is diffused through the oil in numerous jets, evaporating the most valuable and aromatic portions. This steam is generated at a distance from the refiners, so that no direct heat is used, and by this process the scorching of the oil or formation of any empyreumatic product is rendered absolutely impossible. The supply of steam admitted and the consequent rate of distillation is carefully regulated. The first fraction is distilled very slowly, so that any foreign hydrocarbons present are eliminated. Afterwards the pure aromatic essential oil is volatilized, the speed of distillation being increased. After the aromatic oil has been recovered, there remains an oleo-resin (the bitter and insoluble principle), which is cast away. This in old and oxidized oil, sometimes is found to the extent of over 25 per cent. The refined essential oil thus obtained has the pure and sweet odor of its true plant in a high degree, is of the greatest strength, unusual solubility, brilliant and limpid, and is absolutely pure.

The method of enfleurage consists in the absorption of the perfume exhaled from fresh blossoms by a neutral fat or oil. For this purpose pans are filled with fresh lard or beef fat and thickly covered with fresh petals, this covering being renewed until the fat is saturated with the perfume. The fat is then pressed through a sieve, and the thick substance which is expressed and which contains the odoriferous principle is styled pomade; or plates of glass are smeared with fresh lard, or cotton wool is coated with fresh olive oil, and the perfume is allowed to pass over these surfaces, and when the fat or oil is saturated the perfume is extracted from them by solution in alcohol.

The oil of peppermint, which is commercially among the more important of the natural oils produced in the United States, is obtained from several varieties of mint, all classified under the species *Mentha piperita*, which are cultivated in Europe and North America. The plant from which Japanese oil of peppermint is obtained belongs to another species. It is not known that any of the mints referred to in the *Liber de arte distillandi*[1] were peppermint. The oldest known specimens of this plant were those collected by John Ray in Hertfordshire, England, in 1696, and to which, in his *Historia Plantanum*, published in 1704, he gave the name of peppermint. These specimens are still preserved in the herbarium of the British Museum, and they correspond in all essential characteristics with the peppermint which is to-day cultivated in England. The commercial history of this industry dates from about the year 1750, when the cultivation of peppermint was begun in a very small way at Mitcham, Surrey county, England, and by the year 1800 the area under cultivation had reached 100 acres. The industry in England reached its maximum about 1850, when 500 acres were under cultivation, but from that time it diminished, owing to American competition.

According to a private communication from Leander S. Drew, of Lodi, Wis., the records of his establishment show that oil of peppermint was produced in Connecticut before 1812, and that his grandfather, Daniel Drew, made oil of peppermint in Corinth, Orange county, Vt., before 1814, and redistilled oil bought near Cleveland, Ohio, in 1819. Further, he states that Leander Drew, M. D., his father, began the distillation of oils of wormwood, peppermint, spearmint, erigeron, and dittany, in Wisconsin, in 1843. The distillation of pepperment oil began in Wayne county, N. Y., in 1816, and later this became the most important center of its production in the United States. As stated, the cultivation of peppermint was begun in St. Joseph county, Mich., in 1835 and this state has since rivaled New York in this industry.

Formerly it was supposed that a larger yield of oil was obtained from the use of fresh plants in the still, but Todd has shown experimentally, and experience

[1] Brunschwig, 1500.

has verified the showing, that the yield is equally large from the dried as from the fresh material, while a larger quantity of the dried material may be placed in a given still for a single charge, and oil may be displaced from it with threefold the rapidity that it can be from the fresh mint. In addition, as it is the practice of the local distillers to treat not only their own crop but that of their neighbors (one distillery, on an average, serving for about ten planters), the cost of transportation is reduced by previously drying the mint, since the shrinkage in weight is over 49 per cent. Gildemeister and Hoffman,[1] however, suggest that the known difference in solubility of the English and American oils may be due to the fact that the former is distilled from the fresh herb and the latter from the dried herb. The charge for treatment by the distillers is about 25 cents for each pound of oil produced.

Peppermint plants are propagated from roots or runners, the "sets" being planted out in the spring. There are therefore "old or second-crop" plants of previous plantings, which mature usually in August, and the "new crop," which matures in September. The proper time for cutting the mint is when the plants are full blown. The average yield of essential oil varies greatly, depending largely on the extent to which the plants are covered with leaves and blossoms, as it is these which contain the oil. The average yield of oil from green plants is about one-third of 1 per cent, or 6⅔ pounds of oil for each 2,000 pounds of plants. Todd[2] has obtained 18 pounds of oil from 2,000 pounds of well-leaved plants, and but 1½ pounds from a like quantity of coarse plants devoid of leaves. The average yield of oil per acre for the first and second year's crop is 11 pounds.

According to Todd,[3] the average annual production of peppermint oil for the ten years prior to 1886 was about 100,000 pounds. According to Gildemeister and Hoffman,[4] the largest yearly production of peppermint oil in the United States was in 1897 and was distributed as follows:

	Pounds.
Michigan:	
Eastern	13,000
Western	79,000
Northern	25,000
Southern	55,000
Total	172,000
Indiana	32,000
New York	37,000
Other localities	10,000
Total United States	251,000

The consequence of this enormous production was an entirely unexpected drop in price, which has since restricted production.

[1] Volatile Oils, page 641.
[2] Amer. Phar. Assn., page 121. 1886.
[3] Ibid.
[4] The Volatile Oils, page 636.

A by-product of the mint distillation industry is found in the mint hay. After the distillation is completed this is lifted from the steam vat in the form of a large cylindrical cake, and when dried it is eaten with great relish by horses and cattle, or it is composted and returned to the fields as a fertilizer.

Peppermint oil is used as a flavor in food, drink, and confectionery, and in medicine. It is also used as a source of menthol, or peppermint camphor. This menthol separation differs according to the oil used. The Japanese oil is so rich in menthol that it forms a crystalline mass, saturated with the oil, at ordinary temperatures. The American oil solidifies completely in a freezing mixture. The English and Saxon oils very often show crystalline separations only after standing for a long while in the freezing mixture.

Spearmint Oil.[5]—The American spearmint oil is distilled in New York and Michigan from the fresh herb of *Mentha viridis*, *L.* The herb is cultivated to a not inconsiderable extent, as much as 12,000 pounds being obtained in the two states mentioned. The oil is colorless, yellowish or greenish yellow, is liquid, and possesses the characteristic penetrating and disagreeable odor of spearmint. With age and on exposure to the air the oil becomes viscid and darker. It has a specific gravity of 0.92 to 0.94 and is soluble in equal parts of 90 per cent alcohol, but the solution is rendered turbid by the addition of more solvent. An oil distilled by Fritsche Brothers had somewhat different properties. The spearmint had been cultivated on the factory grounds at Garfield, N. J., and was just in blossom when distilled. The yield was just 0.3 per cent. The oil had a specific gravity of 0.98 with an odor quite different from the commercial oil. It is possible that in the distillation of the commercial oil a part of this heavy oil is lost, thus accounting for the lower specific gravity. After the first harvest, toward the close of July, a second was made early in October. The yield from the fresh herb was only 0.18 per cent. The odor of this oil was somewhat less delicate, its specific gravity and rotatory power were lower, 0.961, but it was still heavier than the commercial oils, though never heavier than water.

Oil of Wormwood.[6]—*Artemisia absinthium*, *L.*, is indigenous to many European countries. It has been introduced into North America and is frequently cultivated for commercial purposes. The distilled oil of wormwood was known to Porta about 1570, who called attention to its blue color. It is named in the price ordinances of Frankfort in 1587, and was first examined by Hoffman in 1722 and recommended by him for medicinal purposes.

Whereas, the French oil formerly controlled the market, it is now largely replaced by the cheaper American oil from New York, Michigan, Nebraska, and Wiscon-

[5] The Volatile Oils, page 636.
[6] Ibid., page 684.

sin. The consumption of wormwood oil has decreased considerably, due possibly to the toxic properties of the oil to which attention has been directed. The fresh herb cultivated in Germany yields one-half per cent of oil, which at first is colored dark brown but changes to green after long exposure to the air.

Oil of Erigeron.[1]—*Erigeron canadensis*, *L.*, is a very common weed, which is known in America as fleabane, horseweed, or butterweed. It is frequently found in peppermint fields. The fresh herb yields upon distillation 0.2 to 0.4 per cent of oil, which finds limited medical application in the United States, and which was made official in the United States Pharmacopœia of 1890.

Oil of Sassafras.[2]—The sassafras tree is widely distributed in North America, from Canada to Florida and Alabama, and westward as far as Kansas and the northern part of Mexico. The older bark and wood are odorless; the green parts of the tree, when crushed, smell faintly aromatic, but not of safrol; the wood of the roots, and especially the root bark, are more rich in oil cells.

Next to turpentine oil the oil of sassafras was the first volatile oil distilled in a primitive fashion in North America. On account of the pleasant aroma the root bark was chewed by the aborigines, who called it *pavame.* It was also mixed with smoking tobacco (Rafinesque) and added as an aromatic to refreshing beverages and was used as a remedy. On account of its marked characteristics the sassafras tree is said to have attracted the attention of the Spaniards at their first landing in Florida under Ponce de Leon in 1512; also under De Soto in 1538. They are said to have regarded it as a kind of cinnamon tree. As late as the first half of the Nineteenth century the bark, leaves, and buds were used in the Middle and Central states as a substitute for Chinese tea. As early as 1582, sassafras wood and bark became known in Germany as a new American drug and were used under the name of *Lignum pavanum* (German, Fenchelholz). The bark and wood were apparently first distilled by Angelus Sala in 1620, who mentions that the oil is heavier than water. Schroeder's *Pharmacopœia medicochymica*, published in Frankfort-on-the-Main in 1641, is the first pharmacopœia that gives directions for the distillation of the oil, whereas the municipal price ordinance of Frankfort-on-the-Main of 1587 already enumerates *Oleum ligni sassafras.* Schoepf, who was a careful observer, and who traveled through the Atlantic states in 1783 and 1784, repeatedly refers to the sassafras tree, but does not mention the oil. Evidently the distillation of the oil did not become an industry until the close of the Eighteenth or the early part of the Nineteenth century.

The original process of distillation seems to have been generally very primitive, but it is now conducted in a somewhat more rational manner. The stills, made of 3-inch planks, are from 4 to 5 feet high, about 12 feet square, and strengthened by iron bands. One of the sides is provided with two close-fitting doors, an upper one for charging the still, and a lower one for removing the exhausted material. The wood is split or sawed into thin pieces. The steam, generated in a boiler, enters the still at the bottom, and the distillate is cooled in a coiled condenser and collected in a large copper flask of 20 gallons capacity. About 2 inches from the bottom this flask is provided with a stopcock, through which the oil is drawn off from time to time. The exhausted wood is dried and used as fuel. Such a still has a capacity for 20,000 pounds of wood, and the distillation of this quantity lasts from about forty-eight to fifty hours. The root bark yields from 6 to 9 per cent of oil, and the wood part of the root less than 1 per cent. According to W. H. Phelps,[3] Big Island, Va., 35 pounds of oil per ton of 2,000 pounds of sassafras is a good average yield. The yield from all the factories in Virginia, by the returns, average 23 pounds per ton.

Up to the middle of the Nineteenth century the oil was distilled principally in Pennsylvania, Maryland, and Virginia, and Baltimore and Richmond were the principal commercial centers. In 1860, just prior to the Civil War, not less than 50,000 pounds of sassafras oil were sold annually in Baltimore alone (Sharp). Since the sixties considerable quantities of the oil have also been distilled in New Jersey, New York, Ohio, Indiana, Tennessee, and the New England states, but the practical extinction of the tree has rendered the industry unprofitable.

Wintergreen Oil.[4]—Wintergreen, *Gaultheria procumbens*, *L.* (Family Ericaceæ) grows from the New England states to Minnesota and south as far as Georgia and Alabama. On account of the peculiar odor and taste which develop when the plant is chewed, it was early used by the natives. The distillation of the oil was probably begun in the first decades of the Nineteenth century along with that of sassafras bark and birch bark in the states of Pennsylvania, New Jersey, and New York. At first these aromatics were used for chewing, later for the preparation of refreshing beverages and home remedies, and especially for the much-used "blood purifiers." When the preparation of the volatile oils became successful, these were often used instead of the aqueous extract of the drug. This use is of considerable importance in the history of the introduction of wintergreen and sassafras oils, as both of these were used as popular remedies in the United States since the beginning of the Nineteenth century under the title of patent medicines. The preparation and use of these remedies soon became general, and with these came a greater demand for the oils. Wintergreen oil was especially in demand for the prepara-

[1] The Volatile Oils, page 668.
[2] Ibid., page 395.
[3] Private communication.
[4] The Volatile Oils, page 585.

tion of one of the oldest known remedies in the United States, namely, Swaim's Panacea, introduced in 1815, which at that time had an enormous sale and in the efficiency of which great confidence was placed.

Wintergreen oil does not appear to have been used at that time for any other purpose. The first mention of it in literature is found in a botanical work by Bigelow, a physician of Boston, published in 1818. In it Gaultheria oil is mentioned as a staple article of the drug stores, and it is also stated that this oil occurs not only in *Gaultheria*, but also in *Spiræa ulmaria*, the root of *Spiræa lobata*, and especially in the bark of *Betula lenta*. The oil first appeared in pharmacopœias in the United States Pharmacopæia of 1820. The medicinal use of the oil did not become general until after 1827, when the New York Medical Society made known its use in the preparation of the popular specific mentioned above.

Although the similarity of the volatile oil from *Gaultheria procumbens, L.*, with that from the bark of *Betula lenta, L.*, was known before 1818, the identity of their principal constituent was shown scientifically about the same time by William Proctor, jr., of Philadelphia, in 1842 and Cahours in 1844. From that time on, the oil was no longer distilled exclusively from wintergreen, but often from this, together with birch bark, or from the latter only. The oil came more and more into use as an aromatic for pharmaceutic and cosmetic preparations, for beverages and medicinal remedies, and thus became an article of commerce. In recent time, however, it is often adulterated with kerosene and alcohol. Methyl salicylate has been prepared on a large scale and brought into the market as *artificial oil of wintergreen* since 1886 by Schimmel & Co. It is official in the United States Pharmacopœia.

The preparation of oil of wintergreen has always been carried on in a primitive manner, the distillation being conducted by the smaller farmers at the place where the plant grows. This was first done in the New England states and later in the mountain and forest districts of the states of New York, New Jersey, Pennsylvania, Virginia, and Maryland. Usually old copper whisky stills of various sizes, mostly from 200 to 400 gallons capacity, serve as stills. Sometimes the distillation is done in boxes of oak wood about 8 feet long, 4 feet high, and from 4 to 5 feet broad; mostly, however, in larger alcohol barrels, held together by strong iron hoops, the perforated bottom of which is fitted as tightly as possible into a suitable cast-iron kettle, which is filled with water for distillation. On the upper part of the barrel is placed a copper helm, which is connected with a condensing worm in a large wooden tub.

In the distillation, which is carried on for only a few months in the year, the still, barrel, or box is filled with finely chopped, well-wetted plants. The charge is allowed to stand over night and firing begun in the morning. The distillation is usually complete in eight hours. About 90 per cent of the oil passes over during the first two or three hours, the remaining 10 per cent in the course of the next three or four hours. The crude oil is colored dark by the iron of the condenser. The small producers sell the crude oil obtained to wholesale druggists, who purify it by rectification.

Sweet-birch oil (wintergreen oil).[1]—Cherry birch, or sweet or black birch (*Betula lenta, L.*, family Betulaceæ) is a tree which grows on good forest soil throughout southern Canada and the northern United States, westward as far as Minnesota and Kansas, and to the south as far as Georgia and Alabama. When chewed, its reddish bronze-colored bark develops a peculiar fragrance and taste, and on this account has been used by the natives for chewing and in the preparation of refreshing and medicinal beverages. Next to turpentine oil, the oils of sassafras, wintergreen, and birch bark were among the first oils obtained by distillation in the United States. The similarity in odor and taste of birch-bark oil, with true oil of wintergreen from *Gaultheria procumbens*, was shown before 1818 (Bigelow). The chemical identity of the principal constituent of both was demonstrated by Proctor in 1843. As the demand for wintergreen oil increased, sweet-birch bark was distilled indiscriminately with wintergreen leaves, or even distilled alone, as a substitute, so that the commercial oil is at present obtained almost exclusively from the bark of sweet birch (*Betula lenta, L.*).

For purposes of distillation the young trunks and branches were formerly used. These were cut into pieces from 1 to 4 inches in length, which were macerated for twelve hours previous to distillation. For the latter operation stills like those described under wintergreen oil were used. The bark of the trunk and larger branches is now used, being peeled off in late summer, and either cut or torn by means of toothed rollers, and freshly distilled with water from copper stills. If wintergreen grows abundantly in the neighborhood, it is added to the bark in the still. Preference is given to the one which is the more abundant and more conveniently gathered. According to Kennedy, maceration for twelve hours is considered indispensable to a good yield. A ton of 2,240 pounds of birch bark yields about 5 pounds of oil, which amounts to 0.23 per cent. A like amount of wintergreen yields about 18 pounds of oil. By rational distillation, however, as much as 0.6 per cent of oil can be obtained from the bark.

Proctor recognized, in 1843, that the oil does not preexist in the bark, but results from the interaction of two of the constituents present with water in a similar way to that attending the formation of the oils of bitter almonds, mustard, etc. According to more recent investigations by Schneegans, these substances are Betulase, a ferment, and Gaultherin, a glucoside, which crystallizes with one molecule of water.

[1]The Volatile Oils, page 331.

Oil of Red Cedar Wood.[1]—The Virginia or red cedar is a shrub or tree which is distributed throughout the United States. Its wood is used in the manufacture of cigar boxes, lead pencils, and small ornaments. It is adapted to this purpose on account of its uniform structure, its mild sandalwood odor, and because it is not attacked by insects. For the distillation of the oil, the waste from the lead-pencil manufactory is used, yielding from 2.5 to 4.5 per cent. The exhausted chips are then utilized by the furriers in the preparation of skins. A very inferior oil is obtained in this country as a by-product from the drying chambers of the lead-pencil factories. These chambers are so constructed that the escaping vapors from the cedar wood can be condensed. In this case, however, the high-boiling constituents of the wood remain behind and only the more volatile constituents are obtained. The oil thus obtained is more mobile and its odor is both less fine and less permanent than that of the normal, making it unserviceable for use in perfumery.

Hemlock or spruce needle oil.[2]—The needles and young twigs used in the distillation of this oil seem to be contributed by three different species: The hemlock or spruce, which occurs throughout North America from Canada to Alabama and westward as far as the Pacific; the white spruce; and the black spruce. They are equally widely distributed. In the collection of the leaves and twigs it seems highly probable that no distinction is made between these three species, so that a commercial oil may contain variable amounts of the oils from all three. In fact, the oils, being regarded as identical, are brought into the market under the common name of hemlock or spruce oil. Inasmuch as they are alike in properties and composition, quantitatively, the confusion in this case may be regarded as being of little or no consequence.

Witch-hazel[3] (*Hamamelis virginiana, L.*).—Witch-hazel is a shrub indigenous to and growing in almost all sections of the United States. It is the only species of the genus found in eastern North America. The bark has a bitter, astringent, somewhat sweetish and pungent taste, but no odor. Walter B. Cheney examined witch-hazel bark and found in it tannin, resin, and an extractive, but no indication of an alkaloid or other crystalline principle.[4] It contains a trace of volatile oil, however. Dr. John Marshall, of the University of Pennsylvania, found that hamamelis root contains tannic acid and a trace of volatile oil, but no other active substance.[5]

The bark of the witch-hazel is said to have first attracted attention on account of its use by the North American Indians as a sedative application to external inflammations. It was many years ago strongly recommended by Dr. James Fountain and Dr. N. S. Davis for hemorrhage of the lungs and stomach.[6] Of late years professional attention has been very strongly directed to witch-hazel on account of the enormous sale of a proprietary remedy said to have been made by distilling the bark with very dilute alcohol (6 per cent), and used externally for sprains and bruises and internally for many diseases.

The preparation known as witch-hazel extract, or witch-hazel water, is obtained by digesting 100 parts by weight of Hamamelis shoots and twigs with 200 volumes of water and 15 volumes of alcohol for twenty-four hours. The mixture is then distilled by applying direct heat, but better by means of steam, until 100 volumes of the distillate have been obtained. The preparation should be made from the fresh young twigs of the Hamamelis only, and these are preferably to be collected in the late autumn when the plant is in flower. The returns for 1900 show that 13,248 gallons of alcohol, having a value of $31,606, were consumed in this industry during the census year.

Artificial Essential Oils.—One of the greatest achievements of modern chemistry is the production in the laboratory of chemical substances, such as have been previously known only as the results of vital processes going on in vegetable or animal organs, and this achievement is especially marked in the production of those essential oils which are used as flavors or perfumes. The first step in this development was the discovery by analysis of the compound or compounds which constituted the odorous or fragrant principle existing or produced from the natural substance, as in the recognition by Woehler and Liebig of the existence of benzaldehyde in the oil of bitter almonds; the next was the discovery of a method or methods by which this chemical substance could be artificially produced. Sometimes, however, bodies have been discovered which, while unlike the natural principle, possess an odor which resembles that of the naturally occurring body. There is an example of this in the mono-nitrobenzene, which in its odor resembles oil of bitter almonds and which, together with mono-nitrotoluene, is sold for scenting soap under the name of oil-of-mirbane. In addition to the above, there have long been known and used, amyl acetate as essence of Jargonelle pear, amyl valerate as essence of apple, cinnamic aldehyde as oil of cinnamon, cumic aldehyde as oil of cumin, and many others.

One of these synthetic flavors that has especially attracted attention is *vanillin*, which is the active odorous ingredient of the vanilla pod, in which it exists to the extent of about 2 per cent, appearing on the surface of the bean as a fine white crystalline efflorescence. It was found to be methyl protocatechuic aldehyde, and it was first prepared artificially by Tiemann from coniferin, which is a glucoside occurring in the cambium of various coniferous woods. Later, Tiemann, and

[1] The Volatile Oils, page 276.
[2] Ibid., page 263.
[3] U. S. Dispensatory, 18th ed.: 1899.
[4] Am. Jour. Phar., page 418. 1886.
[5] Therap. Gaz., vol. 11, page 295.
[6] N. Y. Jour. Med., Vol. X, page 208; Trans. Amer. Med. Assoc., Vol. I, page 350.

simultaneously De Laire, discovered that it could be produced by the oxidation of eugenol, the chief constituent of oil of cloves, and this is now the principal source of artificial vanillin, which is manufactured on a considerable scale both in this country and abroad.

Another artificial principle is *coumarin*, which is the chief ingredient in the favorite perfume known as "new mown hay." This body is in nature the active, odorous principle of the Tonquin (Tonka or Tonco) bean, and it is found chemically to be the d-lactone of coumarinic acid. Perkin[1] pointed out that if salicylic aldehyde be heated with acetic anhydride and sodium acetate, and the melt be treated with water and again heated, coumarin and acetic acid are formed.

The odorous body present in the heliotrope blossom finds its likeness in the methylene ether of protocatechuic aldehyde, which is also known to chemists under the name of heliotropin and also piperonal. It was originally made from piperine extracted from pepper, but it is now commercially prepared by the oxidation of safrol or iso-safrol.

The odor of may blossom. or hawthorn, is fairly well reproduced by anisic aldehyde, which, chemically speaking, is the methyl ether of para-oxybenzaldehyde. It can be prepared from carbolic acid by a series of reactions, but it is more easily obtained by oxidizing aniseseed oil.

The much-desired perfume of the violet finds its synthetic rival in the chemical ionone, which Tiemann and Krüger succeeded in producing in 1893, after years of patient research. This is produced by the condensation of citral with acetone in the presence of alkalis, by which pseudo-ionone is formed, and the subsequent heating of this pseudo-ionone with dilute sulphuric acid and a little glycerine or with alkalies. Citral, which is the aldehyde of geraniol, is found in lemon oil, orange oil, the oil of *Eucalyptus maculata* (var. *citriodora*), and lemon-grass oil, the last two named having a considerable proportion of it.

The production of artificial musk has aroused especial interest, since, while in the cases of the preceding chemicals their character had been ascertained from a careful study of the plants in which they naturally occurred, in the case of musk, which is the preputial secretion of the musk deer, the chemistry of the substance is yet unknown. There have been several artificial musks produced, but practically the only one used is manufactured under the patents of Albert Baur and is known as "musk Baur." The patents cover several nitro-derivatives of tertiary butyl-xylene, each of which has the odor of musk.

The synthetic nerolin is prepared by heating b-naphthol with methyl alcohol and sulphuric acid, while the artificial neroli oil is a mixture of geraniol and linalol with their acetic esters and the methyl ester of anthranilic acid. Artificial lilac is terpineol prepared from oil of turpentine, and this body is used in mixtures for the preparation of other perfumes, such as artificial hyacinth. Cinnamyl alcohol and benzyl alcohol have the odor of hyacinth; methyl benzoate the odor of niobe oil; linalyl acetate the odor of bergamot oil; while secondary styrolyl acetate has a marked odor of jasmine oil.

It has already been noted that methyl salicylate has been prepared on a large scale and brought into the market since 1886 as artificial oil of wintergreen. Yet this enumeration of synthetic chemicals used as flavors, or as perfumes, by no means exhausts the list, and it is easily believable that the number of these substances and the quantity of the product will greatly increase. It should be especially noted that these artificially prepared substances are often purer and better than those which are extracted from plants or animal substances.

Foreign Commerce in Essential Oils.—The extent of this commerce is displayed in the following tables, compiled from "The Foreign Commerce and Navigation of the United States" for the year ending June 30, 1900:

IMPORTS OF OILS, VOLATILE OR ESSENTIAL AND DISTILLED, 1891 TO 1900, INCLUSIVE.

YEAR.	Pounds.	Value.	YEAR.	Pounds.	Value.
1891	3,459,533	$1,523,491	1896	....	$1,554,289
1892	3,451,519	1,676,064	1897	....	1,885,523
1893	4,022,117	1,654,036	1898	....	1,511,078
1894	2,861,875	1,102,108	1899	....	1,691,257
1895	....	1,398,956	1900	....	1,859,184

EXPORTS OF OILS, VOLATILE OR ESSENTIAL AND DISTILLED: 1891 to 1900, INCLUSIVE.

YEAR.	PEPPERMINT OIL.		All other, value only.	YEAR.	PEPPERMINT OIL.		All other, value only.
	Pounds.	Value.			Pounds.	Value.	
1891	45,321	$120,831	$65,104	1896	85,290	$174,810	$102,487
1892	54,987	156,418	68,501	1897	162,492	257,484	146,569
1893	99,629	267,422	79,920	1898	145,375	180,811	201,497
1894	80,225	209,722	64,907	1899	117,462	118,227	162,358
1895	87,633	194,616	190,798	1900	89,558	90,298	166,424

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[1] J. Chem. Soc., vol. 21, pages 53 to 181.

Group XVII.—Compressed and Liquefied Gases.

In the report of the Eleventh Census, Part III, page 279, it is stated that "the use of compressed ammonia gas has reached large proportions in the last decade, and has proved a valuable aid in the preservation of food, the refrigeration of malt liquors, and the manufacture of ice. The introduction of the use of anhydrous ammonia has given great impetus to the manufacture of special machinery adapted to its employment in the departments named. Taken as a whole, its manufacture may be classed as a distinct industry." Although Prof. A. C. Twining,[1] of New Haven, Conn., had in 1850 received a patent for an ice machine using ethyl, ether, or other compressed gas, and had in 1855 a machine of 1 ton capacity in operation in Cleveland, Ohio,[2] and although in 1867, and probably earlier, the ammonia ice machines of Ferdinand Carré were in active operation, this seems to have been the first allusion in the census reports to compressed gases, and no data are there given for them. At the census of 1900 returns were made not only for compressed or liquefied ammonia (known technically as anhydrous ammonia), but also for sulphur dioxide, carbon dioxide, nitrogen monoxide (known technically as nitrous oxide), oxygen, and liquid air, the manufacture being carried on during the census year in 30 different establishments regularly devoted to this business. In addition there were 6 establishments reported in which liquefied gases were produced as a subordinate part of the product, the major part of the product being in some instances other than chemicals. Besides, 1 idle establishment was reported. Taking the returns together, it is found that there were 37 establishments devoted to this manufacture, producing $1,220,297 of products and giving employment to 251 wage-earners and $2,185,535 of capital. These establishments were distributed as follows:

GEOGRAPHICAL DISTRIBUTION OF ESTABLISHMENTS FOR COMPRESSING AND LIQUEFYING GASES: 1900.

STATES.	Number of establishments.	Capital.	Average number of wage-earners.	Product.	Per cent of total.
United States	37	$2,185,535	251	$1,220,297	100.0
New York	9	631,143	68	238,882	19.6
New Jersey	7	232,542	30	144,276	11.8
Pennsylvania	5	457,720	47	239,713	19.6
Ohio	3	52,980	18	53,085	4.3
Illinois	3	285,435	35	180,350	14.8
Missouri, Michigan, Delaware, California, Massachusetts, Vermont, and Wisconsin	10	525,715	53	363,991	29.9

Of these establishments 19, employing 181 wage-earners and $1,650,094 of capital, were engaged in producing liquefied carbon dioxide, and the output for the census year amounted to 12,196,061 pounds, of a value of $708,864. In addition, 1 establishment using carbon dioxide in manufacture reported having produced and consumed 165,000,000 pounds of this gas during the year; but, though it was compressed, it was not liquefied for use. There was employed in the manufacture of the liquefied carbon dioxide reported above, 7,027 tons of magnesite, 2,011 tons of limestone, 774 tons of coke, and 4,771 tons of sulphuric acid, and among other products there were obtained 3,095,000 pounds of Epsom salts, 3,278 tons of calcined magnesite, and 5,000 bushels of lime. About 3,500,000 pounds of the carbon dioxide reported came from fermentation or from effervescent springs.

Ten establishments employing 52 wage-earners and $453,328 in capital were engaged during the census year in producing anhydrous ammonia, and the output for the year amounted to 2,443,729 pounds, having a value of $448,157, and there were consumed in this manufacture 2,148 tons of ammonium sulphate, 4,199,708 pounds of aqua ammonia, and 83,402 bushels of lime.

Carbon Dioxide (carbonic acid gas, CO_2).—Carbon dioxide was liquefied by Faraday in glass tubes as early as 1823, through the pressure resulting from the gas being set free from combination. In 1834 Thilorier operated this method on a much larger scale by the use of wrought-iron cylinders in place of the glass tubes. He discovered that by allowing the liquid to rapidly evaporate the reduction in temperature was so great that a portion of the CO_2 became solid. By moistening this solid CO_2 with ethyl ether he obtained a temperature of $-100°$ C. In 1837 Dr. John Torrey, of New York, liquefied this compound in tubes and applied the liquid to guns as a propellent. In 1844 Natterer invented a pump by which very high pressures were obtained, and through which the liquefaction of carbon dioxide could be better accomplished than by the self-compression method previously used. In all these cases when liquefying carbon dioxide the gas was not only subjected to pressure, but it was also cooled. In 1869 Prof. W. N. Hill, at the United States naval torpedo station, Newport, R. I., proposed the use of liquefied CO_2 in torpedoes. In June-August, 1873,[3] he made more than 500 pounds of the material, and the manufacture was continued at the station at intervals for some years.

In a private communication from John B. Stobaeus, of Charles Cooper & Co., Newark, N. J., it appears that he began the liquefaction of carbon dioxide on a commercial scale in the United States in July, 1884, and put the product on the market. The gas was generated from magnesite imported from Greece, by reaction with sulphuric acid, and the by-product was Epsom salts. The material was sent to the trade in steel tubes weighing about 27 pounds each, and these tubes were fitted with a valve having a conical seat, which was invented by Mr. Stobaeus. The books of this firm show that 1,188

[1] Barnard's Report on Paris Exposition of 1867, pages 368 to 386.

[2] Refrigerating and Ice-Making Machinery, page 24.

[3] Liquid Carbonic Acid, page 4.

cylinders, containing 14,256 pounds of CO_2, were produced in 1885, and 10,704 cylinders, containing 128,448 pounds of CO_2, in 1891. The manufacture has since been taken up by others, and in addition to the method used by Mr. Stobaeus the carbon dioxide is now obtained by burning magnesite, by which magnesia is obtained as the by-product; or dolomite, by which a cement is obtained as the by-product; or marble or limestone, by which quicklime is obtained as the by-product; by treating marl with sulphuric acid; and by burning coke. The carbon dioxide issuing from effervescent mineral springs, and that produced in the fermenting tubs during the brewing of beer, is also collected and liquefied. In all of these processes the gas is washed and otherwise purified before compression.

From the data given by Mr. Stobaeus it appears that the cylinders supplied by his firm held 12 pounds of CO_2 each. The American Carbonate Company, of New York, advertise to supply cylinders in two sizes, containing 10 and 20 pounds of CO_2, respectively, representing 600 and 1,200 gallons of gas, the net weight of the cylinders being 27 and 70 pounds. Several of the companies announce that the cylinders are tested for a pressure of 3,700 pounds per square inch.

Compressed carbon dioxide is used in charging soda water, mineral waters, cider, beer, and other effervescent drinks. By attaching a charged cylinder of the gas, governed by a proper regulating valve, to a barrel of beer or other beverage the liquid is not only continuously charged with the gas, but by the gas pressure the liquid is forced to the point where it is desired to serve it. By its use the old art of "Kraeusen," which consisted in adding to stored beer, as it was being casked or bottled, some beer in the first stages of fermentation, has been displaced. Carbon dioxide is used in the manufacture of salicylic acid and of many carbonates. It is proposed for use as a medicinal agent by inhalation and in baths; for raising dough in the manufacture of aerated bread; as a refrigerating medium; as a buoyant material in raising wrecks or preventing disabled ships from sinking; and for extinguishing fires, R. Ogden Doremus having found that but 20 per cent of CO_2 in the air of the locality where fire exists is sufficient to arrest the progress of the flames. It has been used by the Government as a motive power for automobile torpedoes.

Anhydrous ammonia.—This material is the chemical substance ammonia (NH_3) in a pure and dry condition and in a compressed and liquefied state, and it is manufactured by the distillation of the ordinary 26° ammonia of commerce in a suitable apparatus. This apparatus, which should be of sufficient strength to stand a pressure of 65 pounds to the square inch, comprises a still, a condenser, three separators, and a drier or dehydrator. The still is heated by a suitable steam coil to a temperature of about 212° F., when the ammoniacal gas, together with a certain amount of water, passes off into the first separator, which latter is usually situated on the top of, and forms an upward extension of, the still. In this first separator the greater portion of the watery particles carried over are eliminated by a series of perforated plates, through the perforations of which the gas has to pass, and are returned to the still through a dip pipe. From this first separator the partly dried gas passes through a water-cooled worm in the condenser, and then successively through the two other separators to the drier or dehydrator, where it is passed through a set of similarly perforated plates to those in the first separator, but having small-sized lumps of freshly burnt lime placed upon them, by which any moisture that may still remain in the gas is removed, and the completely anhydrous product can then be passed into the ammonia pump or compressor. It is found advisable to work the still at a pressure above 30 pounds to the square inch, so as to admit of the liquid being raised to a slightly higher temperature than the boiling point of water at atmospheric pressure, without causing the water to boil, the result of this being that the whole, or practically the whole, of the ammonia will be set free, while at the same time the least possible amount of the water will be vaporized and passed over with the ammonia gas.

Or it may be obtained from ammonium salts by heating them with lime and treating the gas as above described. The salt usually employed is ammonium sulphate. Aqua ammonia, or ammonia water, is of different strengths, according to the amount of NH_3 dissolved in it, but the standard strength has a specific gravity of 26° Beaumé, and it contains 38.5 per cent by volume, or 26.6 per cent by weight of anhydrous ammonia. Thus 3.76 pounds of 26° ammonia will be required to make 1 pound of anhydrous ammonia. An excellent table of the yields of anhydrous ammonia from 26° ammonia is given by Iltyd I. Redwood.[1] The ammonium sulphate or sulphate of ammonia of commerce is reckoned as containing 25 per cent of anhydrous ammonia.

It is believed that some at least of the owners of ice machines produce the anhydrous ammonia that they employ, either in originally charging their machines, or in making good any loss which may take place, but there are no returns on this point. It appears also that there is some anhydrous ammonia imported, the report on "The Foreign Commerce and Navigation of the United States" from the Treasury Department placing this at 14,210 pounds, having a value of $5,870 for the year 1891, but the data for such importations as may have occurred in other years of the past decade do not appear separately.

Although Fourcroy and Vauquelin and, at about the same time, Guyton de Morveau, announced that they had accomplished the liquefaction of ammonia gas, it is believed that, as they had no suitable means for drying the gas, they failed to obtain the anhydrous ammonia.

[1] Theoretical and Practical Ammonia Refrigeration, page 113.

It was first certainly liquefied by Faraday in 1823, and it was not long before it was being produced in considerable quantities. Larkin and Scheffer began the commercial manufacture in St. Louis, Mo., in 1879.

Anhydrous ammonia appears, as stated above, to have first been used for refrigeration by Ferdinand Carré in his absorption machine, but it was not long before it was employed in compression machines of the type invented by Perkins and Twining, based on the refrigerating principle, which was demonstrated by Doctor Cullen in 1755, and although it has had to compete with ethyl ether, carbon dioxide, sulphur dioxide, and air, it is to-day the material which is most largely used in ice machines, and this is the principal use for this substance, though recent researches indicate that other uses will soon be found for it in chemical manufacture and in other arts.

Sulphur Dioxide (sulphurous acid gas, SO_2).—This substance is produced by burning sulphur in air or oxygen, 1 pound of sulphur giving 2 pounds of sulphur dioxide. It was liquefied by Monge and Clouet about the beginning of the Nineteenth century. The liquefied sulphur dioxide is now a regular article of commerce, and is sent into the trade in glass "siphons" and in iron flasks, as being a convenient means of transportation and storage of the substance for use in chemical laboratories and in manufacture. The liquid has found some use in ice machines. The substance is used as a reducing agent, as a bleaching agent, and as a disinfectant. Hardin[1] states that at present (1899) "about 4,000,000 kilograms of this liquid are being prepared annually."

Nitrogen Monoxide (hyponitrous oxide, nitrous oxide, laughing gas, N_2O).—This body is prepared by heating ammonium nitrate to a temperature not exceeding 258° C., when the gas is evolved. It is carefully purified, well washed, and then compressed in steel cylinders. This gas was first liquefied by Faraday in 1823. The Lennox Chemical Company began the liquefaction of the gas for the trade at Cleveland, Ohio, in 1883. The exhilarating properties of the gas were discovered by Sir Humphry Davy, who was the first to inhale it, in 1809, and it then received the name of laughing gas. It is now used as an anaesthetic agent in minor surgical operations, especially in dentistry, its use for this purpose having been suggested by Dr. Horace Wells, and it was first applied to him in the extraction of a tooth at Hartford, Conn., December 11, 1844.

Oxygen.—This gas, as commercially supplied in the compressed condition, is produced by heating potassium chlorate mixed with black oxide of manganese. It is sold in the market for use in medicine by inhalation, when it is usually mixed with nitrous oxide, essential oils, and other bodies which are believed to possess therapeutic qualities. Liquid oxygen is not known to be produced commercially except as referred to under liquid air, but it was the first of the so-called permanent gases to be liquefied, this having been independently effected by Pictet and Cailletet in 1877.

Liquid Air.—Atmospheric air is a mixture of approximately 21 per cent of oxygen and 78 per cent of nitrogen by volume, with ninety-four one-hundredths of 1 per cent of argon, about four one-hundredths of 1 per cent of carbon dioxide, and variable quantities of water vapor, ammonia, and other bodies, according to locality and conditions. After 1823, when Perkins[2] erroneously believed that he had liquefied air, numerous unsuccessful attempts were made to accomplish this result, but in 1877 Raoul Pictet and Louis Cailletet, working independently in Switzerland and in France, achieved the result on a small laboratory scale, and it was later repeated by Wroblewski, Olzewski, and Dewar, who improved the methods so as to notably increase the yields, and in 1893 Dewar froze air into a clear, transparent solid. The liquefaction of air on an industrial scale began about this time with the invention of the machines of Linde, Hampson, and Tripler, and later those of Ostergren and Burger, Dewar, Kuhn, Chase, Code, O'Doherty, Johnson, and others.

The methods may be classified as the cascade method of Pictet, Cailletet, Wroblewski, and Onnes; the self-intensive motor method of Siemens, Kuhn, and Johnson; the countercurrent free-expansion system of Linde, Hampson, Tripler, and Ostergren, and Burger; and the self-intensive work method of the American Liquid Air Company, known as the Ala system. Emmens[3] states that the principal features of the method by which the liquefaction of air can be effected on a commercial scale was clearly described in the specifications of British patent No. 2064, granted to Charles William Siemens in 1857.

Owing to the complex composition of air, several different products are obtained by its liquefaction, notably liquid oxygen and nitrogen and solid carbon dioxide. Pictet has invented a separator by which these bodies may be rapidly separated for use, and there is thus drawn off at −70° F., solid carbon dioxide; at −290° F., commercial oxygen gas of 50 per cent purity; at −296° F., oxygen gas of 99 per cent purity; at −300° F., liquid oxygen and nitrogen gas of 95 per cent purity; at −310° F., nitrogen gas of 99 per cent purity; at −312° F., liquid air; and at −316° F., liquid nitrogen.

While many commercial uses for liquid air have been proposed, it is not known to be so used at present. It may, however, be now looked upon as a source of oxygen which promotes combustion and enables man to obtain high temperatures and high illuminating power, but it is not yet proved that this method of

[1] The Rise and Development of the Liquefaction of Gases, page 234.

[2] Annals of Philosophy, vol. 6, page 66.

[3] Liquefied Air, page 2.

heating and lighting can compete economically with electricity. Liquid air does enable man to readily obtain low temperatures, which can be usefully employed in chemical operations, and a continually extending use may be looked for in this direction. Elihu Thomson has pointed out that it may possibly find a useful application in increasing the efficiency of conductors of electricity.

Chlorine.—This gas, which may be produced by the action of muriatic acid on black oxide of manganese or by the electrolysis of common salt, is produced commercially abroad in the liquid state, but no returns are made of it in this country. It is used in chemical manufactures and for bleaching and disinfection. It is sent out to the trade in iron cylinders.

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Group XVIII.—Fine Chemicals.

Under this classification are grouped the chemically pure chemicals manufactured for sale, the chemical substances which are made for use in laboratories and in pharmacy, and those in which, like the salts of silver and of gold, the price of the unit of measure is relatively very high. It is to be noted that though this term is used in the market the dividing line between "fine chemicals" and "heavy chemicals" is by no means sharply drawn or constant. The statistics for fine chemicals, 1900, are:

FINE CHEMICALS, BY KIND, QUANTITY, AND VALUE: 1900.

KIND.	Number of establishments.	Unit of measure.	Quantity.	Value.
Acetone	3	Pounds	1,638,715	$178,666
Acids, C. P	8	Pounds	2,847,575	148,971
Alkaloids	5	Ounces	3,387,522	1,743,264
Ammonia, C. P	3	Pounds	254,952	18,131
Ether	8	Pounds	263,238	129,876
Esters	7	Pounds	576,571	66,675
Gold salts	7	Ounces	8,594	90,145
Iodides	3	Pounds	20,714	32,831
Pepsin	3	Pounds	19,030	76,120
Phosphorus	3	Pounds	487,690	150,100
Platinum salts	3	Ounces	7,312	54,600
Rare earths	3	Pounds	5,373	28,200
Silver salts	9	Ounces	1,252,604	499,345
Vanillin	4	Ounces	124,874	113,050

In this table only those fine chemicals that were produced in notable quantity and in more than two different establishments are enumerated. How large the list is may be understood when it is stated that the total value of all the products classified under this legend is $4,216,744 while the total value of those enumerated in the table, excluding such as appear also in other classifications, is $3,148,974.

Under the term alkaloids is included caffeine, morphine, pilocarpin, quinine and the other alkaloids from the cinchona barks, and strychnine. To the quantity of ether given in the table should be added 1,400,000 pounds of ether used in the explosive industry, much of which was made from tax-free alcohol and known as "Government ether." Among the esters manufactured for sale were ethyl acetate, ethyl butyrate, amyl acetate, and amyl butyrate. Under the legend "phosphorus" are included upward of 300,000 pounds which were produced by electro-chemical processes. Under "rare earths" there were reported cæsium zirconate, cerium oxide, didymium oxide, lanthanum oxide, radioactive barium, thorium nitrate, and thorium oxide. The gold and platinum salts were chlorides and the silver salts consisted of the nitrate. The vanillin was synthetic.

In addition, as showing the variety of this manufacture, it may be remarked that there were returned reports on acetanilide, bromine, chloral, chloroform, chloride of sulphur, coumarin, ethyl chloride, formaldehyde, and glycosine. Many fine chemicals are undoubtedly lost to this group from having been reported under the head of "pharmaceutical preparations" or drugs, and thus passed to another classification outside of the "chemical industry."

Acetone is produced by the dry distillation of calcium acetate or other acetates, the other product of the reaction being a metallic carbonate. A commercial source of it is therefore found in the treatment of the residue left after manufacturing anilin by the distillation of nitrobenzene with acetic acid and iron. E. R. Squibb,

M. D.,[1] has developed a commercial process for its manufacture from acetic acid. It occurs largely in some varieties of wood spirit.

Formerly all nitrogen-containing bodies occurring in plants and possessing basic characters or the derivatives of these, from which bases could be isolated were designated as alkaloids, but with the better knowledge of their constitution which modern organic chemistry has furnished, these bodies have been distributed among various classes of organic compounds. Thus caffeine is a uric acid derivative; piperine, a pyridine derivative; quinine, a quinoline derivative; and morphine, an isoquinoline derivative. In the commercial treatment of these bodies, however, it has seemed best to use the term alkaloid with its old significance because, that substances of a similar nature have been found in animals, we must more properly speak of these as vegetable alkaloids; all of the bodies returned in this census being from this source. As they occur in plants they are generally combined with acids such as malic, citric, or tannic and the like, and the commercial preparation of the alkaloids consists in their extraction from the bark, fruit, leaf, or root by means of suitable solvents, among which ether, chloroform, amyl alcohol, grain alcohol, petroleum ether, and benzene may be enumerated. By the use of alkalies the bases may be isolated, and by the use of sulphuric, or other acids, salts may be formed by which to facilitate the extraction and purification of the alkaloids.

In 1820 the separate alkaloids in cinchona bark (quinine, cinchonine, etc.) were determined, and, shortly after, Pelletier began their manufacture in France. About the same time John Farr started a quinine factory in Philadelphia, and was followed at a later day by John Currie, who built one in New York. From the correspondence it appears that the establishment of Rosengarten & Sons, of Philadelphia, manufactured sulphate of quinine in 1823, sulphate of morphine and acetate of morphine in 1832, piperine in 1833, strychnine in 1834, veratrine in 1835, and codeine in 1836. Extract of quinine was manufactured by John Farr,[2] of Philadelphia, in 1825.

Ether (ethyl ether, common ether, sulphuric ether) is the di-ethyl oxide and is made by the reaction of grain alcohol with sulphuric acid. The process invented for its manufacture by Williamson is a continuous one, and, theoretically, one portion of sulphuric acid will convert an unlimited quantity of alcohol into ether. As a fact, some of the sulphuric acid is reduced, and not only is there loss of acid and alcohol, but in consequence of this reduction the ether becomes contaminated with sulphur dioxide and must be purified for use. According to Squibb,[3] 360 pounds of concentrated sulphuric acid suffices to etherify 120 barrels of clean spirit. The acid charge must then be changed, as the mixture has become dark and tarry, and liable to froth in the still. The production of sulphur dioxide in the process may be prevented by using benzene-sulphonic acid in place of sulphuric acid in the still. Other ethers are also produced in the continuous process by substituting other alcohols for ethyl alcohol.

Ether was manufactured by Rosengarten & Sons at Philadelphia in 1823, and by Carter & Scattergood, of the same city, in 1834. It is used as an anæsthetic agent and as a solvent in many arts; but its largest use to-day is as a solvent in the manufacture of smokeless powder.

The esters known also as ethereal salts, were formerly styled compound ethers. They are compounds in which there is present both an alcohol radical and an acid radical. They are usually commercially prepared by treating an alcohol with sulphuric acid in the presence of a mineral salt containing the desired acid radical. Thus, ethyl acetate (known as acetic ether) is obtained by distilling dried sodium acetate with ethyl alcohol and sulphuric acid, and ethyl nitrite (which is the active principle of spirit of niter or spirits of nitrous ether) is prepared by distilling sodium nitrate with ethyl alcohol and sulphuric acid. Acetic ether and spirit of niter were manufactured at Philadelphia by Rosengarten & Sons in 1823.

According to Mr. John McKesson[4] it was an American surgeon, Beaumont, who made, between 1825 and 1833, the famous classical observations upon the phenomena of digestion in the living stomach, which revealed the functions of the gastric juice, and it is to Schwann that the discovery of the active principle of this juice in 1836 is due. Schwann named this principle pepsin, though he was unable to separate it. The history of American commerce in pepsin practically begins with the introduction of Scheffer's pepsin in 1872. To Scheffer is due the credit of the invention of the simple, practical, and widely adopted "salt" process for isolating the pepsin from the gastric juice of the stomachs of hogs. "Pepsin prepared by this method appeared in commerce principally as 'saccharated pepsin,' the ferment being incorporated with a large proportion of milk sugar. In 1879 Fairchild introduced the original form of pepsin in scales, 'free from added substance or reagents.' The appearance of this pepsin of phenomenal strength, with the recognition of the fallacy of administering the ferment in the largely diluted form then in vogue, was the signal for great activity in the manufacture and improvement of commercial pepsins. The obvious importance of stomach digestion naturally directed attention chiefly to the stomach ferments, and the medicinal use of the digestive ferments still remains popularly identified with pepsin; yet the other digestive ferments, especially those of the pancreas, possess far wider scope of activity

[1] J. Am. Chem. Soc., vol. 17, page 197. 1895.
[2] J. Phil. Coll. Pharm., Vol. I, No. 2. May, 1826.
[3] Ephemeris, vol. 2, page 590.

[4] One hundred years of American Commerce, Vol. II, page 610. 1859.

and are relatively of wider importance. Practical recognition and application of these pancreas ferments must fairly be attributed to Fairchild, who in 1880 introduced the *extractum pancreatis*, containing diastase for the conversion of starch, trypsin for the conversion of albumin, the emulsifying ferment for the digestion of fats, and the milk-curdling ferment.

"Pepsin now appears in a great number of popular as well as official forms, and is prepared generally by pharmaceutical manufacturers everywhere. We have in the United States the only house in the world engaged, in the manufacture of the digestive ferments and predigested foods, as an exclusive specialty. The digestive ferments occupy a brilliant position in modern therapeutics, and the progress of physiological chemistry suggests still further utilization of the animal organic principles as recently shown in the successful and important treatment of disease by the thyroid gland." The pancreatin, trypsin, and other ferments, except pepsin, mentioned above are included in the statistics for pharmaceutical preparations.

The statistics for the bromine production of the United States in 1900 were largely collected on the Salt schedule (No. 9), and were published in a special report of the census. Since this element is isolated from the mother liquors of salt works it is natural that the material should be returned as a minor product of that industry. There are instances, however, where the bromine collected as such, or in the form of bromide, is the chief or sole product of the industry, and these more naturally have been reported on the Chemical schedule (No. 17). Reducing the bromides thus produced to bromine and combining the data received on all the schedules, it appears that during the census year 1900 there were produced in the United States 480,742 pounds of bromine having a value of $111,121, which is the value at the works.

It may be of interest to compare this result with the following statistics from The Mineral Industry for 1899, page 68. The production of bromine in the United States, including the proportionate amount of bromine contained in potassium bromide, decreased during 1899, falling from 486,978 pounds to 433,003 pounds; the price, however, increased from 28 to 29 cents. The production of bromine in the world is still controlled by the association of American producers, and by the Leopoldshall-Stassfurt convention, which has several years longer to run.

PRODUCTION OF BROMINE IN THE UNITED STATES.

YEAR.	Michigan, pounds.	Ohio, pounds.	Pennsylvania, pounds.	West Virginia, pounds.	Total, pounds.	Metric tons.	Total value.
1895	30,280	152,360	104,647	107,567	394,854	179	$102,662
1896	42,000	212,850	152,600	149,835	559,285	249	143,074
1897	[1]147,256	124,972	116,967	97,954	487,149	221	136,402
1898	[1]141,232	106,860	119,998	118,888	486,978	221	136,354
1899	[1]138,272	82,368	111,150	101,213	433,003	196	125,571

[1] Including the bromine equivalent of the product recovered as potassium bromide.

The manufacture of bromine was begun in the United States in 1846 by Dr. David Alter,[1] of Freeport, Pa. In 1866 works were erected at Tarentum, Pa., and in 1868 at Pomeroy, Meigs County, Ohio. By the introduction of improved processes the price of this article has fallen from $6 per pound in 1856 to 28 cents per pound, which is the approximate price to-day.

Among the chemicals used as anæsthetic agents and as a solvent for organic substances, chloroform holds a high position. It was formerly manufactured by the action of bleaching powder on grain alcohol, but the latter is now largely replaced by acetone. Squibbs[2] says that if 58 pounds of acetone be used to 600 pounds of bleaching powder containing 35 per cent of available chlorine, the yield of chloroform will be 150 to 180 per cent of the weight of acetone employed.

The foreign commerce in fine chemicals is exhibited in the following tables, compiled from the publications of the Bureau of Statistics of the United States Treasury Department:

[1] Tenth Census of the Unites States, report on manufactures, page 1011.

[2] J. Am. Chem. Soc., vol. 18, page 244; 1896.

IMPORTS FOR CONSUMPTION FOR THE YEARS ENDING JUNE 30, 1891-1900.

YEAR.	ACONITE BARK, LEAF, AND ROOT.		NUX VOMICA.		ALL SALTS OF MORPHIA OR MORPHINE.		SULPHATE OF MORPHIA OR MORPHINE AND ALL ALKALOIDS OR SALTS OF.		ALL SALTS OF STRYCHNIA OR STRYCHNINE.		ETHERS, SULPHURIC.		FRUITS, ETHERS, OILS, OR ESSENCE.	
	Pounds.	Value.	Pounds.	Value.	Ounces.	Value.	Pounds.	Value.	Ounces.	Value.	Pounds.	Value.	Pounds.	Value.
1891	2,761	$266	1,394,013	$32,930	29,564	$42,269			230	$175	8	$1		
1892			1,392,437	34,038	38,758	43,301			305	153	100	28	611	$1,540
1893	4,351	236	1,720,315	41,567	23,580	25,035			16,538	7,053	20	2	762	800
1894	1,329	108	1,720,056	39,821	29,076	36,452			566	259	145	32	1,148	2,285
1895			595,497	9,620	16,029	18,507			1,158	502	55	5	756	964
1896	3,034	197	1,275,500	15,668	896	1,083			8,766	3,405	191	24	1,132	1,731
1897	4,020	620	1,298,637	15,200	14,949	30,301			1,377	578	466	44	2,375	9,158
1898			2,026,465	29,529	2,382	2,832	13,409	$32,836	13,049	6,381	476	103	3,276	5,781
1899	1,392	120	1,636,152	28,995			13,081	35,357	15,394	6,570	187	35	2,290	3,669
1900	3,808	274	3,070,536	65,460			26,208	75,274	7,753	3,362	817	110	2.573	4,507

IMPORTS FOR CONSUMPTION FOR THE YEARS ENDING JUNE 30, 1891-1900—Continued.

YEAR.	ALKALOIDS OR SALTS OF CINCHONA BARK.						ALL OTHER ALKALOIDS OR SALTS OF CINCHONA.		PHOSPHORUS.		BROMINE.		IODINE.	
	Bark or other material from which quinine may be extracted.		Cinchonidia.		Sulphate of quinia.								Crude.	
	Pounds.	Value.	Ounces.	Value.	Ounces.	Value.	Ounces.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891	2,672,364	$301,085	156,229	$3,856	3,079,000	$805,821	112,013	$23,977	151,166	$53,590			241,186	$382,009
1892	3,423,941	299,998	11,483	1,586	2,686,677	542,440	156,442	29,366	85,622	31,643	53,563	$7,094	164,185	167,893
1893	2,374,041	196,867	364,192	11,714	3,027,819	556,782	48,030	11,695	89,874	44,068	780	234	327,248	589,186
1894	2,502,224	143,194	313,640	7,177	2,141,130	470,816	40,850	10,991	20,757	11,927	20	11	401,501	587,127
1895	2,012,399	117,998	72,425	3,534	1,308,969	327,541	37,027	10,857	28,747	14,131				
1896	2,699,789	165,699	282,321	9,980	2,950,078	754,050	76,507	23,147	50,027	26,646				
1897					2,714,147	489,821	367,373	57,237	60,731	29,870				
1898			303,278	38,802	3,643,298	752,211	424,665	106,961	43,351	21,849			401,214	805,783
1899			233,885	34,932	2,788,663	665,819	985,480	252,141	12,399	7,366			315,476	573,469
1900			101,335	15,924	2,628,060	763,986	515,168	155,817	25,228	9,789			573,128	1,452,434

YEAR.	IODINE—continued.				CHLORAL HYDRATE.		CHLOROFORM.		IODOFORM.		HYDRIODATE, IODIDE, AND IODATE OF POTASH.		CALOMEL AND OTHER MERCURIAL MEDICINAL PREPARATIONS.	
	Crude and resublimed.		Resublimed.											
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891			35	$106					1,242	$19,459	1,024	$935	7,801	$5,244
1892			4	14			35	$15	244	890	186	505	12,630	8,114
1893			6	25			11	14	176	649	187	475	13,495	7,941
1894			7	31			43	18	103	382	181	464	8,435	4,715
1895	31,374	$48,350			20,097	$10,976	239	164	158	583	235	561	8,280	4,209
1896	291,895	566,908			30,275	17,367	137	46	243	926	5,489	9,289	13,900	7,154
1897	391,551	872,526			63,360	36,138	91	18	116	437	2,774	5,032	12,349	6,053
1898			22	53	40,263	23,063	542	123	30	96	280	649	12,316	6,386
1899			43	146	12,370	7,562	227	72	52	163	2,168	3,607	21,963	11,848
1900			501	1,410	795	1,634	75	36	202	602	1,288	2,155	16,647	10,163

Group XIX.—Chemicals General (Including all Chemical Products not Especially Enumerated Elsewhere).

This group includes a very large variety of products, and while they are enumerated here more in detail than has been feasible in any previous census report, it is not to be concluded that the presentation is complete.

The total number of establishments belonging to this group, and forming Class A, is 78, while 107 other establishments, forming Class B, made these products as a subordinate part of their industry. The great variety of products belonging to this group permits only a few general divisions, tabulated in table below, the amount of each product made in the works, but consumed there in the manufacture of other products, being entered separately so far as known. Classes A and B are combined for the sake of brevity.

CHEMICALS GENERAL, BY KIND, QUANTITY, AND VALUE: 1900.

PRODUCTS.	Number of establishments.	PRODUCTS.	
		Pounds.	Value.
Ammonia, aqua	A, 16; B, 12	26,758,068	$1,237,745
Ammonia, consumed		1,524,632	20,488
Ammonium, aqua sulphate	A, 2; B, 4	11,094,554	288,667
Ammonium, sulphate consumed		1,681,700	43,724
Ammonium salts, sundry	A, 2; B, 4	1,904,479	128,768
Ammonium salts, consumed		423,683	(1)
Antimony salts	A, 3; B, 3	211,956	22,778
Chrome products	A, 5; B, 5	15,407,882	1,130,257
Copperas	A, 1; B, 9	27,746,570	133,392
Copperas, consumed		1,987,000	7,948
Cream tartar	A, 8	11,286,680	2,130,104
Dyers' chemicals	A, 2; B, 8	6,653,247	105,895

1 Not given.

CHEMICALS GENERAL, BY KIND, QUANTITY, AND VALUE: 1900—Continued.

PRODUCTS.	Number of establishments.	PRODUCTS.	
		Pounds.	Value.
Epsom salts	A, 2; B, 5	9,239,809	$75,066
Glauber's salts	A, 3; B, 15	31,314,255	160,065
Glycerin	A, 5; B, 5	15.383,798	2,012,886
Glycerin, consumed		4,000,000	480,000
Lead acetate	A, 3; B, 3	1,296,991	73,190
Saltpeter	A, 6	13,088,680	482,580
Silicate, sodium	A, 5; B, 3	65,302,901	416,005
Sulphur, refined	A, 4	25,998,638	393,548
Tin salts	A, 4; B, 9	6,247,205	603,937
Vitriol, blue	A, 2; B, 2	8,460,243	544,817
Zinc salts	A, 4; B, 10	9,511,909	353,902

The incompleteness of even this partial return is evident when it is noted that the ammonium sulphate produced by the gas and coke industries, the glycerin from soap and other works, and the metallic salts, such as blue vitriol, etc., produced in metallurgical works, are not included here. The difficulty of obtaining a fairly complete enumeration of chemical products is shown by the fact that the returns collected on Special Schedule No. 17 give a total value for "chemicals, not otherwise specified," of $2,142,419. In many cases it would not have been possible for the respective establishments to give these products in more detail, because this item is made up in part of small quantities of special chemicals made to fill certain orders, nor would the information have sufficient practical value to warrant the expenditure of the labor required to make more complete returns. In some instances, however, more definite information would have been desirable and could have been secured had circumstances permitted.

While 17 establishments reported a production of 26,506,818 pounds of niter cake, valued at $37,360, 15 establishments produced 81,191,424 pounds of salt cake, valued at $345,277, and 10 establishments produced 62,701 tons of pyrites cinder, valued at $105,631, it is at once evident that these figures are only a small portion of the actual product. Where an acid chamber is operated in connection with a fertilizer works, the niter cake is usually consumed in the manufacture of fertilizers. While there is usually no sale for the pyrites cinder, a few works report using pyrites, the cinder of which is returned to other works for special treatment, but, in most cases, the cinder is simply "dumped," in the hope that at some time in the future a market may be found for it.

The following table gives the quantities and values of the various chemical products enumerated in this group, the amounts designated by "C" being the figures collected from other branches of industry. As these are elsewhere reported, they must be so entered to prevent apparent duplication:

KIND.	Unit.	Quantity.	Value.
Acetate:			
Lead	Pound	1,296,991	$73,190
Sodium	Pound	708,360	21,193
Aluminum chloride	Pound	903,118	12,724
Ammonia, aqua	Pound	28,282,700	1,258,233
Ammonium carbonate	Pound	1,351,389	97,808
Ammonium chloride	Pound	516,410	26,742
Ammonium nitrate	Pound	36,680	4,218
Ammonium sulphate:			
Class A and B	Pound	11,094,554	288,668
Class C	Pound	12,200,931	334,869
Antimony salts	Pound	211,956	22,778
Barium carbonate	Pound	2,400,000	24,800
Barium chloride	Pound	1,100,000	16,600
Barium sulphate (satin white)	Pound	2,144,000	47,962
Bone ash	Pound	2,596,500	55,130
Calcium chloride	Pound	7,079,040	28,357
Carbon disulphide	Pound	773,800	31,392
Chemicals not specified	Pound	....	2,142,419
Chrome products	Pound	15,407,882	1,130,257
Copper salts (see also vitriol blue)	Pound	100,000	18,180
Copperas	Pound	29,733,570	143,327
Cream of tartar	Pound	11,286,680	2,137,104
Dyers' chemicals	Pound	6,653,247	105,895
Epsom salts	Pound	9,239,809	75,066
Fluorides (of alkalies)	Pound	480,000	40,000
Fluoride, calcium residue	Pound	9,906,900	7,000
Glauber's salts	Pound	31,314,255	160,065
Glycerin:			
Class A and B	Pound	15,383,798	2,012,886
Class C	Pound	11,128,676	1,202,715
Iron salts (see also copperas)	Pound	2,246,358	83,287
Magnesium salts (see also Epsom salts)	Pound	26,312,000	134,700
Manganese salts	Pound	30,000	1,000
Metals (sundry, by-products)	Pound	....	503,548
Metallic oxides (sundry)	Pound	48,000	15,000
Nitrite, sodium	Pound	769,170	67,194
Niter cake	Pound	26,506,818	37,360
Paris green	Pound	674,650	80,958
Phosphate:			
Acid calcium	Pound	2,510,694	95,307
Sodium	Pound	4,231,160	121,796
Sundry	Pound	1,221,150	70,343
Salt:			
Common (by-product)	Pound	53,978,689	80,832
Scouring	Pound	531,250	19,922
Salt cake	Pound	81,191,424	345,277
Saltpeter	Pound	13,088,680	482,580
Silicate, sodium	Pound	65,302,901	416,005
Sulphur, refined	Pound	25,998,638	393,548
Sulphur chloride	Pound	10,000	3,500
Sulphate:			
Sodium	Pound	6,467,744	29,659
Sodium bi-	Pound	6,156,742	27,103
Sulphide sodium	Pound	2,967,717	32,634
Sulphites:			
Sundry	Pound	149,500	19,300
Sundry bi-	Pound	2,922,850	34,486
Sulphite, sodium hypo-	Pound	10,469,744	144,868
Sulphate, calcium, residues	Pound	....	25,402
Tin salts	Pound	6,247,205	603,937
Vitriol, blue:			
Class A and B	Pound	8,460,243	544,817
Class C	Pound	26,274,358	1,174,081
Zinc salts	Pound	9,511,909	353,902
Sundries	Pound	....	159,036

In considering the various items of this table, the quantities given for the lead and sodium acetates, as also for aluminum chloride, probably, fairly represent the total production of these articles, since they are made only in works which belong to "chemical industries," and which have given fairly detailed reports. Still, and this is true for all other cases, where these substances are made in small quantities, they may be, and usually are, included in "chemicals not specified," which aggregates so large a value.

The quantities of aqua ammonia and of the various ammonium salts enumerated are probably less than the true amounts, since these are made in many industries, some of which do not belong to the chemical category. It is, however, reasonable to suppose that these figures do cover the greater part of such product because, although it has not been possible to get direct figures for the quantity of ammonia liquors, produced by the gas works, still most of these sell their liquors to outside chemical works which have furnished figures of their own production. Similarly, while some of the makers of boneblack, and other industries producing ammonia liquors, were classified in other categories, most of their ammonia product was refined elsewhere, and appears in this tabulation.

The ammonium products reported, other than sulphate, and their contents in NH_3 (anhydrous ammonia) are as follows:

	Pounds.	Pounds.
Ammonia, anhydrous liquid	2,443,729 = NH_3	2,443,729
Ammonia, aqua, 20 per cent	28,282,700 = NH_3	5,656,540
All other ammonia salts	1,894,474 = NH_3	531,387
	32,620,903	8,631,686

In addition to these figures, a certain amount of ammonium nitrate, picrate, etc., has been made and consumed in the explosive industry, and, moreover, it is likely that not all of these products have been so reported as to be identified and separated. It is, therefore, fair to assume that the total quantity of ammonium products, other than sulphate, made in the United States during the census year, and entering into consumption, is equivalent to 10,000,000 pounds of anhydrous ammonia.

The total reported quantity of ammonium sulphate is as follows:

	Pounds.	Pounds.
From chemical industry	11,094,554 = NH_3	2,773,639
From chemical industry, consumed	1,681,700 = NH_3	420,425
From coke industry	11,984,931 = NH_3	2,996,283
From other categories	216,000 = NH_3	54,000
	24,977,185 = NH_3	6,224,347
Used by fertilizer industry	8,239,445 = NH_3	2,059,061
Available for other purposes	16,737,740 = NH_3	4,165,286
Deficit	NH_3	5,834,714
Total required	NH_3	10,000,000

To supply this deficit, the coke industry reports in addition, a production of ammonium liquor of 1,572,325 gallons which, at 8 pounds to the gallon and an average of 18 per cent NH_3, equals 2,517,720 pounds, leaving 3,316,994 pounds to be supplied either as ammonia liquor, or sulphate, by the gas industry and by such other industries as are not already included. Since the quantity contributed by this last class is comparatively very small, the 3,316,994 pounds may be taken as being furnished by the gas industry. The total amount of ammonia produced by it is undoubtedly much greater, but it must be remembered that, in many of the smaller works, the local conditions are such that the ammonia liquor can not be profitably utilized, and hence is run to waste. Despite the demand for ammonium sulphate for fertilizer purposes, it is not a simple matter to make a sulphate suitable for this use, since the crude salt contains sulphocyanate and other impurities which must be removed, as they are highly deleterious to vegetation. Such purification requires special skill and can not be profitably undertaken unless the supply of crude material is sufficiently large to warrant the erection of the proper plant.

Considerable quantities of ammonia liquor and sulphate are made in Europe as by-products from the gases of blast furnaces, and this production will undoubtedly increase with the extending use of gas-driven engines. This use requires that the furnace gases must be carefully cooled and systematically washed, so that the gas shall enter the engine with the minimum of impurities, as these rapidly destroy the working parts of the combustion chambers. Where the gas is used only for heating the stoves and for burning under boilers, such purification is not necessary, and so far, no serious attempt has been made here to produce ammonium salts in blast-furnace work.

In considering the other items of this list, the quantities of antimony salts and barium salts probably cover the entire product. The quantity of bone ash reported is undoubtedly less than the actual product, as is also the case with calcium chloride, since none is reported in the special census report on salt, although formerly a large quantity was produced as a by-product in the Ohio River salt region. The salt of this region contains calcium chloride in place of the calcium sulphate of the New York, Michigan, and other regions, and owing to its presence the salt when made is "soft salt," slightly deliquescent and quickly dissolved. The northern salt, which contains no calcium chloride, is "hard salt" and dissolves much more slowly. Owing to its ready solubility the "soft salt" was formerly preferred in the South for curing meats, as it "struck in" faster, hence there was a better chance of saving the meat in the comparatively warm climate, where ice was unattainable.

Calcium chloride is largely used in solution as the circulating medium in the manufacture of ice and in refrigeration; also, to a subordinate extent, as an air drier and in the manufacture of textile goods; also to some extent as the solution used in charging fire extinguishers. It recommends itself for this last-mentioned use because of the low freezing points of strong solutions of the salt. It is stated that a solution of calcium chloride of 1.25 specific gravity, and containing 27 per cent of the salt, freezes at 32.6° F., and that one at 1.175 specific gravity, freezes at zero. It is, therefore, an easy matter to prepare solutions which will not freeze at the lowest winter temperature of the locality where used, and hence be always ready for service in case of fire.

Chrome products, mainly bichromates of potash or soda, form a considerable item in this list. Ten establishments reported making such products during the census year. The industry has an especial interest, because the methods of manufacture have been largely developed in this country. The Baltimore Chrome Works, still the largest producer, began operations in 1845, which have been continued with great success up to the present time.

The copperas reported is only a portion of the total product, as the product of the metallurgical works is not included. It is made in large quantities by wire mills galvanizing works from the "spent pickle." Before wire rods can be drawn or iron can be galvanized the surface must be carefully cleaned, part of this work being the pickling or immersion of the steel or iron in a bath of moderately diluted sulphuric acid. This dissolves the rust and also some of the metal, so that in time the bath becomes spent, being then a solution of ferrous sulphate containing still much free acid. To neutralize this acid, and at the same time to utilize an otherwise waste material, the iron clippings and other iron scrap of the shops are added to the pickle which dissolves them. The solution is then evaporated and allowed to crystallize. The crystals are removed and the mother liquor used to make Venetian red, by treating it with lime. This causes a precipitation of calcium sulphate mixed with hydrated oxide of iron, various shades of color being obtained by regulating the proportion of lime added and by subsequent treatment.

Cream of tartar, so extensively used in baking powders, is another large item. Eight establishments reported making it, but the bulk of the business is done by two of them.

This manufacture illustrates the refinements of which chemical manufacture on a large scale is capable; for the Tartar Chemical Co., at its works in Brooklyn, N. Y., is producing cream of tartar by the ton in a chemically pure condition.

The Epsom and Glauber's salts reported probably cover the production, but the figures for glycerine represent only a small part of the actual production, as the product of only a few of the soap-making establishments and other sources is here included.

Sodium silicate, or water glass, is produced in large quantities, as it is extensively used in soap making, calico printing, and fresco painting; for rendering cloth and other draperies noninflammable; as a preservative for timber and porous stone; in the manufacture of artificial stone and in making cements for glass and pottery.

Sulphur chloride is used in vulcanizing caoutchouc; sodium sulphide as a depilatory in tanning; and sodium hyposulphate in photography, dyeing, and calico printing, and for other purposes. The quantity of sulphites reported is only a very small part of that actually made, since the sulphite used in making paper pulp is usually made and consumed in the works, and is not separately reported.

The other items receive no special mention. The quantities given are believed to fairly represent the production of the country, and their methods of preparation and uses may be found in the standard works on technical chemistry.

Subgroup A.—In the course of this work schedules were received from 19 establishments, whose principal products were not originally classified in "chemicals," though the products were the result of operations of a chemical nature. As such establishments are more properly included in this category than in any other, and yet can not well be placed in any of the regular groups, it is deemed advisable to form a special subgroup, XIX A, in which all such are included. Their character and the extent of their operations are shown in the following list:

	Number of establishments.	Quantity.	Value.
		Pounds.	
Camphor, refined	3	598,708	$254,190
Casein	3	609,210	30,336
Dextrin and sizes	4	12,204,570	221,995
Milk sugar	4	1,395,290	110,247
Shellac, refined	3	1,123,752	187,333
Sundry products	2		176,928

In addition, a number of establishments classified under other groups report such substances as subproducts of their operations, the aggregate becoming considerable both in quantities and values, and also emphasizing the importance of care in the preparation and correlation of schedules and in the collection of returns.

At the beginning of this report a list has been given of the principal topics included in the field of "chemical technology," and it has been indicated how far these have been separately treated of in the present census. Referring to this list, it will be observed that no provision was made for taking special returns of establishments manufacturing certain important products, such as glue, soap, starch, etc., noted below, the general schedule for manufactures, No. 3, being used for this purpose.

The following list of the products included in this group, while fairly correct for the special industries enumerated above, must therefore, for all of the other items, be taken as representing only a portion of the total product of such articles throughout the country during the census year.

PRODUCTS INCLUDED IN SUBGROUP A.

	Number of establishments.	Unit.	Quantity.	Value.
Boiler compounds	1	Barrels	200	$6,400
Bone black	7	Tons	15,100	586,736
Brandy	3			14,561
Camphor, refined	4	Pounds	625,128	264,830
Caramel	3	Pounds	1,736,000	87,000
Casein	3	Pounds	609,210	30,954
Cement	2	Tons	10,150	82,500

PRODUCTS INCLUDED IN SUBGROUP A—Continued.

	Number of establishments.	Unit.	Quantity.	Value.
Chemical compounds, sundry	5			$102,228
Cider	1			563
Dextrine, sizes, etc	5	Pounds	19,106,784	470,518
Disinfectants	2			1,865
Extracts, flavoring	1	Gallons	5,000	60,000
Filler, crown	1	Tons	2,963	36,931
Filler for fertilizing	1	Tons	14,677	35,000
Gelatine	1	Pounds	922,261	251,872
Glue	13	Pounds	11,079,408	701,596
Gum compound	1	Pounds	336,012	38,716
Gypsum, precipitated	2	Tons	1,264	1,264
Ink	3			41,000
Licorice extract	1	Pounds	1,178,226	89,610
Milk sugar, refined	4	Pounds	1,375,290	110,290
Oils for textile work	1	Pounds	133,300	7,000
Paste, or flour	4	Pounds		15,042
Pyrites cinder	11	Tons	62,701	105,631
Residues, factory	10			15,637
Shellac, refined	7	Pounds	1,832,290	317,585
Soaps, etc	11			207,716
Starch	1	Pounds	1,372,889	30,890
Wax, sealing	3	Pounds	111,500	12,400
				3,726,292

Miscellaneous.—The examination of schedules for tabulation has furnished a large amount of products which are not chemical, and therefore would not be included in our returns, except that they are side products of establishments belonging to this category. In addition, there are values such as "custom work," increasing the profits of an establishment, and the "bonus" paid by cities to garbage-reduction works, which is necessary to the existence of such works.

The following list shows the variety and value of these articles, quantities being given where possible, and may be useful as supplementing the returns for such products so far as these may be separately reported:

	Number of establishments.	Unit.	Quantity.	Value.
Apples, evaporated	1	Pounds	35,000	$1,100
Asphalt, paving	1	Pounds	47,000	1,364
Baking powder	2	Pounds	755,506	54,058
Bird seed	1	Case	13,718	30,865
Bluing	2	Pounds	200,000	7,500
Brushes	1	Dozens	350	3,000
Building materials	3			68,440
Candles	3	Pounds	1,792,075	181,475
Bones, garbage reduction	5			161,790
Containers	9			213,675
Corks	1			5,000
Cottonseed products	5			189,021
Custom work	12			79,940
Dental plaster	1		3,864,000	77,270
Fish, edible	1	Barrels	2,000	8,000
Flour	1			2,000
Graphite, ground	1	Tons	200	2,400
Grease, tallow, etc	61			1,034,248
Hides	17			158,198
Horns, hoofs, etc	13			22,443
Ice, manufactured	1	Tons	7,200	15,000
Hay, mint	6	Tons	2,100	6,356
Mirrors	1			74,218
Oils:				
Animal	20			655,363
Fish	25	Gallons	1,135,264	222,929
Linseed	1	Gallons	460,344	207,155
Cake	1	Pounds	6,051,400	60,514
Poultry foods	7	Pounds	2,265,352	31,528
Pottery, chemical	1	Pounds		462
Pickled goods	1	Pounds	112,894	5,515
Roofing materials	7			438,779
Sundries:				
Animal	3			62,859
Metallic	3			42,918
Mineral	2			12,400
Vegetable	6			34,123
Wax, modeling	1	Pounds	25,000	3,750
Total				$4,175,656

The foreign commerce, in substances treated of in this group, is set forth in the following tables, compiled from the publications of the Bureau of Statistics of the United States Treasury Department:

IMPORTS FOR CONSUMPTION FOR THE YEARS ENDING JUNE 30, 1891-1900.

YEAR.	AQUA, OR WATER AMMONIA.		AMMONIA, CARBONATE OF, MURIATIC OR SAL-AMMONIAC, AND SULPHATE OF.		POTASH, CHROMATE AND BICHROMATE.		SODA, BICHROMATE AND CHROMATE.		ARGAL OR ARGOL, OR CRUDE TARTAR.		ARGOLS, OR WINE LEES.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891	276,756	$12,858	24,331,113	$740,667	1,234,085	$95,951	545,458	$31,565	21,579,102	$2,197,507	....	....
1892	....	3,136	14,275,362	472,276	1,058,521	81,287	703,246	44,091	24,813,171	2,216,525	....	....
1893	....	718	18,794,599	560,222	969,067	79,174	671,503	44,183	28,770,810	2,341,575	....	....
1894	....	....	7,638,848	309,701	1,009,499	83,420	267,397	17,657	22,373,180	1,504,200	....	....
1895	....	....	19,836,379	653,146	2,024,776	173,139	600,600	40,321	27,911,122	1,893,730	....	....
1896	....	....	30,523,313	804,671	1,444,716	129,339	556,631	38,103	28,481,665	2,724,709	....	....
1897	....	....	24,891,603	576,152	1,366,074	112,783	319,641	22,070	23,457,576	1,967,042	....	....
1898	....	....	20,695,623	456,273	1,016,029	79,495	295,549	19,027	741,150	65,154	18,461,479	$1,525,873
1899	....	....	19,228,311	520,762	1,099,093	75,254	598,262	29,861	....	....	23,300,762	1,914,450
1900	....	....	22,185,935	684,904	645,183	41,449	474,654	21,982	....	....	27,339,489	2,388,693

YEAR.	NITRATE OF POTASH OR SALTPETER, CRUDE.		NITRATE OF SODA.		GLYCERIN.		CAMPHOR, REFINED.		DEXTRIN, BURNT STARCH, GUM SUBSTITUTE, OR BRITISH GUM.		IRON, SULPHATE OF, OR COPPERAS.	
	Pounds.	Value.	Tons.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891	15,040,757	$459,084	100,428	$2,923,374	13,975,577	$996,686	63	$21	6,319,352	$212,968	896,937	$4,103
1892	14,254,514	435,839	109,863	2,976,816	14,197,549	831,810	56,820	17,361	3,275,326	137,408	495,696	2,597
1893	16,560,599	465,666	91,661	3,062,715	16,540,213	893,636	156,291	51,229	4,650,215	161,430	1,010,039	4,099
1894	9,671,217	251,418	88,079	2,785,048	8,321,853	519,296	137,882	44,233	3,988,361	121,963	927,162	3,619
1895	8,735,290	245,552	124,803	4,124,712	13,488,825	784,613	271,164	83,382	....	....	542,316	1,344
1896	14,758,974	389,524	127,557	3,870,724	21,158,829	1,472,302	153,912	68,785	....	....	1,123,443	4,161
1897	19,719,876	408,761	83,331	2,640,389	12,717,098	1,182,099	249,994	84,639	4,874,656	124,719	991,000	6,925
1898	12,920,986	270,291	125,081	2,729,750	12,274,987	774,709	170,406	54,602	3,737,575	108,919	250,270	1,087
1899	19,985,505	409,818	122,314	2,054,805	15,665,252	1,024,131	90,743	28,806	3,402,474	99,056	127,041	606
1900	10,332,836	269,739	184,247	4,736,807	27,943,106	2,155,414	109,971	42,901	5,950,487	169,470	2,700	111

YEAR.	LEAD.				MAGNESIA, SULPHATE OF, OR EPSOM SALTS.		MILK, SUGAR OF.		REFINED SULPHUR.		SULPHATE OF COPPER, OR BLUE VITRIOL.	
	Brown, acetate of.		White, acetate of.									
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Tons.	Value.	Pounds.	Value.
1891	....	....	13,279	$707	16,370	$206	251,408	$42,330	307	$6,579	3,432	$310
1892	2,902	$123	1,220	101	31,742	360	236,869	34,304	....	....	2,189	156
1893	....	....	2,185	154	61,337	480	98,785	12,089	6	118	8,941	363
1894	....	....	3,217	220	59,294	402	31,346	3,499	48	1,255	2,470	140
1895	3,510	154	59,399	2,822	650	16	14,117	1,828	122	2,392	245,787	5,481
1896	30,154	934	48,060	1,873	100,859	691	16,365	2,162	306	5,338	876,401	28,792
1897	26,020	850	3,122	190	240,573	1,122	17,117	2,824	430	9,111	192,114	6,797
1898	6,008	257	3,594	231	91,137	614	1,844	270	55	1,542	12,302	518
1899	3,437	138	5,145	337	74,186	526	4,064	461	227	5,802	15,981	342
1900	18,192	711	4,093	269	377,274	2,163	2,378	399	186	4,470	2,134	113

YEAR.	HYPOSULPHITE OF SODA.		NITRITE OF SODA.		PHOSPHATE OF SODA.		SILICATE OF SODA, OR OTHER ALKALINE SILICATES.		SULPHATE OF SODA OR GLAUBER'S SALTS.		SULPHATE OF SODA, SALT OR NITER CAKE.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1891	....	....	....	....	....	....	536,030	$6,429	274,784	$2,167	16,927,804	$85,368
1892	....	....	....	....	....	....	571,153	7,090	187,398	2,088	22,465,878	121,900
1893	....	....	....	....	....	....	608,228	6,991	489,798	4,012	44,180,349	221,846
1894	....	....	....	....	....	....	485,435	5,054	924,874	4,916	11,794,686	43,938
1895	....	....	....	....	....	....	492,207	4,562	49,414	4,497	37,248,332	107,459
1896	....	....	....	....	....	....	580,310	6,277	1,916,486	9,769	25,692,755	71,801
1897	6,965,581	$74,501	....	....	505,373	$9,045	600,132	5,468	612,026	3,366	7,748,600	36,590
1898	11,007,111	98,733	155	$37	1,436,171	24,699	417,476	3,971	732,094	7,120	5,228,000	20,662
1899	10,686,997	94,534	5,455	298	3,723,907	69,175	527,531	4,256	519,080	5,828	4,984,940	20,569
1900	8,676,351	78,691	308,386	15,838	2,226,835	43,817	1,306,782	9,536	1,028,240	8,892	6,382,260	29,086

TABLE 1.—FERTILIZERS:

		United States.	Alabama.	California.	Connecticut.	Delaware.
1	Number of establishments	422	17	8	9	11
	Character of organization:					
2	Individual	136	2	3	6	7
3	Firm and limited partnership	103	9		2	1
4	Incorporated company	183	6	5	1	3
	Capital:					
5	Total	$60,685,753	$1,407,323	$647,506	$382,518	$496,784
6	Land	$3,659,641	$18,118	$79,476	$30,000	$13,500
7	Buildings	$8,930,424	$225,500	$128,210	$48,669	$82,567
8	Machinery, tools, and implements	$7,092,354	$175,518	$59,314	$66,766	$103,639
9	Cash and sundries	$41,003,334	$988,187	$380,506	$237,083	$297,078
10	Proprietors and firm members	361	32	3	8	9
	Salaried officials, clerks, etc.:					
11	Total number	1,712	60	16	30	17
12	Total salaries	$2,124,972	$61,975	$20,148	$28,063	$16,685
	Officers of corporations—					
13	Number	243	10	4	4	3
14	Salaries	$662,741	$21,700	$7,500	$7,200	$5,000
	General superintendents, managers, clerks, etc.—					
15	Total number	1,469	50	12	26	14
16	Total salaries	$1,462,231	$40,275	$12,648	$20,863	$11,685
	Men—					
17	Number	1,381	48	11	21	13
18	Salaries	$1,420,596	$39,475	$12,168	$19,460	$11,205
	Women—					
19	Number	88	2	1	5	1
20	Salaries	$41,635	$800	$480	$1,403	$480
	Wage-earners, including pieceworkers, and total wages:					
21	Greatest number employed at any one time during the year	20,257	840	94	212	393
22	Least number employed at any one time during the year	7,202	260	58	92	59
23	Average number	11,581	439	70	133	148
24	Wages	$4,185,289	$94,965	$40,138	$53,708	$50,553
	Men, 16 years and over—					
25	Average number	11,435	439	70	113	148
26	Wages	$4,142,853	$94,965	$40,138	$48,319	$50,553
	Women, 16 years and over—					
27	Average number	131			20	
28	Wages	$39,463			$5,389	
	Children, under 16 years—					
29	Average number	15				
30	Wages	$2,973				
	Miscellaneous expenses:					
31	Total	$3,734,285	$92,704	$17,638	$19,754	$18,137
32	Rent of works	$96,605	$900	$1,430	$400	$50
33	Taxes, not including internal revenue	$288,006	$22,924	$1,403	$1,164	$1,043
34	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$3,326,181	$68,880	$14,805	$18,190	$17,044
35	Contract work	$23,493				
	Materials used:					
36	Total cost	$28,958,473	$1,387,385	$482,818	$228,242	$399,642
37	Fish, thousands	4,589,632			17,560	200,000
38	Cost	$183,542			$25,189	$40,000
39	Kainit, tons	54,700	13,048		200	1,461
40	Cost	$520,833	$132,172		$7,500	$15,235
41	Limestone, tons	7,158				2,106
42	Cost	$7,322				$752
43	Phosphate rock, tons	806,445	23,940	1,156	17	2,062
44	Cost	$3,554,174	$244,216	$12,462	$143	$7,569
45	Pyrites, tons	288,778	9,520			
46	Cost	$1,466,285	$62,500			
	Acids—					
47	Sulphuric, tons	231,527	500	2,075	231	1,972
48	Cost	$1,355,382	$5,000	$32,000	$1,736	$11,824
49	Nitric, pounds	1,075				
50	Cost	$41				
51	Acid phosphate, tons	286,898	58,385	1,500	3,226	21,262
52	Cost	$2,176,245	$169,820	$25,000	$28,248	$154,292
	Ammonia—					
53	Aqua, pounds	2,620				
54	Cost	$681				
55	Sulphate, pounds	8,239,445		2,302,000		
56	Cost	$186,609		$60,709		
57	Bones, tankage, and offal	$9,766,735	$340,611	$176,955	$88,514	$51,708
58	Common salt, tons	481				
59	Cost	$2,211				
60	Cotton seed and meal	$167,410	$80,218			
61	Lime, bushels	13,130				
62	Cost	$887				
63	Nitrate of potash, tons	884				
64	Cost	$32,156				
65	Nitrate of soda, tons	19,518	252	999	409	58
66	Cost	$709,841	$9,800	$31,868	$14,112	$2,312
67	Potash salts	$3,098,400	$31,270	$98,484	$27,725	$38,861
68	Sulphur, tons	12,728	810	263		60
69	Cost	$268,670	$18,000	$6,102		$1,200
70	Tallow and fats	$28,500				
71	All other components of products	$1,029,163	$12,390	$6,425	$10,664	$4,368
72	Fuel	$797,639	$19,522	$7,707	$6,368	$7,150
73	Rent of power and heat	$17,603	$1,032	$1,112	$50	$262
74	Mill supplies	$176,507	$10,743	$2,077	$860	$2,790
75	All other materials	$2,212,182	$131,265	$21,917	$9,254	$29,613
76	Freight	$1,199.455	$118,826		$7,879	$31,706
	Products:					
77	Aggregate value	$44,657,385	$2,068,162	$670,517	$390,805	$738,703
	Acids—					
78	Sulphuric, 50 Baumé, tons	65,747	2,934			
79	Value	$380,691	$25,000			
80	Sulphuric, 60 Baumé, tons	1,388				
81	Value	$13,678				
82	Sulphuric, 66 Baumé, tons	2,417		634		
83	Value	$44,019		$12,680		
84	Other acids	$11,424				
	Sodas—					
85	Sal soda, tons	18				
86	Value	$277				
87	Other soda products	$1,245				

SUMMARY BY STATES, 1900.

District of Columbia.	Florida.	Georgia.	Illinois.	Indiana.	Kansas.	Kentucky.	Louisiana.	
6	7	41	5	14	3	4	6	1
4	2	11	2	7	1			2
2	1	10	1	5				3
	4	20	2	2	2	4	6	4
$95,086	$733,369	$6,663,618	$1,632,505	$215,875	$229,733	$335,974	$1,290,162	5
$22,000	$92,164	$137,762	$200,200	$8,675	$19,000	$20,000	$46,894	6
$11,000	$135,185	$1,044,804	$213,200	$26,350	$66,450	$27,500	$292,356	7
$18,585	$109,748	$661,134	$84,810	$30,500	$44,448	$40,788	$181,420	8
$43,500	$396,272	$4,819,918	$1,134,295	$150,350	$99,835	$247,686	$769,492	9
8	4	39	4	19	1	2		10
7	29	114	52	18	5	16	27	11
$1,733	$26,731	$147,018	$74,960	$11,640	$6,300	$17,650	$51,107	12
	8	15	3	4		4	10	13
	$9,166	$42,375	$9,000	$4,900		$9,600	$30,000	14
7	21	99	49	14	5	12	17	15
$1,733	$17,565	$104,643	$65,960	$6,740	$6,300	$8,050	$21,107	16
7	18	97	47	12	5	10	17	17
$1,733	$16,265	$103,683	$65,000	$6,340	$6,300	$7,450	$21,107	18
	3	2	2	2		2		19
	$1,300	$960	$960	$400		$600		20
52	242	2,125	438	104	242	165	430	21
27	68	624	308	43	98	34	179	22
22	117	1,126	337	45	155	89	278	23
$9,051	$39,961	$294,887	$172,250	$18,640	$70,882	$39,738	$87,256	24
22	114	1,121	287	45	155	89	259	25
$9,051	$39,511	$293,887	$154,250	$18,640	$70,882	$39,738	$83,656	26
			50				19	27
			$18,000				$3,600	28
	3	5						29
	$450	$1,000						30
$2,617	$34,030	$405,936	$84,997	$9,602	$52,380	$16,508	$103,720	31
$1,210	$1,495	$4,261	$40	$1,100	$40	$2,400	$265	32
$100	$2,307	$36,174	$2,833	$1,389	$2,000	$2,938	$1,116	33
$1,307	$30.228	$365,376	$82,124	$7,113	$50,340	$11,170	$102,339	34
		$125						35
$50,273	$330,649	$2,349,635	$1,005,731	$159,089	$411,139	$166,215	$614,431	36
								37
								38
154	723	10,205					1,858	39
$1,552	$8,640	$98,181					$17,416	40
							21	41
							$54	42
	8,040	120,931	10,280			5,625	15,180	43
	$32,177	$417,037	$59,820			$17,804	$64,015	44
	3,177	37,879					2,457	45
	$17,473	$213,466					$18,033	46
	300	24,202	9,280	320	3,000	4,314		47
	$1,800	$133,207	$81,468	$4,100	$34,440	$32,187		48
								49
								50
1,550	5,547	30,305	5,366	1,105	750	1,910	17,419	51
$14,500	$48,447	$276,183	$48,352	$12,180	$7,110	$20,700	$154,627	52
								53
								54
	600,000	30,000	1,000,000					55
	$15,000	$900	$31,000					56
$24,123	$96,926	$534,781	$540,785	$123,705	$296,496	$56,059	$215,218	57
	6	40					140	58
	$48	$100					$560	59
		$78,192					$9,000	60
								61
								62
								63
								64
15	269	1,333	500			89	46	65
$675	$9,619	$50,035	$19,000			$4,600	$1,702	66
$3,530	$54,300	$136,905	$79,875	$1,628	$17,647	$5,400	$15,644	67
		350					2,627	68
		$8,750					$51,527	69
								70
$1,235	$5,828	$28,146	$7,407	$1,440	$3,875	$13,837	$636	71
$950	$6,249	$52,693	$48,190	$2,940	$15,700	$4,380	$17,970	72
$260	$360				$13,500			73
$205	$2,088	$11,461	$2,904	$846	$3,170	$1,350	$3,745	74
$2,250	$23,389	$192,417	$86,930	$8,375	$19,201	$4,561	$49,284	75
$993	$8,305	$117,181		$3,875		$5,337		76
$78,930	$500,239	$3,367,353	$1,855,160	$255,331	$549,943	$321,245	$909,551	77
	90	856						78
	$623	$5,436						79
							149	80
							$5,960	81
							208	82
							$8,736	83
	$210						$11,214	84
								85
								86
							$840	87

TABLE 1.—FERTILIZERS: SUMMARY

		Maine.	Maryland.	Massachusetts.	Mississippi.	Missouri.
1	Number of establishments	3	40	9	3	3
	Character of organization:					
2	Individual	1	11	4		1
3	Firm and limited partnership		12	2		
4	Incorporated company	2	17	3	3	2
	Capital:					
5	Total	$49,350	$7,003,376	$3,250,030	$353,497	$219,201
6	Land	$1,050	$713,011	$150,179	$17,322	$20,767
7	Buildings	$4,900	$965,287	$227,967	$40,000	$46,957
8	Machinery, tools, and implements	$26,400	$1,108,947	$396,601	$57,162	$37,607
9	Cash and sundries	$17,000	$4,216,131	$2,475,283	$239,013	$113,870
10	Proprietors and firm members	1	37	7		1
	Salaried officials, clerks, etc.:					
11	Total number	2	212	171	15	15
12	Total salaries	$3,400	$245,528	$186,685	$18,650	$12,907
	Officers of corporations—					
13	Number		42	2	6	4
14	Salaries		$98,892	$25,000	$6,150	$3,935
	General superintendents, managers, clerks, etc.—					
15	Total number	2	170	169	9	11
16	Total salaries	$3,400	$146,636	$161,685	$12,500	$8,972
	Men—					
17	Number	2	162	153	9	9
18	Salaries	$3,400	$143,389	$153,553	$12,500	$8,120
	Women—					
19	Number		8	16		2
20	Salaries		$3,247	$8,132		$852
	Wage-earners, including pieceworkers, and total wages:					
21	Greatest number employed at any one time during the year	87	1,983	349	172	81
22	Least number employed at any one time during the year	8	758	161	46	50
23	Average number	34	1,016	227	94	60
24	Wages	$6,990	$457,692	$115,083	$32,800	$27,986
	Men, 16 years and over—					
25	Average number	34	1,010	226	94	59
26	Wages	$6,990	$455,576	$114,619	$32,800	$27,590
	Women, 16 years and over—					
27	Average number		6	1		
28	Wages		$2,116	$464		
	Children, under 16 years—					
29	Average number					1
30	Wages					$396
	Miscellaneous expenses:					
31	Total	$2,120	$354,344	$199,787	$40,186	$36,449
32	Rent of works		$34,846	$4,126		$300
33	Taxes, not including internal revenue	$220	$35,054	$15,209	$6,067	$783
34	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$1,900	$284,444	$180,452	$34,119	$30,714
35	Contract work					$4,652
	Materials used:					
36	Total cost	$22,190	$3,643,846	$1,115,818	$342,389	$137,306
37	Fish, thousands	5,000	12,000			
38	Cost	$1,500	$16,500			
39	Kainit, tons	150	6,895		3,234	40
40	Cost	$1,500	$58,547		$35,800	$400
41	Limestone, tons			38		
42	Cost			$133		
43	Phosphate rock, tons		123,562	18,722	9,000	630
44	Cost		$562,851	$131,734	$22,000	$1,819
45	Pyrites, tons		41,075	9,054	4,000	
46	Cost		$179,259	$43,459	$28,000	
	Acids—					
47	Sulphuric, tons		24,747	1,600	500	432
48	Cost		$146,009	$11,600	$5,000	$2,935
49	Nitric, pounds			1,075		
50	Cost			$41		
51	Acid phosphate, tons	330	29,571	6,653	7,892	175
52	Cost	$4,500	$237,541	$62,368	$67,178	$1,748
	Ammonia—					
53	Aqua, pounds					
54	Cost					
55	Sulphate, pounds		278,521	200,000		
56	Cost		$7,939	$5,500		
57	Bones, tankage, and offal	$5,580	$1,159,285	$402,020	$93,046	$64,690
58	Common salt, tons		140	12		
59	Cost		$700	$72		
60	Cotton seed and meal					
61	Lime, bushels					
62	Cost					
63	Nitrate of potash, tons			1		
64	Cost			$16		
65	Nitrate of soda, tons	38	2,658	3,120	150	
66	Cost	$1,500	$95,602	$112,176	$5,400	
67	Potash salts	$2,480	$436,219	$209,755	$18,560	$1,340
68	Sulphur, tons		6,277			
69	Cost		$141,281			
70	Tallow and fats					
71	All other components of products	$2,310	$81,853	$8,825	$8,280	$47,968
72	Fuel	$250	$56,762	$13,674	$3,375	$7,608
73	Rent of power and heat		$100			
74	Mill supplies	$265	$32,845	$7,322	$5,150	$439
75	All other materials	$1,430	$310,329	$92,993	$34,000	$8,359
76	Freight	$875	$120,224	$14,130	$16,600	
	Products:					
77	Aggregate value	$40,002	$5,481,905	$2,074,590	$492,772	$236,635
	Acids—					
78	Sulphuric, 50 Baumé, tons		19,912			
79	Value		$118,185			
80	Sulphuric, 60 Baumé, tons					
81	Value					
82	Sulphuric, 66 Baumé, tons					
83	Value					
84	Other acids					
	Sodas—					
85	Sal soda, tons					
86	Value					
87	Other soda products		$405			

BY STATES, 1900—Continued.

New Jersey.	New York.	North Carolina.	Ohio.	Pennsylvania.	South Carolina.	Tennessee.	Virginia.	All other states.[1]	
28	32	18	27	61	22	5	39	11	1
11	17	1	9	22	2	...	9	3	2
8	3	7	9	16	1	2	12	...	3
9	12	10	9	13	19	3	18	8	4
$5,690,270	$4,600,559	$2,818,921	$1,887,937	$3,802,794	$10,505,043	$950,397	$4,908,381	$515,545	5
$556,585	$452,071	$99,534	$98,762	$490,711	$109,441	$76,947	$164,328	$21,144	6
$608,382	$720,629	$403,281	$273,879	$681,345	$1,642,600	$313,519	$579,504	$120,383	7
$652,477	$1,012,378	$213,508	$336,003	$508,872	$487,117	$68,339	$483,462	$126,811	8
$3,872,826	$2,415,481	$2,102,598	$1,179,293	$2,121,866	$8,265,885	$491,592	$3,681,087	$247,207	9
30	24	16	26	43	5	4	35	3	10
155	192	51	80	167	85	45	112	19	11
$230,330	$211,207	$65,838	$103,608	$200,755	$164,716	$48,568	$141,872	$26,898	12
21	20	11	13	16	9	7	22	5	13
$88,130	$59,770	$29,823	$26,850	$57,708	$35,976	$19,300	$54,266	$10,600	14
134	172	40	67	151	76	38	90	14	15
$142,200	$151,437	$36,015	$76,758	$143,047	$128,740	$29,268	$87,606	$16,398	16
126	158	40	62	140	75	37	89	13	17
$136,746	$144,867	$36,015	$74,098	$137,608	$128,500	$28,788	$87,156	$15,670	18
8	14	...	5	11	1	1	1	1	19
$5,454	$6,570	...	$2,660	$5,439	$240	$480	$450	$728	20
1,308	2,001	790	858	956	3,066	747	2,236	286	21
755	784	242	246	692	754	201	487	168	22
962	1,033	427	400	765	1,772	443	1,171	218	23
$441,177	$491,898	$109,192	$173,888	$351,873	$479,449	$94,101	$320,774	$110,357	24
929	1,033	426	394	764	1,772	443	1,171	218	25
$432,451	$491,898	$109,117	$171,768	$351,773	$479,449	$94,101	$320,774	$110,357	26
30	...	...	5	...	...	...	...	...	27
$7,894	...	...	$2,000	...	...	...	...	...	28
3	...	1	1	1	...	...	...	...	29
$832	...	$75	$120	$100	...	...	...	...	30
$312,500	$317,826	$108,209	$112,317	$238,324	$675,589	$110,953	$306,382	$61,276	31
$11,069	$7,410	$39	$1,044	$16,023	$1,050	...	$6,187	$1,920	32
$18,429	$20,420	$17,535	$3,626	$10,414	$53,200	$2,713	$27,040	$1,905	33
$282,268	$289,846	$90,625	$107,447	$203,364	$621,339	$108,240	$272,844	$49,663	34
$734	$150	$10	$200	$9,523	...	...	$311	$7,788	35
$3,146,022	$1,909,158	$1,044,267	$1,016,501	$2,684,272	$3,107,710	$790,101	$2,161,423	$352,221	36
14,118	...	4,215,500	700	...	...	...	104,754	20,000	37
$9,765	...	$18,668	$2,800	...	...	...	$57,451	$11,669	38
486	1,263	967	2,530	1,265	9,114	...	1,107	...	39
$4,382	$15,075	$9,587	$21,360	$11,479	$71,226	...	$10,781	...	40
...	169	1,815	75	1,100	...	...	1,666	168	41
...	$755	$2,400	$150	$350	...	...	$2,000	$728	42
85,293	20,834	38,858	28,515	33,413	141,464	36,431	82,482	10	43
$397,982	$142,701	$160,554	$114,172	$200,320	$555,861	$118,067	$290,778	$92	44
14,064	6,940	16,684	5,000	...	83,272	20,668	35,988	...	46
$74,916	$30,611	$88,818	$13,000	...	$399,010	$155,428	$147,312	...	46
60,082	16,559	3,402	21,328	36,057	4,459	310	16,211	646	47
$252,099	$113,652	$19,051	$143,806	$193,759	$24,632	$2,412	$99,236	3,429	48
...	...	...	...	...	...	...	...	...	49
...	...	...	...	...	...	...	...	...	50
12,551	18,123	10,256	8.774	15,600	12,702	1,200	14,646	200	61
$119,061	$154,685	$87,276	$82,519	$137,548	$121,141	$9,000	$130,525	$1,696	52
...	...	...	...	...	...	...	2,620	...	53
...	...	...	...	...	...	...	$681	...	54
726,300	22,624	50,000	...	...	...	...	730,000	2,400,000	55
$20,246	$21,315	$1,500	...	...	...	...	$21,900	$600	56
$1,104,361	$588,924	$354,015	$344,183	$1,094,136	$1,061,977	$141,576	$557,892	$249,169	57
...	84	...	8	40	...	...	10	1	58
...	$336	...	$50	$200	...	...	$85	$60	59
...	...	...	...	...	...	...	...	...	60
...	1,343	...	...	11,430	...	...	357	...	61
...	$225	...	...	$600	...	...	$62	...	62
...	5	...	1	...	...	...	877	...	63
...	$200	...	$60	...	...	...	$31,880	...	64
2,097	1,199	745	336	657	2,169	489	1,774	116	66
$71,770	$41,884	$28,609	$11,650	$26,729	$82,569	$19,707	$64,901	$3,621	66
$525,341	$279,899	$105,866	$36,533	$329,619	$310,118	$114,224	$205,327	$11,850	67
600	1,740	...	1	...	...	...	...	...	68
$12,100	$29,680	...	$30	...	...	...	...	...	69
...	...	...	$1,000	$27,500	...	...	...	...	70
$141,554	$79,737	$8,146	$46,456	$290,702	$99,455	$19,014	$73,424	$25,189	71
$49,966	$195,602	$23,703	$20,348	$54,414	$88,786	$17,071	$55,563	$20,698	72
...	$97	$600	...	$130	...	...	$100	...	73
$14,989	$21,074	$13,683	$6,353	$14,101	$5,909	$2,643	$7,130	$1,365	74
$160,116	$185,769	$86,133	$96,158	$162,031	$223,276	$88,140	$170,017	$15,975	75
$187,374	$6,937	$36,659	$75,873	$40,654	$63,750	$102,819	$234,378	$6,080	76
$4,290,629	$3,147,894	$1,497,625	$1,657,058	$3,644,320	$4,882,506	$1,466,288	$3,415,850	$623,372	77
...	610	...	...	...	41,036	...	309	...	78
...	$4,050	...	...	...	$225,698	...	$1,699	...	79
...	34	...	...	...	...	...	1,205	...	80
...	$488	...	...	...	...	...	$7,230	...	81
...	1,575	...	...	...	...	...	...	...	82
...	$22,603	...	...	...	...	...	...	...	83
...	...	...	...	...	...	...	...	...	84
...	...	...	...	...	...	...	...	...	85
18	...	...	...	...	...	...	...	...	86
$277	...	...	...	...	...	...	...	...	87

[1] Includes establishments distributed as follows: Iowa, 1; Michigan, 1; Minnesota, 1; Nebraska, 1; Oregon, 1; Rhode Island, 1; Texas, 2; Washington, 1; West Virginia, 2.

TABLE 1.—FERTILIZERS: SUMMARY

		United States.	Alabama.	California.	Connecticut.	Delaware.
	Products—Continued.					
	Aggregate value—Continued.					
	Fertilizers—					
88	Total value	$40,445,661	$1,942,708	$586,687	$313,610	$634,213
	Superphosphates—					
89	From minerals, bones, etc., tons	923,198	38,246			2,385
90	Value	$8,471,943	$369,587			$28,250
91	Ammoniated, tons	142,898	2,000		1,000	
92	Value	$2,349,388	$35,000		$23,000	
93	Complete, tons	1,436,682	92,253	17,570	7,325	17,180
94	Value	$25,446,046	$1,433,355	$541,187	$205,931	$283,873
95	All other, tons	291,927	6,670	2,561	2,752	30,377
96	Value	$4,178,284	$104,766	$45,500	$84,679	$322,090
	Chemicals, not otherwise specified—					
97	Epsom salts, pounds	1,400,000				
98	Value	$10,500				
99	Value of all other products	$3,749,890	$100,454	$71,150	$77,195	$104,490
	Products consumed:					
100	Sulphuric acid, tons	571,831	22,020	538		
101	Acid phosphate, tons	88,964				
102	Charcoal, bushels	14,600				14,600
103	All other products consumed, pounds	36,512,386	18,200,000			
	Comparison of products:					
104	Number of establishments reporting for both years	329	11	8	7	9
105	Value for census year	$31,249,588	$1,762,700	$670,517	$344,605	$460,213
106	Value for preceding business year	$27,420,663	$1,527,287	$640,828	$354,160	$401,881
	Power:					
107	Number of establishments reporting	361	17	7	7	9
108	Total horsepower	39,521	1,450	415	334	775
	Owned—					
	Engines—					
109	Steam, number	591	27	8	6	19
110	Horsepower	37,121	1,360	340	245	705
111	Gas or gasoline, number	30		1		
112	Horsepower	410		15		
113	Water wheels, number	16			2	
114	Horsepower	359			66	
115	Electric motors, number	36			2	1
116	Horsepower	841			8	50
117	Other power, number	2				
118	Horsepower	90				
	Rented—					
119	Electric, horsepower	220	30	60	15	
120	Other kind, horsepower	480	60			20
	Establishments classified by number of persons employed, not including proprietors and firm members:					
121	Total number of establishments	422	17	8	9	11
122	No employees	9				
123	Under 5	81	1	1	1	
124	5 to 20	150	6	5	4	8
125	21 to 50	68	3	2	2	1
126	51 to 100	43	4		2	1
127	101 to 250	53	3			1
128	251 to 500	17				
129	501 to 1,000	1				

BY STATES, 1900—Continued.

District of Columbia.	Florida.	Georgia.	Illinois.	Indiana.	Kansas.	Kentucky.	Louisiana.	
$71,480	$496,642	$3,240,304	$1,721,760	$235,836	$549,943	$295,520	$856,201	88
	9,394	131,503	26,108	365	8,978		29,244	89
	$93,940	$1,075,581	$313,850	$10,006	$160,498		$263,821	90
		14,603	4,150	27	6,858		13,037	91
		$229,271	$58,100	$500	$125,745		$221,599	92
3,160	15,435	101,219	43,483	5,750	10,000	17,315	22,842	93
$64,800	$377,535	$1,563,653	$835,335	$116,280	$200,000	$295,520	$367,181	94
449	1,315	26,605	23,433	5,431	4,535		300	95
$6,680	$25,167	$371,799	$514,475	$109,050	$63,700		$3,600	96
								97
								98
$7,450	$2,764	$121,613	$133,400	$19,495		$25,725	$26,600	99
	7,065	78,655					17,718	100
							3,025	101
								102
	380,000							103
6	7	20	3	13	3	4	5	104
$78,930	$500,239	$1,432,461	$514,660	$254,571	$549,943	$321,245	$896,351	105
$73,300	$438,292	$1,317,770	$392,860	$211,270	$421,923	$293,629	$617,632	106
2	5	32	4	14	2	4	6	107
85	412	3,823	1,315	565	620	483	826	108
1	8	54	9	16	2	7	11	109
65	400	3,795	1,315	528	320	483	795	110
				2				111
				37				112
								113
								114
		2					2	115
		28					31	116
								117
								118
	12							119
20					300			120
6	7	41	5	14	3	4	6	121
								122
1	1	2	2	4	1			123
4	1	14	1	9			2	124
1	4	10		1		2	1	125
		8				2	1	126
	1	6	1		2		2	127
		1	1					128
								129

TABLE 1.—FERTILIZERS: SUMMARY

		Maine.	Maryland.	Massachusetts.	Mississippi.	Missouri.
	Products—Continued.					
	Aggregate value—Continued.					
	Fertilizers—					
88	Total value	$27,902	$5,174,357	$2,060,575	$492,772	$139,395
	Superphosphates—					
89	From minerals, bones, etc., tons		124,444	1,282	7,200	2,766
90	Value		$1,176,099	$12,820	$50,400	$44,248
91	Ammoniated, tons		48,608			
92	Value		$690,671			
93	Complete, tons	828	183,705	76,571	30,504	2,774
94	Value	$21,602	$2,977,015	$1,940,605	$442,372	$39,039
95	All other, tons	1,000	27,017	4,280		2,354
96	Value	$6,300	$330,572	$107,150		$56,108
	Chemical, not otherwise specified—					
97	Epsom salts, pounds					
98	Value					
99	Value of all other products	$12,100	$188,958	$14,015		$97,240
	Products consumed:					
100	Sulphuric acid, tons		94,490	18,590	9,000	
101	Acid phosphate, tons				9,000	
102	Charcoal, bushels					
103	All other products consumed, pounds		5,823,200			
	Comparison of products:					
104	Number of establishments reporting for both years	2	34	8	3	3
105	Value for census year	$28,002	$3,936,185	$2,073,910	$492,772	$236,635
106	Value for preceding business year	$28,500	$3,731,268	$1,517,852	$429,000	$234,176
	Power:					
107	Number of establishments reporting	3	32	7	3	2
108	Total horsepower	85	3,647	1,217	415	609
	Owned—					
	Engines—					
109	Steam, number	6	51	26	4	6
110	Horsepower	60	3,263	785	415	609
111	Gas or gasoline, number		4			
112	Horsepower		75			
113	Water wheels, number	1	2			
114	Horsepower	20	44			
115	Electric motors, number	1	7	8		
116	Horsepower	5	205	382		
117	Other power, number			1		
118	Horsepower			50		
	Rented—					
119	Electric, horsepower					
120	Other kind, horsepower		60			
	Establishments classified by number of persons employed, not including proprietors and firm members:					
121	Total number of establishments	3	40	9	3	3
122	No employees					
123	Under 5		4	5		2
124	5 to 20	1	15	1		
125	21 to 50	1	12	1	2	
126	51 to 100	1	2	1	1	1
127	101 to 250		6			
128	251 to 500		1	1		
129	501 to 1,000					

BY STATES, 1900—Continued.

New Jersey.	New York.	North Carolina.	Ohio.	Pennsylvania.	South Carolina.	Tennessee.	Virginia.	All other states.[1]	
$3,703,712	$2,444,420	$1,487,333	$1,562,518	$2,696,969	$4,656,808	$1,464,788	$3,323,479	$265,729	88
105,135	9,810	48,820	24,728	22,975	173,183	35,959	120,633	40	89
$887,020	$105,645	$397,397	$285,698	$310,273	$1,404,569	$456,568	$1,024,893	$780	90
7,283	10,300	3,400	23,805	2,846	...	...	4,300	681	91
$59,580	$338,400	$51,000	$380,936	$53,271	...	...	$72,100	$10,215	92
125,839	87,862	53,528	43,351	120,151	207,860	36,695	106,828	6,654	93
$2,629,511	$1,623,638	$841,632	$700,606	$2,165,825	$3,146,915	$704,220	$1,820,771	$107,645	94
8,039	44,035	14,345	11,918	10,467	7,497	20,400	26,637	9,510	95
$127,601	$376,737	$197,304	$195,278	$167,600	$105,324	$304,000	$405,715	$147,089	96
...	...	...	...	1,400,000	...	...	...	...	97
...	...	...	...	$10,500	...	...	...	...	98
$586,640	$676,333	$10,292	$94,540	$936,851	...	$1,500	$83,442	$357,643	99
25,336	13,958	33,047	8,000	...	138,973	35,495	68,946	...	100
17,527	...	5,545	13,050	35,746	...	5,071	...	...	101
...	...	...	...	...	...	...	...	...	102
957,186	9,400,000	1,000,000	...	752,000	...	...	...	...	103
26	26	13	20	50	7	4	29	8	104
$3,724,270	$2,523,752	$1,130,605	$1,071,155	$3,593,820	$865,429	$1,125,890	$2,129,981	$530,747	105
$3,649,571	$2,390,249	$1,062,897	$916,086	$3,064,029	$792,863	$609,394	$1,873,608	$430,338	106
22	27	16	26	48	18	5	33	10	107
2,778	2,461	1,292	2,168	3,835	3,940	943	4,240	788	108
41	40	29	36	59	36	14	59	16	109
2,638	2,436	1,153	1,993	3,682	3,940	943	4,065	788	110
2	...	16	3	1	...	...	1	...	111
40	...	56	175	10	...	...	2	...	112
...	...	...	...	7	...	...	4	...	113
...	...	...	...	123	...	...	106	...	114
9	1	...	...	...	...	...	3	...	115
100	5	...	...	...	...	...	27	...	116
...	...	...	...	...	...	...	1	...	117
...	...	...	...	...	...	...	40	...	118
...	20	83	...	...	...	...	...	...	119
...	...	...	...	20	...	...	...	...	120
28	32	18	27	51	22	5	39	11	121
...	1	1	2	5	...	...	...	...	122
8	10	3	5	15	2	...	8	5	123
13	10	5	13	22	3	2	8	3	124
1	5	3	3	6	1	...	6	...	125
1	...	3	1	1	2	1	8	2	126
3	4	3	1	1	11	...	7	1	127
2	1	...	2	1	3	2	2	...	128
...	1	...	...	...	...	...	...	...	129

[1] Includes establishments distributed as follows: Iowa, 1; Michigan, 1; Minnesota, 1; Nebraska, 1; Oregon, 1; Rhode Island, 1; Texas, 2; Washington, 1; West Virginia, 2.

TABLE 2.—DYESTUFFS AND EXTRACTS, SUMMARY BY STATES: 1900.

	United States.	Massachusetts.	New Jersey.	New York.	Pennsylvania.	Virginia.	West Virginia.	All other states.[1]
Number of establishments	77	10	10	19	12	8	5	13
Character of organization:								
Individual	28	7	3	7	4	4	1	2
Firm and limited partnership	19	1	2	3	3	3	2	5
Incorporated company	30	2	5	9	5	1	2	6
Capital:								
Total	$7,839,034	$592,510	$591,916	$2,548,136	$1,778,173	$385,904	$272,192	$1,670,203
Land	$1,027,908	$91,800	$121,000	$567,463	$121,450	$37,923	$17,850	$70,422
Buildings	$1,075,033	$68,000	$76,000	$345,504	$273,179	$54,350	$38,000	$220,000
Machinery, tools, and implements	$1,839,946	$60,973	$131,553	$436,703	$537,993	$72,100	$66,049	$534,575
Cash and sundries	$3,896,147	$371,737	$263,363	$1,198,466	$845,551	$221,531	$150,293	$845,206
Proprietors and firm members	61	11	7	7	5	12	7	12
Salaried officials, clerks, etc.:								
Total number	229	27	32	78	36	20	8	28
Total salaries	$312,109	$36,120	$33,783	$91,680	$60,686	$22,050	$7,930	$59,860
Officers of corporations—								
Number	43	3	8	11	12	2	3	4
Salaries	$118,880	$11,100	$17,100	$28,300	$39,900	$1,920	$4,780	$15,780
General superintendents, managers, clerks, etc.—								
Total number	186	24	24	67	24	18	5	24
Total salaries	$193,229	$25,020	$16,683	$63,380	$20,786	$20,130	$3,150	$44,080
Men—								
Number	163	21	18	60	21	18	5	20
Salaries	$181,750	$23,740	$14,817	$59,876	$19,057	$20,130	$3,150	$40,980
Women—								
Number	23	3	6	7	3	...	...	4
Salaries	$11,479	$1,280	$1,866	$3,504	$1,729	...	...	$3,100
Wage-earners, including pieceworkers, and total wages:								
Greatest number employed at any one time during the year	2,094	56	172	562	361	271	98	574
Least number employed at any one time during the year	1,486	35	71	517	286	174	90	312
Average number	1,648	49	88	538	257	201	74	441
Wages	$787,942	$28,226	$40,067	$300,832	$118,544	$58,588	$26,325	$215,360
Men, 16 years and over—								
Average number	1,607	48	78	538	251	183	74	435
Wages	$781,370	$27,626	$38,618	$300,832	$117,169	$56,988	$26,325	$213,812
Women, 16 years and over—								
Average number	36	1	10	...	5	15	...	5
Wages	$5,911	$600	$1,449	...	$1,250	$1,200	...	$1,412
Children, under 16 years—								
Average number	5	...	...	...	1	3	...	1
Wages	$661	...	...	...	$125	$400	...	$136
Miscellaneous expenses:								
Total	$458,212	$20,449	$49,482	$128,447	$158,252	$17,739	$15,320	$68,523
Rent of works	$23,052	$3,606	$3,745	$10,460	$1,785	$1,081	$400	$1,975
Taxes, not including internal revenue	$24,071	$1,910	$2,220	$10,432	$3,272	$1,955	$745	$3,537
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$410,870	$14,933	$43,517	$107,555	$153,134	$14,703	$14,017	$63,011
Contract work	$219	...	...	...	$61	...	$158	...
Materials used:								
Total cost	$4,745,912	$1,123,833	$282,332	$1,263,843	$661,444	$307,481	$144,068	$962,911
Gums	$325	...	...	...	...	...	...	$325
Wood, for extracts, tons	245,198	3,750	12,326	34,441	63,447	48,215	35,700	47,319
Cost	$2,393,179	$42,638	$207,867	$594,826	$514,266	$246,680	$106,900	$680,002
Acids—								
Sulphuric, tons	814	370	...	86	245	...	113	...
Cost	$16,757	$9,990	...	$1,297	$4,000	...	$1,470	...
Nitric, pounds	155,367	105,000	...	...	...	...	50,367	...
Cost	$5,434	$4,200	...	...	...	...	$1,234	...
Mixed, pounds	209,061	...	...	209,061	...	...	...	...
Cost	$3,763	...	...	$3,763	...	...	...	...
Ammonia, aqua, pounds	1,227,000	1,227,000	...	...	...	...	...	...
Cost	$73,620	$73,620	...	...	...	...	...	...
Alcohol, wood, gallons	1,000	...	...	...	...	...	...	1,000
Cost	$800	...	...	...	...	...	...	$800
Bones, tankage, and offal	$750	...	...	...	...	$750	...	...
Common salt, tons	2,254	...	100	2,154	...	...	...	...
Cost	$7,829	...	$447	$7,382	...	...	...	...
Dry colors	$447,649	$397,495	...	$40,500	$8,000	...	...	$1,654
Lead, tons	125	...	...	125	...	...	...	...
Cost	$11,140	...	...	$11,140	...	...	...	...
Lime, bushels	3,840	3,840	...	...	...	...	...	...
Cost	$800	$800	...	...	...	...	...	...
Tallow and fats	$9,000	...	...	...	$9,000	...	...	...
All other components of products	$1,175,402	$538,462	$26,589	$466,939	$38,768	$2,610	$5,115	$97,019
Fuel	$185,307	$8,265	$11,163	$31,193	$22,447	$14,090	$9,000	$87,159
Rent of power and heat	$4,153	...	$1,879	$373	...	$1,323	$578	...
Mill supplies	$74,613	$595	$1,015	$12,713	$4,508	$1,165	$1,670	$52,947
All other materials	$267,918	$43,653	$21,812	$82,177	$45,329	$23,363	$18,101	$33,483
Freight	$69,473	$4,115	$11,570	$11,540	$15,126	$17,600	...	$9,522
Products:								
Total value	$7,350,748	$1,320,881	$502,798	$2,111,811	$1,269,246	$479,372	$245,754	$1,420,886
Acids	$72,900	...	$72,900	...	...	...	...	...
Alums, pounds	1,500,000	1,500,000	...	...	...	...	...	...
Value	$90,000	$90,000	...	...	...	...	...	...
Fertilizers, tons	55	...	...	...	...	55	...	...
Value	$1,500	...	...	...	...	$1,500	...	...
Dyestuffs—								
Natural, pounds	46,662,023	3,532,000	6,160,000	7,880,048	23,831,150	...	...	5,258,825
Value	$2,521,682	$283,800	$206,240	$1,005,079	$816,135	...	...	$210,428
Artificial, pounds	6,581,850	2,123,816	267,100	2,457,162	425,800	...	1,292,360	15,612
Value	$1,806,730	$871,213	$41,858	$787,976	$50,400	...	$11,389	$43,894
Tanning materials—								
Natural—								
Ground or chipped, pounds	49,002,037	...	13,872,000	...	415,117	25,145,920	7,925,000	1,644,000
Value	$465,956	...	$98,600	...	$7,783	$180,158	$156,915	$22,500
Extracts, pounds	60,395,392	...	719,228	7,024,440	18,553,124	17,936,725	3,889,875	12,272,000
Value	$1,216,346	...	$46,684	$295,356	$339,518	$290,065	$75,450	$169,273
Artificial, pounds	1,837,134	376,470	1,460,664	...	...	...	...	...
Value	$52,516	$16,000	$36,516	...	...	...	...	...
Epsom salts, pounds	87,500	...	...	...	87,500	...	...	...
Value	$1,500	...	...	...	$1,500	...	...	...
Value of all other products	$1,121,618	$59,868	...	$23,400	$53,910	$7,649	$2,000	$974,791
Products consumed	$842,250	...	...	$842,250	...	...	...	...

[1] Includes establishments distributed as follows: California, 1; Connecticut, 2; Florida, 2; Illinois, 2; Kentucky, 1; Maine, 1; Michigan, 1; Rhode Island, 2; Tennessee, 1.

TABLE 2.—DYESTUFFS AND EXTRACTS, SUMMARY BY STATES: 1900—Continued.

	United States.	Massachusetts.	New Jersey.	New York.	Pennsylvania.	Virginia.	West Virginia.	All other states.[1]
Comparison of products:								
Number of establishments reporting for both years	66	10	9	17	8	8	3	11
Value for census year	$6,929,350	$1,320,881	$490,798	$1,938,086	$1,088,473	$479,372	$215,254	$1,396,486
Value for preceding business year	$6,240,273	$1,213,358	$441,617	$1,808,320	$1,012,812	$380,116	$169,569	$1,214,481
Power:								
Number of establishments reporting	59	6	7	12	11	8	5	10
Total horsepower	11,518	347	859	4,203	2,818	785	455	2,051
Owned—								
Engines—								
Steam, number	144	6	10	48	27	14	6	33
Horsepower	10,458	297	795	4,148	2,432	470	415	1,901
Gas or gasoline, number	1				1			
Horsepower	300				300			
Water wheels, number	9	1				3		5
Horsepower	325	50				140		135
Electric motors, number	15		3	3	7		1	1
Horsepower	159		3	40	86		15	15
Rented—								
Electric, horsepower	20		5	15				
Other kind, horsepower	256		56			175	25	
Furnished to other establishments, horsepower	55							55
Establishments classified by number of persons employed, not including proprietors and firm members:								
Total number of establishments	77	10	10	19	12	8	5	13
No employees	1				1			
Under 5	12	3	3	2	1		1	2
5 to 20	33	7	5	7	3	4	3	4
21 to 50	14			3	5	1		5
51 to 100	12		2	4	1	3	1	1
101 to 250	2			1	1			
251 to 500	2			1				1
501 to 1,000	1			1				

[1] Includes establishments distributed as follows: California, 1; Connecticut, 2; Florida, 2; Illinois, 2; Kentucky, 1; Maine, 1; Michigan, 1; Rhode Island, 2; Tennessee, 1.

TABLE 3.—PAINTS: SUMMARY

		United States.	California.	Georgia.
1	Number of establishments	419	11	5
	Character of organization:			
2	Individual	120	5	2
3	Firm or limited partnership	109	2	1
4	Incorporated company	190	4	2
	Capital:			
5	Total	$42,501,782	$873,378	$101,300
6	Land	$5,263,179	$8,300	$4,000
7	Buildings	$5,128,578	$159,588	$4,500
8	Machinery, tools, and implements	$7,068,854	$117,463	$11,500
9	Cash and sundries	$25,041,171	$588,027	$81,300
10	Proprietors and firm members	293	10	3
	Salaried officials, clerks, etc.:			
11	Total number	2,512	33	12
12	Total salaries	$3,077,318	$39,922	$9,170
	Officers of corporations—			
13	Number	324	4	2
14	Salaries	$814,037	$5,550	$1,650
	General superintendents, managers, clerks, etc.—			
15	Total number	2,188	29	10
16	Total salaries	$2,263,281	$34,372	$7,520
	Men—			
17	Number	1,910	29	10
18	Salaries	$2,130,270	$34,372	$7,520
	Women—			
19	Number	278		
20	Salaries	$133,011		
	Wage-earners, including pieceworkers, and total wages:			
21	Greatest number employed at any one time during the year	9,514	179	34
22	Least number employed at any one time during the year	6,971	153	30
23	Average number	8,151	163	23
24	Wages	$3,929,787	$100,444	$9,844
	Men, 16 years and over—			
25	Average number	7,357	154	19
26	Wages	$3,711,685	$97,047	$8,704
	Women, 16 years and over—			
27	Average number	744	9	1
28	Wages	$209,540	$3,397	$600
	Children, under 16 years—			
29	Average number	50		3
30	Wages	$8,562		$540
	Miscellaneous expenses:			
31	Total	$3,430,061	$19,165	$10,905
32	Rent of works	$289,366	$6,300	$2,720
33	Taxes, not including internal revenue	$200,720	$1,776	$1,360
34	Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$2,802,642	$10,972	$6,825
35	Contract work	$137,333	$117	
	Materials used:			
36	Total cost	$33,799,386	$853,231	$112,474
37	Gums	$354,660		$6,400
38	Limestone, tons	18,234		
39	Cost	$50,368		
40	Pyrites, tons	20,598		
41	Cost	$122,300		
	Wood—			
42	For alcohol, cords	26		
43	Cost	$52		
44	For extracts, tons	11,745		
45	Cost	$68,783		
	Acids—			
46	Sulphuric, tons	1,989		
47	Cost	$13,915		
48	Nitric, pounds	68,568		
49	Cost	$3,687		
50	Mixed, pounds	1,755,822		
51	Cost	$26,002		
52	Acid phosphate, tons	190		
53	Cost	$1,519		
	Alcohol—			
54	Grain, gallons	9,813		
55	Cost	$16,778		
56	Wood, gallons	32,488		
57	Cost	$26,806		
58	Bones, tankage, and offal	$2,278		
59	Common salt, tons	458		
60	Cost	$2,250		
61	Dry colors	$8,758,499	$130,476	$48,943
62	Glycerine, pounds	692		
63	Cost	$87		
64	Lead, tons	99,052	1,908	
65	Cost	$8,585,688	$152,650	
66	Lime, bushels	33,007		
67	Cost	$6,098		
68	Linseed oil, gallons	11,835,174	172,630	49,551
69	Cost	$5,431,227	$99,556	$29,997
70	Nitrate of soda, tons	1,086		
71	Cost	$36,395		
72	Potash salts	$21,675		
73	Sulphur, tons	2,764		
74	Cost	$58,088		
75	Tallow and fats	$5,700		
76	All other components of products	$5,929,030	$342,275	$8,051
77	Fuel	$514,372	$9,070	$492
78	Rent of power and heat	$42,672	$2,690	$460
79	Mill supplies	$169,090	$1,435	$245
80	All other materials	$3,234,658	$99,404	$7,590
81	Freight	$316,709	$15,675	$10,296
	Products:			
82	Aggregate value	$50,874,995	$1,128,643	$182,279
	Acids—			
83	Sulphuric, 50 Baumé, tons	23,964		
84	Value	$201,299		
85	Sulphuric, 66 Baumé, tons	4,053		
86	Value	$89,179		
87	Nitric, pounds	749,666		
88	Value	$28,112		

Illinois.	Indiana.	Iowa.	Kentucky.	Louisiana.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
33	5	6	9	3	13	30	13	6	1
4		1	3		5	7	4	1	2
2		3	2	1	7	10		1	3
27	5	2	4	2	1	13	9	4	4
$8,387,850	$132,481	$207,485	$174,586	$140,491	$290,222	$1,300,708	$1,559,545	$325,083	5
$379,442		$7,242	$20,422	$21,500	$18,000	$80,476	$111,299	$5,329	6
$228,439	$7,463	$22,550	$25,500	$18,600	$28,000	$207,241	$230,969	$27,085	7
$436,939	$50,751	$20,813	$27,837	$32,499	$78,760	$202,269	$159,674	$44,874	8
$2,343,030	$74,217	$156,880	$100,827	$67,892	$165,462	$810,722	$1,057,603	$247,795	9
8	1	9	7	3	21	26	4	5	10
347	13	31	12	13	26	75	183	29	11
$460,379	$11,166	$23,480	$12,900	$14,242	$25,900	$102,784	$135,265	$28,398	12
49	3	1	6	3	3	19	20	7	13
$111,184	$4,600	$2,400	$7,600	$6,460	$7,000	$39,700	$47,020	$10,258	14
298	10	30	6	10	23	56	163	22	15
$349,195	$6,566	$21,080	$5,300	$7,782	$18,900	$63,084	$88,245	$18,140	16
255	10	24	6	9	23	47	133	19	17
$325,242	$6,566	$19,380	$5,300	$7,002	$18,900	$59,026	$81,192	$17,160	18
43		6		1		9	30	3	19
$23,953		$1,700		$780		$4,058	$7,053	$980	20
835	45	51	62	24	119	384	426	65	21
574	29	29	45	19	104	291	330	50	22
702	33	40	52	21	110	337	384	52	23
$348,674	$13,641	$14,739	$20,326	$10,116	$45,273	$176,101	$129,690	$20,306	24
629	27	34	46	19	94	311	293	42	25
$324,862	$12,835	$13,510	$18,826	$9,544	$41,688	$166,473	$111,194	$17,557	26
72	6	6	6	2	9	26	80	10	27
$23,512	$806	$1,229	$1,500	$572	$2,585	$9,628	$16,837	$2,749	28
1					7		11		29
$300					$1,000		$1,659		30
$414,110	$17,330	$19,833	$7,848	$19,452	$22,172	$112,789	$220,482	$61,331	31
$41,435	$4,381	$20	$1,440		$5,407	$18,170	$5,504	$7,215	32
$21,822	$450	$783	$838	$815	$1,349	$11,591	$7,325	$778	33
$350,763	$10,999	$19,030	$5,570	$18,637	$15,416	$83,028	$207,653	$51,138	34
$90	$1,500							$2,200	35
$4,375,872	$111,015	$255,510	$263,952	$82,271	$265,743	$1,332,899	$1,153,783	$209,145	36
$16,375						$37,848	$46,030		37
									38
									39
									40
									41
									42
									43
									44
									45
					4	2			46
					$109	$40			47
						9,568			48
						$286			49
									50
									51
									52
									53
20									54
$54									55
11,710						600			56
$10,140						$750			57
									58
									59
									60
$1,764,935	$71,819	$84,170	$106,826	25,338	$84,074	$378,334	$431,054	$75,449	61
									62
									63
11,866						3,614			64
$991,042						$325,309			65
2,457				557		5,443			66
$149				$160		$2,708			67
1,640,240	54,908	182,856	221,140	65,691	102,650	390,248	597,415	154,519	68
$730,473	$22,226	$73,947	$93,506	$32,846	$50,080	$171,938	$260,300	$75,159	69
									70
									71
						$21,000			72
									73
									74
									75
$425,991	$4,022	$72,987	$32,252	$12,669	$90,231	$219,152	$182,454	$38,553	76
$50,238	$717	$4,558	$1,590	$2,102	$6,477	$26,108	$10,917	$2,176	77
$10,956	$51		$1,101	$14	$200	$3,600	$813	$1,020	78
$7,752	$271	$640	$445	$272	$810	$3,209	$3,219	$561	79
$346,033	$11,561	$15,156	$23,476	$7,062	$24,362	$128,365	$192,802	$12,608	80
$21,734	$348	$4,052	$4,756	$1,808	$9,400	$14,252	$26,194	$3,619	81
$5,987,548	$165,335	$336,867	$359,085	$132,102	$442,744	$2,005,982	$1,826,742	$357,816	82
									83
									84
									85
									86
									87
									88

Table 3.—PAINTS: SUMMARY

		Missouri.	Nebraska.	New Jersey.	New York.
1	Number of establishments	20	3	27	82
	Character of organization:				
2	Individual	2		7	29
3	Firm or limited partnership	5		7	17
4	Incorporated company	13	3	13	36
	Capital:				
5	Total	$3,078,899	$881,657	$2,507,867	$11,318,449
6	Land	$257,368	$60,000	$122,350	$2,129,678
7	Buildings	$352,018	$356,000	$357,206	$1,095,653
8	Machinery, tools, and implements	$402,858	$98,500	$404,697	$1,495,299
9	Cash and sundries	$2,066,656	$367,157	$1,623,614	$6,597,819
10	Proprietors and firm members	12		20	34
	Salaried officials, clerks, etc.:				
11	Total number	138	41	131	505
12	Total salaries	$213,626	$58,456	$178,228	$717,339
	Officers of corporations—				
13	Number	26	2	17	51
14	Salaries	$63,690	$9,000	$32,015	$178,420
	General superintendents, managers, clerks, etc.—				
15	Total number	112	39	114	454
16	Total salaries	$149,936	$49,456	$146,213	$538,919
	Men—				
17	Number	104	32	106	398
18	Salaries	$145,336	$46,420	$141,137	$512,815
	Women—				
19	Number	8	7	8	56
20	Salaries	$4,600	$3,036	$5,076	$26,104
	Wage-earners, including pieceworkers, and total wages:				
21	Greatest number employed at any one time during the year	577	105	729	2,521
22	Least number employed at any one time during the year	382	69	564	1,855
23	Average number	488	93	626	2,173
24	Wages	$225,830	$53,020	$317,786	$1,175,277
	Men, 16 years and over—				
25	Average number	456	82	558	1,975
26	Wages	$217,587	$49,590	$299,972	$1,125,011
	Women, 16 years and over—				
27	Average number	24	11	68	187
28	Wages	$6,924	$3,430	$17,814	$48,086
	Children, under 16 years—				
29	Average number	8			11
30	Wages	$1,319			$2,180
	Miscellaneous expenses:				
31	Total	$169,984	$70,405	$191,449	$815,946
32	Rent of works	$19,659	$480	$8,524	$99,494
33	Taxes, not including internal revenue	$15,827	$2,147	$10,564	$60,984
34	Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$134,498	$67,778	$158,290	$650,468
35	Contract work			$14,071	$5,000
	Materials used:				
36	Total cost	$3,234,423	$534,256	$2,519,447	$8,344,936
37	Gums	$78		$33,886	$116,527
38	Limestone, tons				8,734
39	Cost				$26,268
40	Pyrites, tons				
41	Cost				
	Wood—				
42	For alcohol, cords				
43	Cost				
44	For extracts, tons				293
45	Cost				$16,523
	Acids—				
46	Sulphuric, tons			119	1,400
47	Cost			$2,984	$2,160
48	Nitric, pounds				
49	Cost				
50	Mixed, pounds			330,000	1,425,822
51	Cost			$5,000	$21,002
52	Acid phosphate, tons				
53	Cost				
	Alcohol—				
54	Grain, gallons				769
55	Cost				$500
56	Wood, gallons			4,136	
57	Cost			$4,953	
58	Bones, tankage, and offal				
59	Common salt, tons			458	
60	Cost			$2,250	
61	Dry colors	$680,596	$92,510	$483,423	$2,210,230
62	Glycerine, pounds				692
63	Cost				$87
64	Lead, tons	15,447	2,901	3,000	24,083
65	Cost	$1,332,088	$242,666	$275,500	$2,124,948
66	Lime, bushels				4,000
67	Cost				$800
68	Linseed oil, gallons	1,155,791	213,779	402,636	2,632,319
69	Cost	$506,392	$102,773	$184,826	$1,248,756
70	Nitrate of soda, tons				20
71	Cost				$1,219
72	Potash salts				
73	Sulphur, tons			620	600
74	Cost			$18,500	$12,595
75	Tallow and fats				$5,700
76	All other components of products	$434,809	$24,471	$1,105,330	$1,573,151
77	Fuel	$26,614	$12,959	$55,810	$109,981
78	Rent of power and heat	$3,870		$550	$11,932
79	Mill supplies	$6,948	$1,505	$11,207	$56,635
80	All other materials	$236,679	$44,354	$296,694	$799,475
81	Freight	$6,349	$13,018	$38,534	$6,547
	Products:				
82	Aggregate value	$4,323,355	$838,151	$3,460,362	$12,543,825
	Acids—				
83	Sulphuric, 50 Baumé, tons				
84	Value				
85	Sulphuric, 66 Baumé, tons				
86	Value				
87	Nitric, pounds				
88	Value				

BY STATES, 1900—Continued.

Ohio.	Oregon.	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Washington.	Wisconsin.	All other states.[1]	
45	3	66	4	5	5	3	5	17	1
7	1	27	2	3	2		1	7	2
16	1	22	1		3	1	3	4	3
22	1	17	1	2		2	1	6	4
$4,306,499	$128,332	$10,263,615	$104,781	$73,546	$14,975	$65,932	$463,236	$801,016	5
$490,596	$5,000	$1,501,877	$5,000	$4,500		$5,500		$25,300	6
$474,905	$6,500	$1,333,868	$21,800	$6,000		$31,000		$133,693	7
$433,921	$18,247	$2,767,768	$16,700	$14,275	$2,925	$6,822	$39,414	$184,049	8
$2,907,077	$98,585	$4,660,002	$61,281	$48,770	$12,050	$22,610	$423,822	$457,974	9
41	2	47	4	3	10	2	6	15	10
396	7	405	13	8		4	43	48	11
$470,581	$8,880	$453,024	$16,164	$11,000		$4,620	$28,761	$53,033	12
55	2	36	2	4		2	3	7	13
$123,160	$4,800	$124,780	$5,000	$8,300		$3,000	$5,700	$12,750	14
340	5	369	11	4		2	40	41	15
$347,421	$4,080	$328,244	$11,164	$2,700		$1,620	$23,061	$40,283	16
297	4	329	8	3		1	30	33	17
$326,283	$3,600	$306,018	$10,124	$2,220		$1,200	$17,046	$37,411	18
43	1	40	3	1		1	10	8	19
$22,138	$480	$22,226	$1,040	$480		$420	$6,015	$2,872	20
919	41	1,862	21	51	19	13	103	329	21
601	39	1,430	15	36	14	10	80	222	22
733	39	1,649	18	45	13	10	78	269	23
$336,746	$22,836	$736,111	$9,998	$17,742	$6,600	$6,770	$28,117	$103,800	24
635	37	1,557	17	42	13	9	68	240	25
$303,493	$21,876	$711,635	$9,890	$17,142	$6,600	$6,620	$24,117	$95,912	26
98	2	87	1	3		1	10	25	27
$33,253	$960	$23,512	$108	$600		$150	$4,000	$7,288	28
		5						4	29
		$964						$600	30
$618,050	$6,033	$511,533	$5,688	$5,160	$2,760	$1,082	$21,400	$85,154	31
$23,576	$2,100	$26,541	$1,259	$996	$1,240	$463	$5,400	$7,042	32
$32,090	$554	$23,298	$313	$291	$86	$140	$2,093	$3,446	33
$502,384	$3,379	$408,839	$4,116	$3,873	$1,434	$479	$13,907	$73,166	34
$60,000		$52,855						$1,500	35
$3,204,558	$86,680	$5,203,343	$106,376	$88,995	$22,032	$31,436	$675,711	$731,298	36
$53,115		$38,410					$225	$5,766	37
		9,500							38
		$24,100							39
		20,598							40
		$122,300							41
								26	42
								$52	43
		11,452							44
		$52,260							45
7		187						270	46
$168		$3,050						$5,404	47
14,000		45,000							48
$782		$2,619							49
									50
									51
		190							52
		$1,519							53
		8,839						185	54
		$15,808						$416	55
4,225		9,132					2,500	185	56
$6,173		$2,553					$2,075	$162	57
		$2,278							58
									59
									60
$907,584	$22,937	$622,542	$51,812	$47,902	$11,434	$11,279	$256,949	$157,883	61
									62
									63
9,831		26,402							64
$817,413		$2,324,072							65
50		17,100						3,400	66
$10		$1,200						$1,071	67
1,431,005	52,550	1,547,008	34,338	48,093	11,822	28,553	493,575	151,857	68
$722,229	$23,758	$637,216	$15,182	$24,047	$5,811	$9,097	$236,945	$74,167	69
		1,066							70
		$35,176							71
		$675							72
		1,544							73
		$26,993							74
									75
$340,791	$27,265	$537,264	$14,100	$4,754	$1,443	$3,914	$81,660	$351,441	76
$34,480	$720	$141,956	$963	$2,721	$252	$25	$2,523	$10,923	77
$1,625	$220	$1,378	$920		$72	$420		$780	78
$15,094	$100	$45,762	$479	$348	$55	$60	$1,008	$11,130	79
$271,532	$5,230	$533,864	$17,996	$8,687	$1,590	$3,328	$93,611	$53,199	80
$33,562	$6,450	$30,348	$4,924	$536	$1,375	$3,313	$715	$58,904	81
$5,165,001	$141,559	$9,137,970	$166,818	$150,790	$39,830	$57,500	$881,767	$1,042,924	82
		23,964							83
		$201,299							84
		4,053							85
		$89,179							86
		749,666							87
		$28,112							88

[1] Includes establishments distributed as follows: Colorado, 2; Connecticut, 2; Delaware, 2; District of Columbia, 1; Kansas, 1; Maine, 2; Mississippi, 1; Nevada, 1; North Carolina, 2; Vermont, 2; Virginia, 1.

TABLE 3.—PAINTS: SUMMARY

		United States.	California.	Georgia.
	Products—Continued.			
	Aggregate value—Continued.			
	Acids—Continued.			
89	Acetic, pounds	1,715,007		
90	Value	$30,569		
91	Sodas	$39,614		
92	Alums, pounds	25,445,612		
93	Value	$342,969		
94	Coal-tar distillery products	$16,716		
	Wood distillation—			
95	Wood alcohol, refined, gallons	78		
96	Value	$110		
97	Charcoal, bushels	1,138		
98	Value	$137		
99	All other	$684		
	Fertilizers—			
100	Complete, tons	465		
101	Value	$10,497		
102	All other, tons	685		
103	Value	$1,878		
	Dyestuffs—			
104	Natural, pounds	1,843,749		
105	Value	$99,779		
106	Artificial, pounds	650,000		
107	Value	$390,000		
	Tanning materials—			
108	Natural, extracts, pounds	554,896		
109	Value	$10,161		
	Paints, colors, and varnishes—			
110	Total value	$48,440,780	$823,224	$182,279
	Pigment—			
111	White lead, pounds	116,102,316	4,800,000	
112	Value	$4,211,181	$237,180	
113	Oxides of lead, pounds	50,759,623	500,000	
114	Value	$2,550,340	$25,895	
115	Lamp, and other blacks, pounds	1,065,000		
116	Value	$60,250		
117	Fine colors, pounds	3,325,252		
118	Value	$736,796		
119	Iron oxides and other earth colors, pounds	33,453,896		
120	Value	$318,242		
121	Dry colors, pounds	157,472,838		
122	Value	$4,066,147		
123	Pulp colors, sold moist, pounds	20,060,935		
124	Value	$861,531		
	Paints:			
125	Paints in oil, in paste, pounds	303,460,028	2,411,622	870,683
126	Value	$17,405,822	$207,797	$56,065
127	Paints already mixed for use, gallons	16,591,745	355,837	91,394
128	Value	$14,618,277	$349,352	$93,714
	Varnishes and japans—			
129	Oil and turpentine varnishes, gallons	1,373,603		
130	Value	$1,236,861		
131	Alcohol varnishes, gallons	46,369		
132	Value	$71,707		
133	Pyroxyline varnishes, gallons	16,291		
134	Value	$16,225		
135	Liquid dryers, japans, and lacquers	$308,495		$7,500
136	All other paints, colors, and varnishes	$1,983,906	$3,000	$25,000
137	Fine chemicals	$4,092		
	Chemicals not otherwise specified—			
138	Copperas, pounds	5,786,400		
139	Value	$29,346		
140	Value of all other products	$1,139,073	$305,419	
	Products consumed:			
	Acids—			
141	Sulphuric, tons	27,141		
142	Nitric, pounds	611,427		
143	Lead oxides, pounds	374,061		
144	White lead, pounds	24,922,647	162,000	
145	All other products consumed, pounds	15,997,525		
	Comparison of products:			
146	Number of establishments reporting for both years	371	10	3
147	Value for census year	$48,884,792	$1,124,965	$84,000
148	Value for preceding business year	$43,348,494	$1,215,560	$92,000
	Power:			
149	Number of establishments reporting	342	8	4
150	Total horsepower	27,183	964	90
	Owned—			
	Engines—			
151	Steam, number	358	4	2
152	Horsepower	23,191	525	60
153	Gas or gasoline, number	18	2	
154	Horsepower	345	21	
155	Water wheels, number	24		
156	Horsepower	845		
157	Electric motors, number	65	19	
158	Horsepower	839	350	
159	Other power, number	3		
160	Horsepower	300		
	Rented—			
161	Electric, horsepower	771	3	30
162	Other kind, horsepower	892	65	
163	Furnished to other establishments, horsepower	414		
	Establishments classified by number of persons employed, not including proprietors and firm members:			
164	Total number of establishments	419	11	5
165	No employees	13		
166	Under 5	120	6	1
167	5 to 20	148	4	4
168	21 to 50	79		
169	51 to 100	35		
170	101 to 250	19	1	
171	251 to 500	4		
172	501 to 1,000	1		

Illinois.	Indiana.	Iowa.	Kentucky.	Louisiana.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
									89
									90
									91
									92
									93
						$15,000			94
									95
									96
									97
									98
									99
									100
									101
									102
									103
									104
									105
									106
									107
									108
									109
$5,939,702	$165,335	$335,367	$357,085	$132,102	$395,931	$1,938,582	$1,826,742	$357,816	110
11,037,475		250,000			80,000	110,496			111
$531,962		$24,750			$4,000	$5,525			112
						3,725,279			113
						$197,440			114
	365,000					700,000			115
	$18,250					$42,000			116
190,000						345,000			117
$31,000						$35,000			118
1,183,565						2,278,000			119
$14,617						$28,435			120
9,853,710		3,042,000			1,533,509	3,445,701	417,418		121
$300,789		$71,566			$33,505	$218,607	$40,737		122
10,000					558,300	739,312			123
$1,000					$31,042	$67,425			124
45,021,424	1,726,100	1,405,000	1,022,640	189,834	1,101,227	10,362,389	9,761,345	796,282	125
$2,634,159	$120,806	$74,150	$70,610	$50,686	$87,519	$633,551	$684,716	$100,084	126
2,586,440	25,112	181,485	387,575	94,017	232,544	479,011	847,205	298,661	127
$1,978,214	$26,279	$134,901	$282,525	$81,416	$205,740	$467,829	$974,318	$257,732	128
41,000					28,750	111,913	69,290		129
$26,250					$3,875	$95,772	$86,363		130
14,000						1,400	3,100		131
$16,000						$2,300	$6,940		132
16,000									133
$16,000									134
$36,511					$4,250	$16,483	$15,468		135
$353,200		$30,000	$3,950		$26,000	$128,215	$18,200		136
									137
2,086,400									138
$12,696									139
$35,150		$1,500	$2,000		$46,813	$52,400			140
						14,959			141
									142
									143
									144
									145
27	3	6	8	3	13	28	12	5	146
$5,889,568	$155,806	$336,867	$329,085	$132,102	$442,744	$1,953,047	$1,824,382	$339,031	147
$5,200,700	$130,000	$238,540	$300,457	$183,306	$367,193	$1,712,444	$1,643,346	$277,500	148
27	5	5	8	2	8	26	12	5	149
2,763	259	147	256	101	328	1,267	837	203	150
22	3	5	5	1	9	21	12	2	151
2,491	200	147	189	40	308	1,132	739	133	152
2	1		1	1					153
27	36		10	36					154
1									155
15									156
1						2	9		157
6						40	83		158
									159
									160
3	23		57			27	5	70	161
221				25	20	68	10		162
80							60		163
33	5	6	9	3	13	30	13	6	164
		2		1		1	1		165
8	1	1	5		5	6	4	1	166
8	3	1	3	1	5	16	3	3	167
10	1	2	1	1	3	5	1	2	168
4						2	2		169
3							2		170
									171
									172

TABLE 3.—PAINTS: SUMMARY

		Missouri.	Nebraska.	New Jersey.	New York.
	Products—Continued.				
	Aggregate value—Continued.				
	Acids—Continued.				
89	Acetic, pounds				
90	Value				
91	Sodas				
92	Alums, pounds				
93	Value				
94	Coal-tar distillery products				$716
	Wood distillation—				
95	Wood alcohol, refined, gallons				
96	Value				
97	Charcoal, bushels				
98	Value				
99	All other				
	Fertilizers—				
100	Complete, tons				
101	Value				
102	All other, tons				
103	Value				
	Dyestuffs—				
104	Natural, pounds				1,843,749
105	Value				$99,779
106	Artificial, pounds			650,000	
107	Value			$390,000	
	Tanning material—				
108	Natural, extracts, pounds				
109	Value				
	Paints, colors, and varnishes—				
110	Total value	$4,108,476	$838,151	$3,022,557	$12,225,159
	Pigments—				
111	White lead, pounds	4,942,814		14,471,171	39,109,000
112	Value	$243,681		$717,047	$547,440
113	Oxides of lead, pounds	3,581,604	1,125,262		12,426,000
114	Value	$183,189	$61,889		$663,176
115	Lamp, and other blacks, pounds				
116	Value				
117	Fine colors, pounds			1,135,284	1,192,466
118	Value			$190,893	$443,755
119	Iron oxides and other earth colors, pounds			500,000	15,458,000
120	Value			$25,000	$121,534
121	Dry colors, pounds	8,455,000		4,756,080	41,433,177
122	Value	$82,494		$441,580	$2,118,799
123	Pulp colors, sold moist, pounds			5,156,948	12,941,596
124	Value			$162,556	$580,623
	Paints—				
125	Paints in oil, in paste, pounds	45,782,816	8,850,306	8,545,256	68,997,820
126	Value	$2,267,924	$553,950	$517,159	$4,009,797
127	Paints already mixed for use, gallons	1,527,528	221,712	622,542	2,875,234
128	Value	$1,285,649	$219,712	$580,189	$2,862,426
	Varnishes and japans—				
129	Oil and turpentine varnishes, gallons	650		178,832	460,500
130	Value	$650		$148,245	$417,495
131	Alcohol varnishes, gallons			3,285	1,000
132	Value			$4,571	$1,000
133	Pyroxyline varnishes, gallons				
134	Value				
135	Liquid dryers, japans, and lacquers	$21,250		$23,857	$53,044
136	All other paints, colors, and varnishes	$23,639	$2,600	$211,460	$406,070
137	Fine chemicals				$4,092
	Chemicals not otherwise specified—				
138	Copperas, pounds				
139	Value				
140	Value of all other products	$214,879		$47,805	$214,079
	Products consumed:				
	Acids—				
141	Sulphuric, tons				
142	Nitric, pounds				
143	Lead oxides, pounds				
144	White lead, pounds		7,251,300		
145	All other products consumed, pounds			1,147,946	
	Comparison of products:				
146	Number of establishments reporting for both years	18	3	22	71
147	Value for census year	$4,161,355	$838,151	$2,490,554	$12,276,700
148	Value for preceding business year	$4,460,387	$758,424	$2,042,534	$11,743,756
	Power:				
149	Number of establishments reporting	15	3	23	63
150	Total horsepower	1,703	310	1,885	5,723
	Owned—				
	Engines—				
151	Steam, number	18	3	30	63
152	Horsepower	1,565	310	1,792	4,762
153	Gas, or gasoline, number	1			3
154	Horsepower	6			40
155	Water wheels, number			1	6
156	Horsepower			25	265
157	Electric motors, number	3		1	5
158	Horsepower	6		25	73
159	Other power, number				
160	Horsepower				
	Rented—				
161	Electric, horsepower	106			288
162	Other kind, horsepower	20		43	295
163	Furnished to other establishments, horsepower				76
	Establishments classified by number of persons employed, not including proprietors and firm members:				
164	Total number of establishments	20	3	27	82
165	No employees			1	2
166	Under 5	4		8	21
167	5 to 20	8	1	7	27
168	21 to 50	6		7	14
169	51 to 100	1	2	2	14
170	101 to 250			2	2
171	251 to 500	1			2
172	501 to 1,000				

BY STATES, 1900—Continued.

Ohio.	Oregon.	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Washington.	Wisconsin.	All other states.[1]	
		1,715,007							89
		$30,569							90
		$39,614							91
		25,445,612							92
		$342,969							93
		$1,000							94
								78	95
								$110	96
								1,138	97
								$137	98
								$684	99
		465							100
		$10,497							101
		685							102
		$1,878							103
									104
									105
									106
									107
		554,896							108
		$10,161							109
$5,127,261	$96,131	$8,237,632	$166,818	$145,790	$39,830	$57,500	$881,717	$1,039,593	110
8,822,814		32,478,546							111
$383,475		$1,516,121							112
1,508,000		27,893,478							113
$79,792		$1,338,959							114
									115
									116
254,000		207,502						1,000	117
$19,900		$16,048						$200	118
80,000		6,294,331		7,660,000					119
$1,200		$96,816		$30,640					120
1,441,781		57,164,490						25,929,972	121
$95,010		$516,561						$146,499	122
		594,379					60,400		123
		$12,842					$6,043		124
30,595,967	30,576	56,313,415	629,800	142,000	241,429		6,000,000	2,662,097	125
$1,752,553	$7,644	$2,908,062	$70,775	$28,400	$15,600		$412,500	$141,315	126
2,574,468	78,991	1,994,333	35,554	106,073	26,200	48,600	430,000	471,329	127
$2,362,313	$88,487	$1,381,036	$33,829	$86,750	$23,930	$57,500	$387,550	$396,886	128
229,976		218,534						34,158	129
$237,237		$189,491						$31,483	130
1,505		17,829	1,250				2,500	500	131
$3,510		$31,612	$1,250				$3,324	$1,200	132
		291							133
		$225							134
$48,429		$57,902			$300		$14,300	$4,201	135
$143,842		$171,957	$60,964				$58,000	$317,809	136
									137
		3,700,000							138
		$16,650							139
$37,740	$45,428	$128,410		$5,000			$50	$2,400	140
		12,182							141
		611,427							142
		374,061							143
		17,509,347							144
		14,846,296						3,283	145
39	3	65	4	5	5	2	5	11	146
$4,955,569	$141,559	$9,124,952	$166,818	$150,790	$39,830	$17,500	$881,767	$1,027,650	147
$3,934,070	$90,794	$7,365,106	$135,822	$131,600	$28,060	$15,100	$516,500	$765,295	148
37	2	62	1	2	4	2	5	13	149
2,350	35	6,267	108	122	30	50	367	1,018	150
26	1	108	2	1	3		5	12	151
2,033	30	5,492	100	100	25		367	651	152
4		1		1				1	153
92		50		22				5	154
1		11						4	155
1		210						329	156
12		12						1	157
120		127						9	158
		3							159
		300							160
47	5	28			5	50		24	161
57		60	8						162
28		155	15						163
45	3	66	4	5	5	3	5	17	164
2				1			1	1	165
9		23	2	1	3	2	2	7	166
18	2	22	1	2	2	1	1	5	167
11	1	11	1	1				1	168
2		5						1	169
2		4					1	2	170
1									171
		1							172

[1] Includes establishments distributed as follows: Colorado, 2; Connecticut, 2; Delaware, 2; District of Columbia, 1; Kansas, 1; Maine, 2; Mississippi, 1; Nevada, 1; North Carolina, 2; Vermont, 2; Virginia, 1.

Table 4.—VARNISHES:

		United States.	California.	Connecticut.	Illinois.	Indiana.	Kentucky.
1	Number of establishments	181	3	8	19	3	3
	Character of organization:						
2	Individual	59	2	1	4		
3	Firm or limited partnership	41		2	2		
4	Incorporated company	81	1	5	13	3	3
	Capital:						
5	Total	$17,550,892	$148,500	$373,962	$2,344,728	$208,039	$187,749
6	Land	$1,573,916	$42,000	$22,400	$297,178	$11,556	$8,500
7	Buildings	$2,358,905	$21,000	$25,454	$348,279	$57,056	$25,775
8	Machinery, tools, and implements	$1,448,609	$11,000	$25,072	$180,996	$23,322	$13,807
9	Cash and sundries	$12,169,462	$74,500	$301,036	$1,518,275	$116,105	$139,667
10	Proprietors and firm members	119	1	6	10		
	Salaried officials, clerks, etc.:						
11	Total number	1,198	6	17	171	25	32
12	Total salaries	$1,939,333	$7,860	$21,550	$242,157	$32,480	$26,554
	Officers of corporations—						
13	Number	154	2	9	19	6	2
14	Salaries	$463,819	$2,700	$8,550	$66,104	$8,372	$2,150
	General superintendents, managers, clerks, etc.—						
15	Total number	1,044	4	8	152	19	30
16	Total salaries	$1,475,514	$5,160	$13,000	$176,053	$24,108	$24,404
	Men—						
17	Number	919	4	8	132	19	24
18	Salaries	$1,410,643	$5,160	$13,000	$166,616	$24,108	$22,650
	Women—						
19	Number	125			20		6
20	Salaries	$64,871			$9,437		$1,754
	Wage-earners, including pieceworkers, and total wages:						
21	Greatest number employed at any one time during the year	1,658	14	49	210	18	45
22	Least number employed at any one time during the year	1,485	12	26	163	17	45
23	Average number	1,546	14	32	187	18	41
24	Wages	$995,803	$7,316	$19,250	$124,688	$9,632	$19,940
	Men, 16 years and over—						
25	Average number	1,479	14	22	177	18	41
26	Wages	$976,174	$7,316	$16,250	$122,980	$9,632	$19,940
	Women, 16 years and over—						
27	Average number	62		10	9		
28	Wages	$18,878		$3,000	$1,552		
	Children, under 16 years—						
29	Average number	5			1		
30	Wages	$751			$156		
	Miscellaneous expenses:						
31	Total	$1,616,642	$4,850	$46,959	$138,423	$9,954	$3,841
32	Rent of works	$47,458	$120	$750	$5,611		$240
33	Taxes, not including internal revenue	$84,431	$380	$1,646	$10,498	$1,407	$1,061
34	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$1,425,031	$4,350	$44,563	$120,584	$8,547	$2,540
35	Contract work	$59,722			$1,730		
	Materials used:						
36	Total cost	$10,939,131	$88,900	$234,474	$1,276,709	$143,514	$205,668
37	Gums	$2,947,060	$22,714	$107,499	$438,643	$48,872	$49,102
	Acids—						
38	Sulphuric, tons	2					
39	Value	$86					
40	Mixed, pounds	144,482					
41	Cost	$3,567					
	Alcohol—						
42	Grain, gallons	65,146	940	100	2,890	601	
43	Cost	$151,089	$2,150	$220	$5,491	$1,396	
44	Wood, gallons	274,221	2,773	690	88,206	591	
45	Cost	$255,354	$3,766	$1,400	$73,230	$591	
46	Dry colors	$260,317		$4,043	$7,302		
47	Lime, bushels	500					
48	Cost	$100					
49	Linseed oil, gallons	4,308,943	33,154	40,831	481,471	87,356	47,485
50	Cost	$2,056.469	$18,527	$21,772	$205,038	$37,589	$27,351
51	Potash salts	$609					
52	All other components of products	$3,713,681	$32,420	$78,984	$399,736	$38,516	$114,211
53	Fuel	$105,366	$715	$1,790	$17,235	$975	$994
54	Rent of power and heat	$4,741		$50	$50		
55	Mill supplies	$13,534	$5	$215	$994	$25	$135
56	All other materials	$1,261,952	$4,503	$15,569	$114,604	$11,235	$13,875
57	Freight	$165,206	$4,100	$2,932	$14,386	$4,315	
	Products:						
58	Aggregate value	$18,687,240	$130,805	$399,759	$2,190,265	$237,502	$334,978
	Cyanides—						
59	Potassium cyanide, pounds	25,945					
60	Value	$10,082					
61	Yellow prussiate of potash, pounds	25,000					
62	Value	$500					
63	Dyestuffs, artificial, pounds	40,000					
64	Value	$5,000					
	Paints, colors, and varnishes—						
65	Total value	$18,576,074	$130,805	$399,759	$2,190,265	$237,502	$315,978
	Pigments—						
66	Fine colors, pounds	81,000			11,000		
67	Value	$211,000			$1,000		
68	Dry colors, pounds	6,600,000					
69	Value	$304,000					
	Paints—						
70	Paints in oil, in paste, pounds	2,950,370				8,500	
71	Value	$195,637				$330	
72	Paints already mixed for use, gallons	287,850			8,034	9,500	
73	Value	$245,849			$17,196	$5,800	
	Varnishes and japans—						
74	Oil and turpentine varnishes, gallons	12,909,248	123,670	133,521	1,576,053	263,624	454,550
75	Value	$13,096,693	$120,392	$304,479	$1,594,904	$195,260	$314,603
76	Alcohol varnishes, gallons	503,442	2,670	175	134,943	1,210	100
77	Value	$833,522	$5,300	$404	$187,538	$3,569	$145
78	Pyroxyline varnishes, gallons	143,836		28,810		383	
79	Value	$162,601		$36,012		$594	
80	Liquid driers, japans, and lacquers	$2,781,115	$5,113	$43,104	$259,293	$21,949	$1,230
81	All other paints, colors, and varnishes	$745,657		$15,760	$130,334	$10,000	
82	Explosives, gun cotton, or pyroxyline, pounds	42,752					
83	Value	$45,959					

Maryland.	Massachusetts.	Michigan.	Missouri.	New Jersey.	New York.	Ohio.	Pennsylvania.	All other states.[1]	
3	14	4	7	24	40	20	27	6	1
1	5	2	2	6	19	4	13		2
1	3	2		3	10	6	9	3	3
1	6		5	15	11	10	5	3	4
$48,604	$358,384	$934,370	$165,323	$3,949,265	$5,630,082	$1,195,885	$1,816,431	$189,570	5
	$18,900	$28,500	$17,000	$300,548	$530,518	$90,081	$198,435	$8,300	6
$9,000	$36,088	$167,837	$8,660	$673,931	$617,937	$163,352	$183,138	$21,398	7
$9,456	$54,800	$53,796	$19,717	$364,641	$426,433	$84,519	$170,350	$10,700	8
$30,148	$248,596	$684,237	$119,946	$2,610,145	$4,056,194	$857,933	$1,264,508	$149,172	9
3	11	10	2	11	19	21	17	8	10
9	42	65	19	251	298	120	120	23	11
$7,264	$44,174	$150,400	$27,194	$372,559	$641,208	$165,317	$172,216	$28,400	12
2	11		2	31	33	20	12	5	13
$1,080	$22,423		$3,000	$99,470	$148,620	$58,050	$32,500	$10,800	14
7	31	65	17	220	265	100	108	18	15
$6,184	$21,751	$150,400	$24,194	$273,089	$492,588	$107,267	$139,716	$17,600	16
6	25	50	17	193	244	89	96	12	17
$6,100	$19,601	$141,600	$24,194	$257,424	$480,503	$101,645	$134,022	$14,020	18
1	6	15		27	21	11	12	6	19
$84	$2,150	$8,800		$15,665	$12,085	$5,622	$5,694	$3,580	20
13	57	108	29	235	554	120	181	25	21
11	46	103	23	212	527	111	164	25	22
12	51	106	27	221	537	109	167	24	23
$5,488	$31,595	$49,416	$17,361	$158,085	$343,558	$76,841	$119,428	$13,205	24
11	46	95	27	217	515	108	165	23	25
$5,254	$29,995	$46,736	$17,361	$157,173	$335,003	$76,541	$119,088	$12,905	26
1	5	11		2	21	1	1	1	27
$234	$1,600	$2,680		$612	$8,360	$300	$240	$300	28
				2	1		1		29
				$300	$195		$100		30
$3,994	$26,439	$262,401	$10,368	$197,258	$537,238	$165,960	$201,497	$7,460	31
$740	$5,976	$180	$2,990	$7,645	$13,202	$5,110	$4,054	$840	32
$197	$1,828	$10,296	$687	$15,564	$26,204	$8,494	$5,474	$695	33
$3,057	$18,635	$251,925	$6,691	$174,049	$497,332	$152,356	$134,477	$5,925	34
					$500		$57,492		35
$34,734	$274,441	$814,857	$125,021	$1,306,244	$3,954,088	$910,910	$1,391,371	$178,200	36
$3,204	$101,632	$176,920	$28,551	$500,884	$1,041,516	$180,586	$209,530	$37,407	37
					2				38
					$86				39
				144,482					40
				$3,567					41
	1,080	9,434	100	10,124	34,158	1,070	4,296	353	42
	$2,604	$21,698	$245	$23,669	$80,080	$2,434	$10,303	$799	43
	1,200	200	6,899	40,867	109,676	4,635	14,702	3,782	44
	$1,100	$200	$4,112	$41,850	$103,880	$6,230	$13,850	$5,145	45
$4,400	$2,929		$4,041	$559	$1,534	$4,100	$217,075	$14,334	46
						500			47
						$100			48
9,726	99,091	315,607	45,925	441,705	1,567,095	375,066	675,611	88,820	49
$4,863	$47,958	$156,799	$20,240	$214,755	$721,707	$186,960	$348,312	$44,598	50
				$609					51
$18,851	$95,600	$197,279	$58,207	$399,854	$1,417,212	$428,366	$375,533	$58,912	52
$614	$3,175	$3,706	$1,396	$11,768	$42,685	$8,940	$9,874	$1,500	53
	$220		$50	$504	$2,955	$292		$620	54
$102	$194	$3,080	$85	$1,622	$4,563	$1,530	$884	$100	55
$1,950	$15,795	$155,176	$7,283	$101,307	$534,149	$81,423	$192,198	$12,885	56
$750	$3,234	$100,000	$811	$5,296	$3,721	$9,949	$13,812	$1,900	57
$64,521	$500,672	$1,561,150	$231,168	$2,753,562	$6,334,467	$1,538,623	$2,161,495	$248,273	58
				25,945					59
				$10,082					60
				25,000					61
				$500					62
					40,000				63
					$5,000				64
$64,521	$500,672	$1,561,150	$230,168	$2,731,726	$6,272,219	$1,535,623	$2,157,413	$248,273	65
					70,000				66
					$210,000				67
							6,600,000		68
							$304,000		69
	40,000		14,107	127,655	2,000		2,758,108		70
	$2,000		$15,000	$35,293	$100		$142,914		71
			14,740		46,900	3,750	168,926	36,000	72
			$9,600		$46,015	$3,625	$124,013	$39,600	73
27,050	324,619	1,563,673	109,519	1,486,013	4,467,708	1,015,589	1,190,122	173,537	74
$19,950	$346,828	$1,543,074	$126,990	$2,106,076	$4,248,219	$940,160	$1,047,181	$188,577	75
	3,000	475	2,106	64,258	219,705	41,799	27,301	5,700	76
	$9,060	$1,511	$3,277	$119,652	$400,428	$46,597	$46,041	$10,000	77
			6,500	5,366	102,777				78
			$16,000	$10,995	$99,000				79
$16,571	$122,910	$15,193	$59,301	$350,382	$1,021,069	$463,870	$401,034	$96	80
$28,000	$19,874	$1,372		$109,328	$247,388	$81,371	$92,230	$10,000	81
				7,752	35,000				82
				$10,959	$35,000				83

[1] Includes establishments distributed as follows: Louisiana, 1; Maine, 1; Minnesota, 1; Oregon, 1; Rhode Island, 1; Virginia, 1.

TABLE 4.—VARNISHES: SUMMARY

		United States.	California.	Connecticut.	Illinois.	Indiana.	Kentucky.
	Products—Continued.						
	Aggregate value—Continued.						
84	Fine chemicals	$5,000					
85	Value of all other products	$44,625					$19,000
86	Products consumed	$748,624		$21,000			
	Comparison of products:						
87	Number of establishments reporting for both years	162	3	8	18	3	2
88	Value for census year	$17,441,726	$130,805	$399,759	$2,137,765	$237,502	$285,700
89	Value for preceding business year	$15,510,030	$119,660	$435,113	$1,960,058	$209,676	$220,000
	Power:						
90	Number of establishments reporting	93		3	14	2	2
91	Total horsepower	4,192		62	482	67	140
	Owned—						
	Engines—						
92	Steam, number	102		1	12	2	4
93	Horsepower	3,699		35	422	50	140
94	Gas or gasoline, number	10			4		
95	Horsepower	156			32		
96	Water wheels, number	5					
97	Horsepower	105					
98	Electric motors, number	27			3	2	
99	Horsepower	93			8	17	
100	Other power, number	1		1			
101	Horsepower	25		25			
	Rented—						
102	Electric, horsepower	85		2	20		
103	Other kind, horsepower	29					
104	Furnished to other establishments, horsepower	120			75		
	Establishments classified by number of persons employed, not including proprietors and firm members:						
105	Total number of establishments	181	3	8	19	3	3
106	No employees	5					
107	Under 5	58	1	2	4		1
108	5 to 20	85	2	5	8	2	1
109	21 to 50	21		1	5	1	
110	51 to 100	7			2		1
111	101 to 250	5					

BY STATES, 1900—Continued.

Maryland.	Massachusetts.	Michigan.	Missouri.	New Jersey.	New York.	Ohio.	Pennsylvania.	All other states.[1]	
...	...	...	...	...	$5,000	...	...	...	84
...	...	...	$1,000	$295	$17,248	$3,000	$4,082	...	85
...	...	...	...	$546,000	$116,000	...	$65,624	...	86
3	13	3	7	20	35	19	22	6	87
$64,521	$492,672	$1,560,150	$231,168	$2,638,552	$5,644,005	$1,534,373	$1,836,481	$248,273	88
$72,686	$423,439	$1,252,354	$215,894	$2,400,716	$4,796,734	$1,436,418	$1,768,808	$198,474	89
2	6	1	3	11	24	10	14	1	90
52	430	250	48	475	1,136	230	795	25	91
1	6	1	2	10	32	9	22	...	92
40	325	250	13	458	1,036	205	725	...	93
1	...	...	1	...	2	...	2	...	94
12	...	...	25	...	27	...	60	...	95
...	1	...	...	...	4	...	...	...	96
...	100	...	...	...	5	...	...	...	97
...	...	...	...	2	17	2	1	...	98
...	...	...	...	2	41	15	10	...	99
...	...	...	...	...	...	...	...	...	100
...	...	...	...	...	...	...	...	...	101
...	3	...	...	15	10	10	...	25	102
...	2	...	10	...	17	...	...	...	103
...	...	25	...	...	20	...	...	...	104
3	14	4	7	24	40	20	27	6	105
...	...	1	...	1	1	...	2	...	106
...	5	1	3	6	14	7	13	1	107
3	9	1	4	12	15	10	8	5	108
...	...	...	...	3	6	2	3	...	109
...	...	...	...	1	2	1	...	...	110
...	...	1	...	1	2	...	1	...	111

[1] Includes establishments distributed as follows: Louisiana, 1; Maine, 1; Minnesota, 1; Oregon, 1; Rhode Island, 1; Virginia, 1.

TABLE 5.—EXPLOSIVES: SUMMARY BY STATES, 1900.

	United States.	California.	Illinois.	Indiana.	Michigan.	New Jersey.	New York.	Ohio.	Pennsylvania.	All other states.[1]
Number of establishments	97	7	3	6	5	10	5	9	36	16
Character of organization:										
Individual	10				1			1	8	
Firm and limited partnership	11						1	1	9	
Incorporated company	76	7	3	6	4	10	4	7	19	16
Capital:										
Total	$19,465,846	$3,283,928	$493,566	$876,146	$351,930	$4,283,307	$451,505	$1,972,451	$2,819,458	$4,933,555
Land	$1,168,753	$206,987	$32,474	$27,250	$9,680	$136,125	$40,000	$315,000	$110,466	$290,771
Buildings	$3,003,089	$909,985	$52,240	$181,825	$47,200	$502,664	$67,475	$365,786	$391,515	$484,399
Machinery, tools, and implements	$3,114,120	$394,029	$124,443	$78,114	$50,598	$556,104	$101,815	$373,000	$943,102	$492,915
Cash and sundries	$12,179,884	$1,772,927	$284,409	$588,957	$244,452	$3,088,414	$242,215	$918,665	$1,374,375	$3,665,470
Proprietors and firm members	23				1		2	3	17	
Salaried officials, clerks, etc.:										
Total number	768	82	14	37	24	255	19	56	102	179
Total salaries	$914,447	$130,860	$14,133	$55,400	$42,580	$206,822	$18,003	$92,520	$130,394	$223,735
Officers of corporations—										
Number	161	13	5	6	4	33	10	17	28	45
Salaries	$349,371	$20,650	$10,180	$14,400	$9,200	$63,907	$9,180	$51,300	$61,280	$109,274
General superintendents, managers, clerks, etc.—										
Total number	607	69	9	31	20	222	9	39	74	134
Total salaries	$565,076	$110,210	$3,953	$41,000	$33,380	$142,915	$8,823	$41,220	$69,114	$114,461
Men—										
Number	558	64	7	28	18	208	9	32	66	126
Salaries	$544,421	$107,450	$3,560	$39,720	$32,020	$137,711	$8,823	$38,260	$65,139	$111,738
Women—										
Number	49	5	2	3	2	14		7	8	8
Salaries	$20,655	$2,760	$393	$1,280	$1,360	$5,204		$2,960	$3,975	$2,723
Wage-earners, including pieceworkers, and total wages:										
Greatest number employed at any one time during the year	5,352	1,047	115	291	136	1,348	145	378	727	1,165
Least number employed at any one time during the year	3,830	762	48	166	85	926	64	313	553	913
Average number	4,502	906	71	245	113	1,146	85	352	629	955
Wages	$2,383,756	$602,765	$32,064	$118,979	$66,282	$563,621	$52,288	$178,786	$320,362	$448,609
Men, 16 years and over—										
Average number	4,349	882	71	217	108	1,137	85	350	598	901
Wages	$2,346,887	$593,128	$32,064	$114,299	$64,749	$561,743	$52,288	$178,286	$312,357	$437,973
Women, 16 years and over—										
Average number	117	24		28	5	8		2	27	23
Wages	$30,781	$9,637		$4,680	$1,533	$1,732		$500	$7,405	$5,294
Children, under 16 years—										
Average number	36					1			4	31
Wages	$6,088					$146			$600	$5,342
Miscellaneous expenses:										
Total	$1,096,604	$255,278	$15,007	$43,546	$19,833	$215,621	$11,543	$103,756	$200,371	$231,649
Rent of works	$6,350	$1,600		$25	$200			$1,110	$3,215	$200
Taxes, not including internal revenue	$64,161	$10,178	$1,081	$3,081	$1,183	$8,326	$1,968	$9,198	$10,889	$18,257
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$1,018,435	$243,500	$13,926	$38,440	$14,250	$207,295	$9,575	$92,748	$186,267	$212,434
Contract work	$7,658			$2,000	$4,200			$700		$758
Materials used:										
Total cost	$10,334,974	$2,669,634	$143,937	$610,209	$501,584	$2,048,837	$201,331	$773,269	$1,500,252	$1,885,921
Wood, for alcohol, cords	600									600
Cost	$4,800									$4,800
Acids—										
Sulphuric, tons	7,864	140		2,005	406	4,954			342	17
Cost	$130,699	$2,296		$36,895	$9,748	$65,736			$15,728	$296
Nitric, pounds	467,587	319,987							113,600	34,000
Cost	$17,171	$13,359							$2,272	$1,540
Mixed, pounds	66,906,146	12,100,000		3,020,000	6,694,964	21,052,244	548,861	6,208,183	9,874,537	7,407,357
Cost	$1,505,754	$148,718		$86,449	$189,276	$372,403	$15,221	$164,207	$238,593	$290,887
Ammonia, aqua, pounds	649,703			120,703	140,000	340,000			48,640	360
Cost	$11,303			$3,438	$2,000	$3,400			$2,443	$22
Alcohol—										
Grain, gallons	122,516	7,712				113,753			1,051	
Cost	$47,406	$17,350				$28,930			$1,126	
Wood, gallons	14,004					13,604			400	
Cost	$10,531					$10,166			$365	
Glycerine, pounds	16,983,918	5,765,997		1,407,659	1,152,501	3,866,604	72,883	816,169	1,913,237	1,988,868
Cost	$2,016,557	$681,840		$157,945	$142,873	$434,101	$9,110	$109,304	$258,357	$223,027
Lead, tons	7								7	
Cost	$910								$910	
Nitrate of potash, tons	1,847		257			28	549	383	44	586
Cost	$150,544		$19,826			$2,780	$48,807	$31,282	$3,354	$44,495
Nitrate of soda, tons	88,524	22,503	2,182	4,735	2,203	14,518	1,883	8,379	14,876	17,250
Cost	$2,902,866	$700,396	$69,776	$164,567	$76,342	$485,704	$62,821	$277,529	$495,576	$570,155
Potash salts	$45,947					$20,902			$1,000	$24,045
Sulphur, tons	12,742	5,482	323	198	51	308	344	1,355	2,031	2,650
Cost	$317,382	$126,355	$7,004	$6,773	$1,002	$7,296	$11,035	$33,243	$57,872	$66,803
All other components of products	$1,056,602	$403,278	$8,503	$47,541	$18,138	$244,041	$9,070	$13,781	$70,582	$241,668
Fuel	$356,950	$110,645	$3,576	$18,209	$6,731	$82,763	$4,675	$24,168	$32,721	$73,462
Rent of power and heat	$5,500	$5,500								
Mill supplies	$130,384	$53,611	$2,304	$1,747	$1,824	$23,458	$2,956	$12,260	$20,633	$11,591
All other materials	$1,258,883	$288,107	$20,161	$66,306	$27,995	$254,321	$36,351	$86,568	$228,748	$250,326
Freight	$364,784	$118,179	$12,787	$20,339	$25,655	$12,836	$1,285	$20,927	$69,972	$82,804
Products:										
Total value	$17,125,418	$4,283,818	$289,735	$976,247	$691,766	$3,549,216	$332,998	$1,330,489	$2,595,180	$3,075,969
Acids—										
Sulphuric, 50° Beaumé, tons	310					187			123	
Value	$7,478					$5,428			$2,050	
Nitric, pounds	1,507,126			140,706		1,366,420				
Value	$22,054			$2,814		$19,240				
Other kinds of acids	$2,111					$2,111				
Explosives—										
Gunpowder, pounds	123,314,103	500,000	6,358,250	4,925,000		5,477,900	5,939,200	21,627,675	34,961,649	43,524,429
Value	$5,310,351	$80,000	$270,974	$214,324		$240,027	$263,594	$927,098	$1,507,807	$1,806,527
Nitroglycerine, pounds	3,618,692			675,000	4,000	14,199		1,455,113	1,163,918	306,462
Value	$783,299			$118,750	$2,000	$2,191		$351,970	$256,289	$52,099
Guncotton, or pyroxyline, pounds	228,342	50,000				178,342				
Value	$103,702	$30,000				$73,702				
Dynamite, pounds	85,846,456	27,055,910		6,456,041	6,643,975	25,550,543	671,215		8,507,676	10,961,096
Value	$8,247,223	$2,895,703		$614,934	$652,174	$2,185,365	$69,404		$790,872	$1,039,271

[1] Includes establishments distributed as follows: Alabama, 2; Connecticut, 1; Delaware, 1; Iowa, 1; Kansas, 1; Maine, 1; Massachusetts, 2; Missouri, 1; Tennessee, 2; Vermont, 1; Virginia, 1; West Virginia, 1; Wisconsin, 1.

TABLE 5.—EXPLOSIVES: SUMMARY BY STATES, 1900—Continued.

	United States.	California.	Illinois.	Indiana.	Michigan.	New Jersey.	New York.	Ohio.	Pennsylvania.	All other states.[1]
Products—Continued.										
Total value—Continued.										
Explosives—Continued.										
Smokeless powder, pounds	2,973,126	1,361,000		68,938		1,477,633		61,555		4,000
Value	$1,655,948	$816,600		$22,936		$765,991		$49,021		$1,400
All other explosives	$850,453	$452,250	$18,761		$37,592	$175,000		$2,400	$16,900	$147,550
Value of all other products	$142,799	$9,265		$2,489		$80,161			$21,762	$29,122
Products consumed:										
Acids—										
Sulphuric, tons	32,366	25,200		3,605		3,561				
Nitric, pounds	14,558,135	3,600,000		1,986,740	586,105	8,385,290				
Mixed, pounds	12,000,000	12,000,000								
Charcoal, bushels	48,285									48,285
Ether, pounds	1,192,704	799,579				393,125				
Nitrate of ammonia, pounds	158,307			81,115	77,192					
Nitroglycerine, pounds	31,661,806	10,895,803		2,254,788	2,547,820	8,877,764	182,000	105,350	2,756,709	4,041,572
Pyroxyline, pounds	1,301,461			4,310		1,297,151				
All other products consumed, pounds	6,230,313	1,715,372				275,617				4,239,324
Comparison of products:										
Number of establishments reporting for both years	80	6	2	5	4	9	5	8	28	13
Value for census year	$16,218,540	$4,236,568	$272,578	$972,498	$603,426	$3,471,183	$332,998	$1,276,489	$2,073,731	$2,979,069
Value for preceding business year	$13,607,449	$3,573,032	$241,768	$774,203	$490,370	$2,553,693	$303,985	$1,144,097	$1,813,112	$2,713,188
Power:										
Number of establishments reporting	93	7	2	6	5	9	5	9	34	16
Total horsepower	22,080	1,279	560	760	271	3,458	1,329	3,979	3,673	6,771
Owned—										
Engines—										
Steam, number	315	20	4	11	11	56	13	34	101	65
Horsepower	13,242	695	560	660	121	2,582	390	2,136	2,803	3,295
Gas or gasoline, number	7	2					2		1	2
Horsepower	72	9					32		15	16
Water wheels, number	190	7			6		33	11	46	87
Horsepower	5,674	200			150		817	602	853	3,052
Electric motors, number	177	18		22		55	6	52		24
Horsepower	2,885	220		100		826	90	1,241		408
Other power, number	4	2				1			1	
Horsepower	97	45				50			2	
Rented—										
Electric, horsepower	110	110								
Furnished to other establishments, horsepower	180							180		
Establishments classified by number of persons employed, not including proprietors and firm members:										
Total number of establishments	97	7	3	6	5	10	5	9	36	16
Under 5	7			1					6	
5 to 20	30	1		2	2	1	1	4	16	3
21 to 50	29	2	1	1	2	2	4	1	10	6
51 to 100	15	1	2	1	1	1		2	4	3
101 to 250	12	2		1		5		2		2
251 to 500	3					1				2
501 to 1,000	1	1								

[1] Includes establishments distributed as follows: Alabama, 2; Connecticut, 1; Delaware, 1; Iowa, 1; Kansas, 1; Maine, 1; Massachusetts, 2; Missouri, 1; Tennessee, 2; Vermont, 1; Virginia, 1; West Virginia, 1; Wisconsin, 1.

TABLE 6.—OIL, ESSENTIAL: SUMMARY BY STATES, 1900.

	United States.	Connecticut.	Indiana.	Michigan.	New York.	Virginia.	All other states.[1]
Number of establishments	70	5	7	22	14	13	9
Character of organization:							
Individual	47	2	7	17	7	7	7
Firm and limited partnership	17	1	....	5	3	6	2
Incorporated company	6	2	....	....	4	....	....
Capital:							
Total	$612,657	$65,500	$18,425	$227,496	$256,885	$13,884	$30,467
Land	$180,331	$11,700	$14,235	$88,246	$52,220	$145	$13,785
Buildings	$130,401	$32,100	$1,020	$57,390	$35,910	$3,120	$861
Machinery, tools, and implements	$78,219	$11,200	$1,950	$25,010	$29,075	$4,719	$6,265
Cash and sundries	$223,706	$10,500	$1,220	$56,850	$139,680	$5,900	$9,556
Proprietors and firm members	73	4	7	28	2	22	10
Salaried officials, clerks, etc.:							
Total number	42	2	....	13	24	2	1
Total salaries	$25,523	$2,000	....	$9,290	$13,318	$519	$396
Officers of corporations—							
Number	7	....	....	....	7	....	....
Salaries	$3,680	....	....	....	$3,680	....	....
General superintendents, managers, clerks, etc.—							
Total number	35	2	....	13	17	2	1
Total salaries	$21,843	$2,000	....	$9,290	$9,638	$519	$396
Men—							
Number	31	2	....	13	13	2	1
Salaries	$21,343	$2,000	....	$9,290	$9,138	$519	$396
Women—							
Number	4	....	....	....	4	....	....
Salaries	$500	....	....	....	$500	....	....
Wage-earners, including pieceworkers, and total wages:							
Greatest number employed at any one time during the year	505	17	80	263	63	60	22
Least number employed at any one time during the year	283	10	76	87	52	48	10
Average number	199	8	13	97	42	29	10
Wages	$69,100	$2,957	$2,903	$28,667	$24,295	$6,819	$3,459
Men, 16 years and over—							
Average number	191	7	13	93	39	29	10
Wages	$67,186	$2,503	$2,903	$28,032	$23,470	$6,819	$3,459
Women, 16 years and over—							
Average number	7	1	....	3	3	....	....
Wages	$1,839	$454	....	$560	$825	....	....
Children, under 16 years—							
Average number	1	....	....	1	....	....	....
Wages	$75	....	....	$75	....	....	....
Miscellaneous expenses:							
Total	$49,762	$2,260	$366	$7,368	$38,411	$691	$666
Rent of works	$2,720	$10	....	$10	$2,427	$183	$90
Taxes, not including internal revenue	$3,240	$235	$152	$1,376	$1,326	$51	$100
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$43,398	$1,615	$214	$5,982	$34,658	$457	$472
Contract work	$404	$400	....	....	....	....	$4
Materials used:							
Total cost	$596,112	$29,208	$2,876	$124,803	$412,832	$21,807	$4,586
Gums	$440	....	....	....	$440	....	....
Wood, for extracts—							
Tons	1,441	692	....	....	....	....	749
Cost	$5,726	$3,003	....	....	....	....	$2,723
Alcohol, grain—							
Gallons	13,258	10,000	....	....	3,248	....	10
Cost	$31,630	$23,850	....	....	$7,756	....	$24
All other components of products	$513,188	....	$2,307	$116,723	$373,894	$19,194	$1,070
Fuel	$16,241	$250	$305	$1,996	$11,929	$1,246	$515
Rent of power and heat	$543	....	....	....	$543	....	....
Mill supplies	$2,481	$78	$9	$1,065	$1,125	$170	$34
All other materials	$21,604	$1,925	$255	$4,519	$13,515	$1,182	$208
Freight	$4,259	$102	....	$500	$3,630	$15	$12
Products:							
Aggregate value	$850,093	$45,530	$14,180	$208,568	$531,000	$37,772	$13,043
Essential oils—							
Total value	$843,731	$45,530	$14,180	$202,258	$531,000	$37,772	$12,991
Natural, pounds	881,829	300	17,683	218,453	517,462	117,721	10,210
Value	$737,032	$480	$14,180	$202,258	$469,351	$37,772	$12,991
Witch-hazel, gallons	110,260	91,000	....	....	19,260	....	....
Value	$54,649	$45,050	....	....	$9,599	....	....
Artificial, value	$52,050	....	....	....	$52,050	....	....
Value of all other products	$6,362	....	....	$6,310	....	....	$52
Comparison of products:							
Number of establishments reporting for both years	56	3	7	21	11	7	7
Value for census year	$805,605	$35,480	$14,180	$206,768	$513,030	$24,643	$11,504
Value for preceding business year	$763,770	$25,000	$16,898	$204,490	$482,830	$23,060	$11,492
Power:							
Number of establishments reporting	52	5	2	17	11	13	4
Total horsepower	1,048	137	8	252	432	193	26
Owned—							
Engines—							
Steam, number	63	4	2	22	18	14	3
Horsepower	980	87	8	252	417	193	23
Gas or gasoline, number	2	....	....	....	1	....	1
Horsepower	5	....	....	....	2	....	3
Water wheels, number	2	2	....	....	....	....	....
Horsepower	50	50	....	....	....	....	....
Rented—							
Electric, horsepower	8	....	....	....	8	....	....
Other kind, horsepower	5	....	....	....	5	....	....

[1] Includes establishments distributed as follows: California, 2; Florida, 1; Massachusetts, 1; North Carolina, 1; Pennsylvania, 2; Wisconsin, 2.

TABLE 6.—ESSENTIAL: SUMMARY BY STATES, 1900—Continued.

	United States.	Connecticut.	Indians.	Michigan.	New York.	Virginia.	All other states.[1]
Establishments classified by number of persons employed, not including proprietors and firm members:							
Total number of establishments	70	5	7	22	14	13	9
No employees	5			1	1		3
Under 5	38	4	2	13	9	7	3
5 to 20	24	1	6	6	3	6	3
21 to 50	2			1	1		
101 to 250	1			1			

[1] Includes establishments distributed as follows: California, 2; Florida, 1; Massachusetts, 1; North Carolina, 1; Pennsylvania, 2; Wisconsin, 2.

		United States.	California.	Connecticut.	Illinois.	Indiana.	Maine.
1	Number of establishments	459	21	3	26	7	5
	Character of organization:						
2	Individual	113	4	....	5	....	3
3	Firm and limited partnership	97	4	....	3	3	....
4	Incorporated company	249	13	3	18	4	2
	Capital:						
5	Total	$89,091,430	$1,844,928	$311,399	$2,384,062	$1,076,390	$550,426
6	Land	$9,924,613	$248,752	$8,850	$449,938	$90,269	$2,335
7	Buildings	$14,447,998	$289,511	$21,000	$299,569	$206,398	$47,396
8	Machinery, tools, and implements	$25,173,778	$651,992	$146,849	$887,849	$478,601	$467,459
9	Cash and sundries	$39,545,041	$654,673	$134,700	$746,706	$301,122	$33,236
10	Proprietors and firm members	242	11	....	13	7	3
	Salaried officials, clerks, etc.:						
11	Total number	2,123	62	12	96	41	7
12	Total salaries	$2,923,033	$70,493	$9,068	$119,028	$53,077	$2,733
	Officers of corporations—						
13	Number	326	19	4	16	5	1
14	Salaries	$741,570	$21,300	$2,800	$30,125	$13,000	$1,000
	General superintendents, managers, clerks, etc.—						
15	Total number	1,797	43	8	80	36	6
16	Total salaries	$2,181,463	$49,193	$6,268	$88,903	$40,077	$1,733
	Men—						
17	Number	1,660	36	7	69	35	6
18	Salaries	$2,115,477	$44,543	$6,060	$84,458	$39,877	$1,733
	Women—						
19	Number	137	7	1	11	1	....
20	Salaries	$65,986	$4,650	$208	$4,445	$200	....
	Wage-earners, including pieceworkers, and total wages:						
21	Greatest number employed at any one time during the year	22,081	628	55	692	353	22
22	Least number employed at any one time during the year	16,603	263	40	505	299	20
23	Average number	19,054	390	45	579	297	12
24	Wages	$9,401,467	$230,395	$31,716	$309,286	$154,173	$4,928
	Men, 16 years and over—						
25	Average number	18,132	387	45	513	294	12
26	Wages	$9,141,804	$228,973	$31,716	$293,006	$153,408	$4,928
	Women, 16 years and over—						
27	Average number	856	3	....	48	2	....
28	Wages	$248,011	$1,422	....	$13,187	$660	....
	Children, under 16 years—						
29	Average number	66	....	....	18	1	....
30	Wages	$11,652	....	....	$3,093	$105	....
	Miscellaneous expenses:						
31	Total	$4,363,868	$89,823	$8,877	$90,293	$74,406	$2,991
32	Rent of works	$153,715	$1,280	$4,000	$11,100	$30	$500
33	Taxes, not including internal revenue	$306,696	$8,089	$608	$7,113	$5,183	$263
34	Rent of offices, insurance, interest, and all sundry expenses, not hitherto included.	$3,870,595	$80,454	$4,269	$72,080	$69,193	$2,228
35	Contract work	$32,862	....	....	....	....	....
	Materials used:						
36	Total cost	$34,564,137	$1,406,425	$105,105	$1,175,571	$487,066	$16,758
37	Gums	$514,627	....	....	$16	....	....
38	Limestone, tons	765,064	1,600	....	9,250	....	....
39	Cost	$660,220	$8,000	....	$1,330	....	....
40	Phosphate rock, tons	9,845	300	....	200	....	....
41	Cost	$66,088	$3,900	....	$500	....	....
42	Pyrites, tons	324,461	6,331	2,597	4,337	18,867	1,000
43	Cost	$1,512,490	$34,658	$13,585	$25,965	$108,789	$5,000
	Wood—						
44	For alcohol, cords	494,447	....	....	....	15,000	....
45	Cost	$1,250,942	....	....	....	$40,000	....
46	For extracts, tons	3,000	3,000	....	....	....	....
47	Cost	$18,000	$18,000	....	....	....	....
	Acids—						
48	Sulphuric, tons	37,832	746	....	6,797	245	....
49	Cost	$429,903	$22,122	....	$66,525	$3,520	....
50	Nitric, pounds	2,439,297	....	....	25,000	....	....
51	Cost	$127,811	....	....	$1,000	....	....
52	Mixed, pounds	550,500	398,500	....	....	....	....
53	Cost	$21,047	$3,186	....	....	....	....
54	Acid phosphate, tons	59	50	....	....	....	....
55	Cost	$4,552	$2,000	....	....	....	....
56	Argols	$2,204,800	$245,000	....	....	....	....
	Ammonia—						
57	Aqua, pounds	415,609,303	89,158,596	....	....	7,000	....
58	Cost	$1,051,703	$12,542	....	....	$350	....
59	Sulphate, pounds	8,745,568	200,000	328	130,268	....	....
60	Cost	$471,117	$4,250	$11	$4,056	....	....
	Alcohol—						
61	Grain, gallons	120,474	....	....	400	....	....
62	Cost	$263,472	....	....	$938	....	....
63	Wood, gallons	3,371,090	....	....	....	....	....
64	Cost	$1,457,854	....	....	....	....	....
65	Bones, tankage, and offal	$543,898	$56,000	....	$62,998	....	....
66	Common salt, tons	38,996	454	17	5,058	8,048	....
67	Cost	$130,108	$1,639	$76	$19,120	$10,494	....
68	Dry colors	$9,868	....	....	....	....	....
69	Glycerine, pounds	17,651,212	....	....	617,195	....	....
70	Cost	$1,402,762	....	....	$57,642	....	....
71	Lead, tons	5,217	....	....	....	....	....
72	Cost	$20,359	....	....	....	....	....
73	Lime, bushels	7,378,408	3,509	....	2,002	18,432	....
74	Cost	$434,367	$700	....	$397	$3,090	....
75	Linseed oil, gallons	13,000	....	....	....	....	....
76	Cost	$7,500	....	....	....	....	....
77	Nitrate of potash, tons	3,353	....	....	....	....	....
78	Cost	$117,499	....	....	....	....	....
79	Nitrate of soda, tons	37,892	3,410	1,070	490	4,222	30
80	Cost	$1,250,520	$104,758	$35,692	$17,668	$148,631	$1,200
81	Potash salts	$725,187	$8,500	....	$1,200	....	$2,289
82	Sulphur, tons	55,296	4,454	1,655	2,265	....	....
83	Cost	$1,080,716	$102,926	$32,104	$46,397	....	....
84	Tallow and fats	$337,317	....	....	....	....	$3
85	Wood ashes, bushels	801,047	....	....	....	25,200	21,960
86	Cost	$39,507	....	....	....	$1,280	$2,044
87	All other components of products	$10,423,149	$406,743	$3,656	$577,112	$90,239	$30

SUMMARY BY STATES, 1900.

Maryland.	Massachusetts.	Michigan.	Missouri.	Nevada.	New Jersey.	New York.	Ohio.	Pennsylvania.	Rhode Island.	Wisconsin.	All other states.[1]	
7	17	51	8	3	61	92	35	100	4	4	15	1
1	2	80	1	...	14	25	13	11	2	...	2	2
1	4	7	...	3	10	18	6	36	1	1	...	3
5	11	14	7	...	37	49	16	53	1	3	13	4
$1,806,272	$1,877,371	$7,503,858	$1,969,875	$48,075	$17,284,675	$22,105,837	$3,670,401	$22,756,656	$340,724	$288,455	$3,272,031	5
$551,000	$65,969	$1,047,560	$181,224	$5,000	$2,114,179	$1,159,611	$397,680	$2,030,346	$18,000	...	$1,553,900	6
$239,182	$348,814	$1,531,264	$294,389	$2,050	$2,797,240	$3,391,799	$518,045	$3,939,376	$42,500	...	$484,965	7
$505,465	$367,912	$3,258,405	$427,586	$7,025	$3,728,737	$5,484,870	$976,144	$6,709,182	$31,300	$154,995	$889,407	8
$510,625	$1,100,176	$1,666,624	$1,066,676	$34,000	$8,644,519	$12,069,557	$1,778,532	$10,077,752	$248,924	$133,460	$343,759	9
3	8	46	1	7	38	23	21	54	3	2	2	10
33	92	143	78	1	402	503	164	415	11	33	30	11
$51,424	$133,091	$215,999	$111,606	$600	$577,337	$718,831	$199,166	$572,846	$12,903	$43,050	$31,781	12
8	15	30	10	...	39	69	22	66	1	6	15	13
$22,650	$42,240	$64,690	$27,237	...	$132,060	$192,584	$32,710	$138,098	$2,600	$2,876	$15,700	14
25	77	113	68	1	363	434	142	349	10	27	15	15
$28,774	$90,851	$151,309	$84,369	$600	$445,277	$526,247	$166,456	$434,748	$10,403	$40,174	$16,081	16
22	66	106	62	1	348	404	126	323	9	27	13	17
$27,284	$86,244	$147,286	$81,032	$600	$438,358	$511,149	$158,424	$423,111	$9,983	$40,174	$15,161	18
3	11	7	6	...	15	30	16	26	1	...	2	19
$1,490	$4,607	$4,023	$3,337	...	$6,919	$15,098	$8,032	$11,637	$420	...	$920	20
584	747	3,409	366	48	3,419	5,332	745	4,551	151	70	909	21
408	529	2,341	336	35	2,541	3,856	551	4,101	76	55	647	22
475	622	2,897	340	20	3,048	4,531	609	4,278	100	64	747	23
$246,454	$338,716	$1,162,634	$162,851	$7,170	$1,575,132	$2,302,999	$340,332	$2,198,243	$43,204	$26,258	$267,476	24
472	580	2,851	277	18	2,755	4,429	583	4,055	85	49	727	25
$245,648	$328,631	$1,155,673	$150,557	$6,680	$1,473,582	$2,269,815	$333,063	$2,136,905	$40,804	$24,569	$263,846	26
3	39	46	37	2	289	102	24	211	15	15	20	27
$806	$9,476	$6,961	$7,152	$490	$100,918	$33,184	$7,000	$69,036	$2,400	$1,689	$3,630	28
...	3	...	26	...	4	...	2	12	...	...	...	29
...	$609	...	$4,642	...	$632	...	$269	$2,302	...	...	...	30
$103,388	$268,236	$503,732	$135,806	$2,086	$638,013	$1,142,851	$157,810	$931,869	$35,995	$57,549	$120,143	31
$4,037	$5,780	$3,085	$7,200	...	$17,337	$64,620	$7,687	$16,881	$4,125	$5,700	$453	32
$8,284	$16,791	$25,674	$16,775	$126	$52,403	$81,947	$16,744	$50,838	$2,866	$834	$12,158	33
$91,067	$240,665	$471,183	$111,831	$1,960	$549,796	$993,784	$132,877	$861,657	$29,004	$51,015	$107,532	34
...	$5,000	$3,790	...	...	$18,477	$2,500	$602	$2,493	...	...	...	35
$781,909	$1,080,826	$2,707,464	$1,335,798	$6,050	$6,994,508	$8,669,561	$2,083,721	$6,805,769	$117,828	$131;421	$658,357	36
...	$93,381	...	...	...	$163,902	$186,388	$1,200	$69,240	$500	...	...	37
...	...	315,690	...	...	...	316,016	100	61,829	...	...	70,579	38
...	...	$274,161	...	...	...	$289,722	$1,000	$49,659	...	...	$36,348	39
3,195	...	3,465	...	...	1,337	1,270	...	78	...	...	...	40
$19,775	...	$16,807	...	...	$12,016	$12,700	...	$390	...	...	...	41
14,107	25,840	5,238	...	...	71,718	48,439	37,421	76,981	4,183	...	7,402	42
$68,731	$104,011	$31,791	...	...	$315,729	$196,847	$181,025	$378,477	$25,470	...	$22,412	43
...	280	82,694	...	...	3,208	108,885	...	280,872	...	...	3,508	44
...	$1,680	$124,830	...	...	$12,364	$271,681	...	$791,417	...	...	$8,970	45
...	...	...	...	...	...	...	...	...	...	...	...	46
...	...	...	...	...	...	...	...	...	...	...	...	47
3,368	2,166	3,463	622	...	10,162	3,017	241	7,005	...	...	...	48
$18,540	$32,473	$38,173	$6,779	...	$115,806	$55,446	$3,359	$67,160	...	...	...	49
...	659,287	...	...	...	1,692,610	15,400	12,000	35,000	...	...	...	50
...	$26,889	...	...	...	$97,496	$656	$20	$1,750	...	...	...	61
...	...	...	...	...	...	...	...	52,000	100,000	...	...	52
...	...	...	...	...	...	...	...	$10,861	$7,000	...	...	53
...	...	...	...	...	...	4	...	5	...	...	...	54
...	...	...	...	...	...	$452	...	$2,100	...	...	...	56
...	...	...	...	...	$1,044,800	$915,000	...	...	...	...	...	66
...	436	29,291,188	41,049,931	...	98,949,132	180,000	43,017,000	105,392,150	...	...	8,563,870	57
...	$26	$488,162	$116,538	...	$52,740	$9,000	$25,810	$197,894	...	...	$148,641	58
200,000	...	...	1,133,931	...	4,299,424	557,753	19,549	1,062,458	14,128	...	1,127,729	59
$6,000	...	...	$136,561	...	$118,332	$143,189	$579	$29,468	$478	...	$28,193	60
...	15	...	36,837	...	36,747	14,250	6,675	24,150	2,400	...	...	61
...	$37	...	$81,841	...	$74,557	$34,628	$12,880	$53,091	$5,500	...	...	62
...	54,271	...	7,250	...	252,622	3,001,916	3,500	51,531	...	...	...	63
...	$43,470	...	$5,700	...	$147,689	$1,226,404	$4,000	$30,591	...	...	...	64
$1,700	...	$414,924	$125	...	...	$7,809	...	$342	...	...	...	65
50	1,568	1,462	509	...	5,989	11,475	5,226	4,020	...	...	120	66
$250	$2,310	$6,014	$2,124	...	$25,980	$30,643	$13,130	$17,968	...	...	$360	67
...	$5,631	...	...	...	$4,237	...	...	...	...	...	...	68
...	...	...	...	...	...	10,000,000	7,033,017	1,000	...	...	...	69
...	...	...	...	...	...	$830,000	$514,970	$150	...	...	...	70
...	27	...	...	...	...	5,181	...	9	...	...	...	71
...	$2,409	...	...	...	...	$16,845	...	$1,105	...	...	...	72
190,000	18,000	134,256	50,474	...	98,664	5,800,194	27,429	1,017,284	6,085	...	12,079	73
$22,000	$7,200	$22,452	$8,095	...	$15,467	$254,246	$4,303	$92,499	$1,826	...	$2,092	74
...	...	...	...	...	...	...	...	13,000	...	...	...	75
...	...	...	...	...	...	...	...	$7,500	...	...	...	76
...	...	...	...	...	...	79	...	3,274	...	...	...	77
...	...	...	...	...	...	$5,446	...	$112,053	...	...	...	78
1,011	2,067	...	58	...	14,666	4,561	5,870	...	113	...	324	79
$36,848	$70,799	...	$2,198	...	$468,808	$148,350	$197,457	...	$3,903	...	$14,208	80
$131,800	$4,858	$67,905	$5,400	...	$234,302	$58,062	$25,149	$185,752	...	...	...	81
937	3,309	...	1,003	...	15,482	12,302	2,460	10,381	937	...	111	82
$21,300	$61,291	...	$22,021	...	$273,429	$254,271	$48,602	$198,064	$18,186	...	$2,125	83
...	...	...	...	...	...	$4,006	$273,314	$60,000	...	...	...	84
...	...	584,617	...	...	...	...	169,270	...	...	...	...	85
...	...	$29,440	...	...	...	...	$6,743	...	...	...	...	86
$290,704	$344,721	$119,986	$849,244	$4,725	$2,808,375	$1,579,708	$547,697	$2,586,378	$39,251	$113,526	$61,054	87

[1] Includes establishments distributed as follows: Arizona, 1; Colorado, 2; Delaware, 1; District of Columbia, 1; Kentucky, 1; Nebraska, 1; New Hampshire, 1; North Carolina, 2; Tennessee, 1; Vermont, 2; Virginia, 1; West Virginia, 1.

		United States.	California.	Connecticut.	Illinois.	Indiana.	Maine.
	Materials used—Continued.						
	Total cost—Continued.						
88	Fuel	$3,539,098	$147,200	$9,164	$81,056	$42,419	$1,635
89	Rent of power and heat	$222,356		$60	$300		$1,055
90	Mill supplies	$212,434	$6,333	$507	$8,860	$1,398	$127
91	All other materials	$2,991,156	$70,256	$10,250	$149,693	$36,176	$810
92	Freight	$1,021,710	$147,712		$52,798	$680	$2,565
	Products:						
93	Aggregate value	$62,676,730	$2,061,470	$290,320	$2,085,625	$1,037,832	$31,638
	Acids—						
94	Total value	$11,853,498	$654,760	$279,804	$407,263	$572,148	$17,542
95	Sulphuric, 50° Baumé, tons	97,858	3,537				402
96	Value	$427,393	$44,091				$3,214
97	Sulphuric, 60° Baumé, tons	16,829	2,369				1,034
98	Value	$242,879	$33,460				$14,328
99	Sulphuric, 66° Baumé, tons	409,547	5,437	9,126	12,450	19,419	
100	Value	$5,508,625	$103,444	$162,815	$224,130	$231,487	
101	Nitric, pounds	28,704,709	3,380,340	1,592,280	508,758	350,748	
102	Value	$1,404,743	$158,293	$79,871	$35,600	$15,530	
103	Mixed, pounds	36,468,819		1,466,044		6,434,418	
104	Value	$1,111,158		$36,600		$240,510	
105	Tartaric, pounds	997,004	90,000				
106	Value	$294,603	$27,000				
107	Acetic, pounds	14,641,673			867,920		
108	Value	$345,951			$11,120		
109	Other acids	$2,518,146	$288,472	$518	$136,413	$84,621	
	Sodas—						
110	Total value	$11,596,915	$666,025	$7,038	$303,771	$299,463	
111	Sal soda, tons	63,231	3,870		5,061	3,487	
112	Value	$779,166	$58,370		$67,489	$34,874	
113	Soda ash, tons	386,361	1,320				
114	Value	$4,768,383	$17,160				
115	Bicarbonate of soda, tons	68,185	225				
116	Value	$1,324,843	$9,000				
117	Caustic soda, tons	78,779	3		2,458		
118	Value	$2,917,955	$125		$221,325		
119	Borax, tons	5,637	5,502				
120	Value	$502,480	$490,330				
121	Other soda products	$1,304,088	$91,040	$7,038	$14,957	$264,589	
122	Potashes, pounds	3,764,806			820,000	135,200	88,290
123	Value	$174,476			$53,349	$6,350	$2,935
124	Alums, pounds	152,520,259			10,130,000		
125	Value	$2,013,607			$95,600		
	Coal-tar products—						
126	Coal-tar distillery products	$809,830	$11,415				
127	Chemicals made from coal-tar distillery products	$512,264	$19,217				
	Cyanides—						
128	Potassium cyanide, pounds	2,291,335					
129	Value	$591,280					
130	Yellow prussiate of potash, pounds	6,140,406					
131	Value	$993,514					
132	Other cyanides	$129					
	Wood distillation—						
	Wood alcohol—						
133	Crude, gallons	4,191,379					
134	Value	$1,660,061					
135	Refined, gallons	3,038,140				100,000	
136	Value	$2,296,898				$65,000	
137	Acetate of lime, tons	43,413				1,000	
138	Value	$981,286				$30,000	
139	Charcoal, bushels	17,154,302				750,000	
140	Value	$726,672				$30,000	
141	All other wood distillates	$9,534					
	Fertilizers—						
	Superphosphates—						
142	From minerals, bones, etc., tons	1,810					
143	Value	$20,417					
144	Complete, tons	17,242	2,000				
145	Value	$339,600	$50,000				
146	All other fertilizers, tons	7,243			1,900		
147	Value	$95,132			$33,145		
	Bleaching materials—						
148	Hypochlorites, tons	2,143			297		
149	Value	$115,608			$38,649		
150	Other bleaching agents	$376,478					
151	Electro-chemical products	$1,305,368					$9,631
	Dyestuffs—						
152	Natural, pounds	513,302					
153	Value	$36,547					
154	Artificial, pounds	3,896,458					
155	Value	$54,948					
	Tanning materials—						
	Natural—						
156	Extracts, pounds	1,062,500	1,050,000		12,500		
157	Value	$32,500	$30,000		$2,500		
158	Artificial, pounds	616,950					
159	Value	$12,639					
	Paints, colors, and varnishes—						
160	Total value	$541,892	$15,750			$490	
	Pigments—						
161	Fine colors, pounds	674,650					
162	Value	$80,958					
163	Iron oxides and other earth colors, pounds	318,360					
164	Value	$6,660					
165	Dry colors, pounds	3,661,403	2,100,000				
166	Value	$57,881	$15,750				
	Paints—						
167	Paints in oil, in paste, pounds	67,467					
168	Value	$1,668					
169	Paints, already mixed for use, gallons	20,755					
170	Value	$6,559					
	Varnishes and japans—						
171	Oil and turpentine varnishes, gallons	3,907					
172	Value	$3,907					

BY STATES, 1900—Continued.

Maryland.	Massachusetts.	Michigan.	Missouri.	Nevada.	New Jersey.	New York.	Ohio.	Pennsylvania.	Rhode Island.	Wisconsin.	All other states.[1]	
$90,013	$94,053	$838,706	$30,990	$475	$375,770	$959,437	$95,643	$563,672	$8,356	$2,687	$197,822	88
$50	$1,118		$1,881		$1,620	$212,997		$1,250	$25		$2,000	89
$33,609	$9,781	$18,287	$1,758	$120	$37,183	$47,847	$10,931	$28,397	$599	$275	$6,422	90
$40,589	$138,993	$157,768	$64,543	$730	$544,202	$858,463	$111,664	$668,400	$3,625	$11,617	$123,487	91
	$35,695	$58,058			$49,704	$59,364	$4,245	$600,141	$3,109	$3,416	$4,223	92
$1,271,410	$2,010,830	$5,364,724	$1,804,090	$20,950	$12,207,289	$15,994,366	$3,576,260	$13,034,384	$292,794	$264,196	$1,338,552	93
$176,569	$900,968		$81,830		$3,353,192	$1,712,961	$1,386,325	$2,038,652	$153,994		$117,490	94
31,643	37,395				8,936	816		15,101	28			95
$176,569	$35,110				$55,136	$11,000		$99,773	$2,500			96
						50		13,356	20			97
						$1,000		$193,799	$292			98
	27,634		2,869		123,236	59,296	40,147	97,590	7,092		5,251	99
	$414,211		$54,500		$1,474,011	$873,911	$527,944	$1,190,530	$148,952		$102,690	100
	3,082,046				12,890,260	4,100,541	1,377,291	1,222,445	20,000		180,000	101
	$86,741				$665,533	$222,740	$72,248	$55,887	$1,500		$10,800	102
					5,081,134	6,392,516	17,094,707					103
					$259,583	$159,800	$414,665					104
						720,000		187,004				105
						$208,000		$59,603				106
			652,673		6,478,443	4,127,162		2,515,575				107
			$10,650		$187,196	$95,470		$41,515				108
	$364,906		$16,680		$711,733	$141,040	$371,468	$397,545	$750		$4,000	109
$39,500	$118,182	$2,826,377	$30,129	$20,950	$170,363	$4,921,144	$122,820	$970,553	$1,800	$174,301	$924,499	110
2,500	232				34	28,095	4,100	12,756		3,096		111
$25,000	$2,900				$410	$357,303	$42,640	$132,990		$57,190		112
		188,165		600		167,552					28,724	113
		$2,158,969		$8,800		$2,066,422					$517,032	114
		10,000				43,812		7,700		23	6,425	115
		$150,000				$885,003		$154,000		$4,761	$122,079	116
		18,000	111		20	40,499		11,754			5,934	117
		$500,000	$8,679		$820	$1,518,464		$460,845			$207,697	118
				135								119
				$12,150								120
$14,500	$115,282	$17,408	$21,450		$169,133	$93,952	$80,180	$222,718	$1,800	$112,350	$77,691	121
		1,869,116					852,200					122
		$77,609					$34,233					123
	18,266,415	1,480,000				46,211,951		76,431,893				124
	$216,754	$39,500				$593,070		$1,068,683				125
	$12,513		$94,400		$227,400	$29,000	$243,000	$178,102			$14,000	126
			$300,000		$3,600	$14,300		$175,147				127
	50,000		24,099		2,210,000			7,236				128
	$13,020		$3,813		$572,400			$2,047				129
700,000			96,024		2,822,556		518,822	2,003,004				130
$120,700			$14,403		$470,490		$86,852	$301,069				131
								$129				132
		116,010				1,056,083		2,848,326			170,960	133
		$32,225				$431,064		$1,183,095			$13,677	134
	29,652	504,196			90,000	2,207,230	3,000	41,902			62,160	135
	$35,973	$319,553			$67,500	$1,762,812	$4,000	$34,600			$7,460	136
		3,396				11,285		27,732				137
		$43,265				$250,211		$657,810				138
	15,000	2,831,120			152,500	2,310,653		11,079,029			16,000	139
	$1,200	$119,063			$10,800	$103,390		$461,259			$960	140
	$1,200				$5,031	$632		$2,302			$369	141
252		1,528			30							142
$2,268		$17,699			$450							143
390		14,753						99				144
$8,000		$279,588						$2,012				145
717		2,727				1,779		120				146
$4,300		$55,321				$955		$1,411				147
		1,782			56			8				148
		$62,387			$12,972			$1,600				149
	$912		$21,196			$340,612	$3,500	$10,258				150
		$193,256				$1,102,481						151
	513,302											152
	$36,547											153
					2,929,808			736,650			230,000	154
					$29,970			$22,678			$2,300	155
												156
												157
						36,000		580,950				158
						$5,400		$7,239				159
$400		$3,881			$230,598	$262,636		$21,137	$5,000		$2,000	160
						674,650						161
						$80,958						162
130,000						144,000		24,360	20,000			163
$400						$5,600		$160	$500			164
					8,127	1,500,000		53,276				165
					$3,845	$38,000		$286				166
								67,467				167
								$1,668				168
								10,755			10,000	169
								$4,559			$2,000	170
					3,907							171
					$3,907							172

[1] Includes establishments distributed as follows: Arizona, 1; Colorado, 2; Delaware, 1; District of Columbia, 1; Kentucky, 1; Nebraska, 1; New Hampshire, 1; North Carolina, 2; Tennessee, 1; Vermont, 2; Virginia, 1; West Virginia, 1.

		United States.	California.	Connecticut.	Illinois.	Indiana.	Maine.
	Products—Continued.						
	Aggregate value—Continued.						
	Paints, colors, and varnishes—Continued.						
	Total value—Continued.						
	Varnishes and japans—Continued.						
173	Alcohol varnishes, gallons	13,401					
174	Value	$37,840					
175	Pyroxyline varnishes, gallons	43,942					
176	Value	$58,186					
177	Liquid dryers, japans and lacquers	$644					
178	All other varnishes, and japans	$287,589				$490	
	Explosives—						
179	Guncotton, or pyroxyline, pounds	98,405					
180	Value	$39,962					
	Plastics—						
181	Pyroxyline plastics	$1,970,387					
182	All other plastics	$129,013					
	Essential oils—						
183	Natural, pounds	725			32		
184	Value	$464			$100		
185	Artificial	$2,410			$10		
	Compressed and liquified gases—						
186	Anhydrous ammonia	$448,157	$20,488				
187	Carbon dioxide	$696,164	$24,000		$180,350		
188	Compressed and liquified gases, not otherwise enumerated	$70,690					
	Fine chemicals—						
189	Total value	$4,220,339			$100,060		
190	Alkaloids, ounces	3,387,622					
191	Value	$1,743,264					
192	Gold salts, ounces	8,594					
193	Value	$90,145					
194	Silver salts, ounces	1,252,604					
195	Value	$499,345					
196	Platinum salts, ounces	7,312					
197	Value	$54,600					
198	Chloroform, pounds	396,540					
199	Value	$98,070					
200	Ether, pounds	263,238					
201	Value	$129,876					
202	Acetone, pounds	1,638,715					
203	Value	$178,666					
204	All other fine chemicals	$1,426,373			$100,060		
	Chemicals, not otherwise specified—						
205	Total value	$5,148,646	$326,000		$169,695		
206	Glycerine, pounds	15,383,798			1,403,506		
207	Value	$2,012,886			$169,695		
208	Cream of tartar, pounds	10,620,000	1,610,000				
209	Value	$2,081,500	$326,000				
210	Epsom salts, pounds	6,072,309					
211	Value	$45,966					
212	Blue vitriol, pounds	7,500,000					
213	Value	$375,000					
214	Copperas, pounds	14,097,905					
215	Value	$58,581					
216	Phosphates of soda, pounds	3,478,350					
217	Value	$104,554					
218	Tin salts, pounds	4,677,471					
219	Value	$470,159					
220	Value of all other products	$12,799,405	$243,815	$3,478	$701,133	$34,381	$1,530
	Products consumed:						
	Acids—						
221	Sulphuric, tons	925,796	1,415	1,210	6,594	10,190	
222	Nitric, pounds	16,953,659		570,139	155,484	6,198,996	
223	Mixed, pounds	8,902,371				148,671	
224	Charcoal, bushels	1,656,790					
225	Ether, pounds	560					
226	Pyroxyline, pounds	662,884					
227	All other products consumed, pounds	484,925,323	1,659,503		1,317,031	428,729	
	Comparison of products:						
228	Number of establishments reporting for both years	394	19	3	23	5	4
229	Value for census year	$58,786,318	$1,697,235	$290,320	$2,061,551	$911,482	$22,007
230	Value for preceding business year	$49,462,554	$1,429,458	$241,880	$1,762,034	$928,123	$15,300
	Power:						
231	Number of establishments reporting	341	18	1	19	5	2
232	Total horsepower	92,381	984	25	1,606	782	1,411
	Owned—						
	Engines—						
233	Steam, number	1,091	31	2	29	15	1
234	Horsepower	69,560	982	25	1,298	562	6
235	Gas or gasoline, number	17	1		2		
236	Horsepower	361	2		80		
237	Water wheels, number	65					2
238	Horsepower	1,915					1,400
239	Electric motors, number	79			5	11	1
240	Horsepower	2,032			145	220	5
241	Other power, number	5					
242	Horsepower	30					
	Rented—						
243	Electric, horsepower	18,231					
244	Other kind, horsepower	252			83		
245	Furnished to other establishments, horsepower	106	40		6		
	Establishments classified by number of persons employed, not including proprietors and firm members:						
246	Total number of establishments	459	21	3	26	7	5
247	No employees	10					2
248	Under 5	90	3	1	3	1	1
249	5 to 20	178	9	1	14	1	2
250	21 to 50	105	5	1	6	3	
251	51 to 100	31	3		2	1	
252	101 to 250	30	1		1	1	
253	251 to 500	8					
254	501 to 1,000	2					
255	Over 1,000	5					

BY STATES, 1900—Continued.

Maryland.	Massachusetts.	Michigan.	Missouri.	Nevada.	New Jersey.	New York.	Ohio.	Pennsylvania.	Rhode Island.	Wisconsin.	All other states.[1]	
					130	10,500		2,771				173
					$520	$31,500		$5,820				174
					43,942							175
					$58,186							176
								$644				177
		$3,881			$164,140	$106,578		$8,000	$4,500			178
					98,405							179
					$39,962							180
	$111,641				$1,858,746							181
	$119,868				$3,750			$5,395				182
								693				183
								$364				184
						$2,400						185
		$2,976	$79,742		$92,375		$47,905	$126,885			$77,786	186
	$500		$62,844		$59,225	$173,962		$112,828		$79,455	$3,000	187
	$13,200					$52,490	$5,000					188
$12,000	$9,390		$234,056		$406,854	$475,498	$1,650	$2,930,831	$50,000			189
					288,672			3,098,850				190
					$98,213			$1,645,051				191
			5,226		803	65		2,500				192
			$53,448		$9,917	$780		$26,000				193
			103,576		173,000	325,121		650,907				194
			$37,719		$63,890	$120,104		$277,632				195
			6,380		932							196
			$46,678		$7,922							197
					334,000	62,540						198
					$66,800	$31,270						199
			116,350		56,000	74,500		16,388				200
			$56,211		$18,650	$46,700		$9,315				201
					63,593	1,455,865		119,257				202
					$6,359	$158,712		$13,595				203
$12,000	$9,390		$40,000		$135,103	$118,932	$1,650	$959,238	$50,000			204
$116,215	$30,191		$2,554		$1,120,977	$2,133,275	$726,211	$491,873			$31,655	205
						8,000,000	5,607,874				372,418	206
						$1,120,000	$691,536				$31,655	207
					4,210,000	4,800,000						208
					$795,500	$960,000						209
1,421,500						20,000		4,630,809				210
$14,215						$1,000		$30,751				211
								7,500,000				212
								$375,000				213
					871,902	67,403	10,158,600	3,000,000				214
					$5,231	$675	$34,675	$18,000				215
3,400,000			78,350									216
$102,000			$2,554									217
	179,587				3,130,678	257,329		1,109,977				218
	$30,191				$320,246	$51,600		$68,122				219
$791,458	$388,771	$1,292,024	$879,123		$3,470,634	$1,626,073	$914,764	$2,226,425	$82,000	$440	$143,356	220
3,750	11,756	10,205	744		33,878	20,165	2,314	822,975			600	221
	855,500		8,074		5,402,401	2,469,682	953,422	339,961				222
	8,734,700				19,000							223
		267,825				294,000		939,500			155,465	224
								560				225
	239,842				423,042							226
	5,215,478	55,817,010	306,576		18,152,321	389,476,640	1,463,080	8,648,455			2,440,500	227
4	17	47	6	3	45	80	28	90	4	2	14	228
$477,927	$2,010,830	$5,063,708	$1,404,687	$20,950	$11,008,452	$15,699,334	$3,537,317	$12,762,467	$292,794	$189,705	$1,335,552	229
$342,366	$1,492,996	$3,967,557	$1,238,897	$20,400	$9,193,571	$13,529,828	$3,032,065	$10,802,657	$272,369	$173,443	$1,019,610	230
5	12	15	8	2	48	82	20	91	1	3	9	231
460	2,169	21,999	344	50	8,362	34,690	1,280	13,112	125	205	4,777	232
17	28	130	10	3	174	324	50	225	4	4	44	233
445	2,144	21,967	317	48	8,028	15,595	1,280	11,903	125	205	4,630	234
				1	1	2		10				235
				2	7	127		143				236
					1	24		38				237
					5	114		396				238
					4	31		20				239
1		6			215	740		670				240
5		32			1						4	241
					5						25	242
			17			18,094					120	243
10	25		10		102	20					2	244
					10	50						245
7	17	51	8	3	61	92	35	100	4	4	15	246
		3			3		2					247
1	8	29	1		11	10	12	6	1		2	248
	3	7	1	2	18	43	15	49	1	2	10	249
2	3	5	4	1	14	23	5	30		2	1	250
1		2			5	8		6	2		1	251
2	2	2	2		7	5	1	6				252
1	1	1			2	2		1				253
								1			1	254
		2			1	1		1				255

[1] Includes establishments distributed as follows: Arizona, 1; Colorado, 2; Delaware, 1; District of Columbia, 1; Kentucky, 1; Nebraska, 1; New Hampshire, 1; North Carolina, 2; Tennessee, 1; Vermont, 2; Virginia, 1; West Virginia, 1.

TABLE 8.—BONE, IVORY, AND LAMPBLACK: SUMMARY BY STATES, 1900.

	United States.[1]
Number of establishments	15
Character of organization:	
Individual	2
Firm and limited partnership	8
Incorporated company	5
Capital:	
Total	$782,247
Land	$149,103
Buildings	$196,422
Machinery, tools, and implements	$300,571
Cash and sundries	$136,151
Proprietors and firm members	17
Salaried officials, clerks, etc.:	
Total number	21
Total salaries	$23,650
Officers of corporations—	
Number	5
Salaries	$6,360
General superintendents, managers, clerks, etc.—	
Total number	16
Total salaries	$17,290
Men—	
Number	15
Salaries	$16,990
Women—	
Number	1
Salaries	$300
Wage-earners, including pieceworkers, and total wages:	
Greatest number employed at any one time during the year	92
Least number employed at any one time during the year	80
Average number	85
Wages	$46,107
Men, 16 years and over—	
Average number	85
Wages	$46,107
Miscellaneous expenses:	
Total	$75,678
Rent of works	$6,625
Miscellaneous expenses—Continued.	
Total—Continued.	
Taxes, not including internal revenue	$2,260
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$65,902
Contract work	$891
Materials used:	
Total cost	$105,712
Components of products	$66,776
Fuel	$2,663
Mill supplies	$1,771
All other materials	$32,126
Freight	$2,376
Products:	
Total value	$359,787
Pigments—	
Lamp and other blacks, pounds	6,454,345
Value	$359,787
Comparison of products:	
Number of establishments reporting for both years	15
Value for census year	$359,787
Value for preceding business year	$250,816
Power:	
Number of establishments reporting	13
Total horsepower	365
Owned—	
Engines—	
Steam, number	18
Horsepower	345
Gas or gasoline, number	1
Horsepower	20
Establishments classified by number of persons employed, not including proprietors and firm members:	
Total number of establishments	15
Under 5	7
5 to 20	7
21 to 50	1

[1] Includes establishments distributed as follows: Pennsylvania, 12; Connecticut, 1; New York, 1; Ohio, 1.

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900.

STATES AND TERRITORIES.	ESTABLISHMENTS: NUMBER, AND CHARACTER OF ORGANIZATION.				CAPITAL.				
	Total number.	Individual.	Firm and limited partnership.	Incorporated company.	Total.	Land.	Buildings.	Machinery, tools, and implements.	Cash and sundries.
United States	1,740	515	405	820	$238,529,641	$22,947,444	$35,270,850	$46,116,451	$134,194,896
Alabama	19	2	9	8	1,514,791	20,118	239,050	212,824	1,042,799
California	53	16	7	30	6,807,440	590,615	1,509,294	1,236,298	3,471,233
Colorado	4			4	392,865	15,700	81,200	148,550	147,415
Connecticut	31	9	6	16	3,254,506	128,772	429,881	790,778	1,905,075
Delaware	15	8	1	6	2,139,856	95,100	238,467	223,814	1,582,475
District of Columbia	8	4	2	2	111,606	22,000	11,800	29,585	48,221
Florida	10	4	1	5	778,319	95,164	139,185	136,298	407,672
Georgia	46	13	11	22	6,764,918	141,762	1,049,304	672,634	4,901,218
Illinois	88	15	9	64	10,245,146	1,359 232	1,141,727	1,715,112	6,029,075
Indiana	42	14	8	20	2,527,306	151,985	480,112	663,238	1,231,971
Iowa	8	2	3	3	621,171	38,442	103,150	84,013	395,566
Kansas	5	2		3	291,278	24,000	74,450	57,648	135,180
Kentucky	18	3	2	13	740,484	50,522	82,975	98,546	508,441
Louisiana	10		2	8	1,439,153	70,394	313,956	215,419	839,384
Maine	13	5	2	6	1,107,261	71,585	76,594	528,459	430,623
Maryland	63	18	21	24	9,148,474	1,282,011	1,241,469	1,702,628	4,922,366
Massachusetts	83	25	21	37	7,887,795	467,045	979,209	1,149,955	5,291,586
Michigan	97	55	14	28	10,684,794	1,286,685	2,048,160	3,565,983	3,783,966
Minnesota	8	1	2	5	371,083	7,829	37,085	50,374	275,795
Mississippi	4	1		3	372,797	20,322	50,000	57,362	245,113
Missouri	39	6	5	28	6,256,327	496,359	742,024	948,877	4,069,067
Nebraska	5			5	945,517	70,500	382,319	111,576	381,122
Nevada	4		4		53,075	5,000	2,050	7,525	38,500
New Jersey	160	41	30	89	34,307,300	3,350,787	5,015,423	5,838,209	20,102,881
New York	285	104	56	125	46,913,165	4,931,561	6,274,907	8,986,573	26,720,124
North Carolina	23	2	9	12	2,878,088	110,269	411,432	228,823	2,127,564
Ohio	137	34	38	65	13,083,173	1,392,119	1,810,967	2,213,587	7,666,500
Oregon	5	2	2	1	176,332	5,000	6,500	21,247	143,585
Pennsylvania	306	89	102	115	43,964,862	4,602,488	6,979,953	11,928,088	20,454,333
Rhode Island	12	5	2	5	1,165,565	58,700	178,583	162,911	765,371
South Carolina	22	2	1	19	10,505,043	109,441	1,642,600	487,117	8,265,885
Tennessee	14	3	3	8	1,258,373	108,947	356,519	177,114	615,793
Texas	7	2	3	2	50,550	700	5,000	26,225	18,625
Vermont	5	2		3	316,422	8,200	34,685	82,132	191,405
Virginia	64	20	22	22	8,158,747	1,706,496	973,308	1,242,299	4,236,644
West Virginia	9	2	2	5	313,292	27,050	48,900	74,049	163,293
Wisconsin	12	3	4	5	817,341	18,000	8,500	208,759	582,082
All other states[1]	6	1	1	4	165,426	6,544	70,112	31,822	56,948

[1] Includes establishments distributed as follows: Arizona, chemicals, 1; New Hampshire, chemicals, 1, Washington, fertilizer, 1; paints, 3.

Table 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	Proprietors and firm members, number.	SALARIED OFFICIALS, CLERKS, ETC.										
		Total.		Officers of corporations.		General superintendents, managers, clerks, etc.						
						Total.		Men.		Women.		
		Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Number.	Salaries.
United States	1,189	8,605	$11,340,385	1,263	$3,160,458	7,342	$8,179,927	6,637	$7,841,490	705	$338,437
Alabama	32	74	69,640	17	24,984	57	44,656	55	43,856	2	800
California	30	199	269,283	42	57,700	157	211,583	144	203,693	13	7,890
Colorado	....	18	20,520	8	8,300	10	12,220	9	11,500	1	720
Connecticut	20	108	164,481	29	68,200	79	96,281	71	93,586	8	2,695
Delaware	10	36	60,194	9	32,450	27	27,744	26	27,264	1	480
District of Columbia	8	9	5,433	1	2,500	8	2,933	8	2,933	....	....
Florida	6	33	31,031	8	9,166	25	21,865	22	20,565	3	1,300
Georgia	42	126	156,188	17	44,025	109	112,163	107	111,203	2	960
Illinois	37	683	912,841	93	227,373	590	685,468	511	645,656	79	39,812
Indiana	34	134	163,763	24	45,272	110	118,491	104	116,611	6	1,880
Iowa	10	34	28,980	1	2,400	33	26,580	27	24,880	6	1,700
Kansas	2	8	9,940	3	3,640	5	6,300	5	6,300	....	....
Kentucky	9	63	61,564	13	20,350	50	41,214	42	38,860	8	2,354
Louisiana	5	43	66,969	13	36,460	30	30,509	29	29,729	1	780
Maine	8	22	28,533	7	16,200	15	12,333	12	9,733	3	2,600
Maryland	64	280	330,116	55	129,622	225	200,494	213	195,673	12	4,821
Massachusetts	64	422	526,540	53	150,463	369	376,077	323	355,610	46	20,467
Michigan	90	431	558,934	55	123,910	376	435,024	322	413,788	54	21,236
Minnesota	8	32	31 878	7	10,258	25	21,620	21	20,160	4	1,460
Mississippi	1	18	20,714	6	6,150	12	14,564	12	14,564	....	....
Missouri	16	334	412,916	50	107,682	284	305,234	262	294,682	22	10,552
Nebraska	....	43	62,156	2	9,000	41	53,156	34	50,120	7	3,036
Nevada	9	1	600	....	....	1	600	1	600	....	....
New Jersey	106	1,226	1,599,059	149	432,682	1,077	1,166,377	999	1,126,193	78	40,184
New York	113	1,619	2,411,586	201	620,554	1,418	1,791,032	1,286	1,727,171	132	63,861
North Carolina	21	51	65,838	11	29,823	40	36,015	40	36,015	....	....
Ohio	112	820	1,036,692	128	293,570	692	743,122	609	701,410	83	41,712
Oregon	6	10	15,080	2	4,800	8	10,280	7	9,800	1	480
Pennsylvania	200	1,260	1,606,571	173	457,626	1,087	1,148,945	987	1,098,245	100	50,700
Rhode Island	8	46	72,941	7	17,000	39	55,941	31	51,277	8	4,664
South Carolina	5	85	164,716	9	35,976	76	128,740	75	128,500	1	240
Tennessee	9	67	84,243	18	45,800	49	38,443	47	37,483	2	960
Texas	10	2	3,900	....	....	2	3,900	2	3,900	....	....
Vermont	2	15	8,468	4	1,600	11	6,868	4	4,360	7	2,508
Virginia	71	153	182,861	29	64,586	124	118,275	121	117,325	3	950
West Virginia	8	10	9,830	5	6,680	5	3,150	5	3,150	....	....
Wisconsin	10	83	78,691	12	10,656	71	68,035	61	62,020	10	6,015
All other states	3	7	6,695	2	3,000	5	3,695	3	3,075	2	620

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	WAGE-EARNERS, INCLUDING PIECEWORKERS.									
	Total.				Men, 16 years and over.		Women, 16 years and over.		Children, under 16 years.	
	Greatest number employed at any one time during the year.	Least number employed at any one time during the year.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.
United States	61,553	37,939	46,765	$21,799,251	44,635	$21,214,066	1,952	$554,423	178	$30,762
Alabama	887	289	460	99,782	456	99,334	4	448	...	...
California	1,973	1,259	1,547	982,378	1,511	967,922	36	14,456	...	...
Colorado	91	54	67	31,430	63	30,200	4	1,230	...	...
Connecticut	869	525	662	356,532	630	347,583	32	8,949	...	...
Delaware	665	304	403	186,005	399	185,391	1	138	3	476
District of Columbia	57	32	27	11,298	27	11,298	...	...	...	...
Florida	283	85	144	49,161	141	48,711	...	...	3	450
Georgia	2,159	654	1,149	304,731	1,140	302,591	1	600	8	1,540
Illinois	2,294	1,602	1,880	987,870	1,679	927,622	180	56,563	21	3,685
Indiana	891	630	651	317,968	614	311,717	36	6,146	1	105
Iowa	183	137	160	71,451	152	70,022	6	1,229	2	200
Kansas	318	135	197	95,644	197	95,644	...	...	...	...
Kentucky	286	129	190	83,324	184	81,824	6	1,500	...	...
Louisiana	456	200	300	97,827	279	93,655	21	4,172	...	...
Maine	187	73	108	38,810	105	37,710	3	1,100	...	...
Maryland	2,699	1,281	1,613	754,907	1,587	748,166	19	5,741	7	1,000
Massachusetts	1,669	1,101	1,337	117,043	1,257	693,670	75	22,531	5	842
Michigan	4,386	2,966	3,626	1,451,730	3,469	1,421,425	145	28,571	12	1,734
Minnesota	77	62	62	27,466	52	24,717	10	2,749	...	...
Mississippi	176	50	98	35,200	98	35,200	...	...	...	...
Missouri	1,315	991	1,143	513,293	1,018	485,588	75	17,915	50	9,790
Nebraska	199	137	174	100,686	163	97,256	11	3,430	...	...
Nevada	50	37	22	8,670	20	8,180	2	490	...	...
New Jersey	7,211	5,069	6,091	3,095,868	5,674	2,963,539	407	130,419	10	1,910
New York	11,180	7,657	8,940	4,691,897	8,615	4,599,067	313	90,455	12	2,375
North Carolina	805	256	441	113,860	440	113,785	...	...	1	75
Ohio	3,035	1,837	2,218	1,112,593	2,085	1,069,151	130	43,053	3	389
Oregon	48	46	46	26,136	43	24,876	3	1,260	...	...
Pennsylvania	8,713	7,287	7,814	3,883,218	7,459	3,787,584	331	91,443	24	4,191
Rhode Island	330	218	258	132,205	242	129,697	16	2,508	...	...
South Carolina	3,066	754	1,772	479,449	1,772	479,449	...	...	...	...
Tennessee	922	310	594	143,619	582	142,019	3	600	9	1,000
Texas	88	26	48	18,376	48	18,376	...	...	...	...
Vermont	121	44	73	28,809	50	22,271	23	6,538	...	...
Virginia	3,452	1,379	2,154	626,159	2,114	620,809	33	4,350	7	1,000
West Virginia	111	103	87	33,469	87	33,469	...	...	...	...
Wisconsin	232	190	165	65,440	140	59,751	25	5,689	...	...
All other states	69	30	44	24,947	43	24,797	1	150	...	...

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	AVERAGE NUMBER OF WAGE-EARNERS, INCLUDING PIECEWORKERS.											
	Men, 16 years and over.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
United States	45,847	47,271	48,974	46,876	48,598	42,520	40,620	42,231	43,880	43,344	45,065	45,384
Alabama	744	786	773	587	351	267	196	184	268	319	407	590
California	1,469	1,453	1,422	1,549	1,387	1,402	1,523	1,559	1,486	1,586	1,678	1,615
Colorado	56	55	56	53	52	52	86	67	68	72	63	67
Connecticut	520	570	617	659	700	676	665	649	683	642	624	546
Delaware	290	304	351	415	407	366	396	521	594	489	373	289
District of Columbia	21	23	31	36	36	23	29	29	30	24	19	19
Florida	182	220	242	142	126	119	115	105	100	94	109	128
Georgia	1,863	1,987	1,947	1,177	630	498	510	527	682	928	1,469	1,563
Illinois	1,648	1,692	1,751	1,753	1,806	1,683	1,600	1,691	1,759	1,583	1,605	1,567
Indiana	542	566	573	649	635	611	716	718	686	571	547	551
Iowa	142	203	140	139	141	154	144	156	153	150	148	141
Kansas	192	199	181	161	149	143	149	184	224	246	282	259
Kentucky	144	150	195	200	182	194	175	204	244	207	163	146
Louisiana	344	410	420	335	267	247	175	174	234	221	263	259
Maine	58	78	86	171	172	119	119	92	114	86	103	63
Maryland	1,396	1,407	1,525	1,677	1,597	1,456	1,526	1,828	2,199	1,631	1,423	1,407
Massachusetts	1,253	1,297	1,339	1,337	1,210	1,189	1,130	1,229	1,246	1,253	1,309	1,286
Michigan	3,435	3,460	3,559	3,777	3,663	3,767	3,236	3,285	3,332	3,250	3,283	3,584
Minnesota	52	57	55	66	58	57	52	48	49	47	48	48
Mississippi	176	176	161	109	67	39	31	41	51	88	111	139
Missouri	962	981	1,011	1,009	1,036	1,058	1,086	1,056	1,071	1,026	990	913
Nebraska	164	144	133	157	141	164	168	174	185	185	174	173
Nevada	30	16	22	19	14	19	18	18	17	36	17	14
New Jersey	5,537	5,528	5,907	6,000	5,764	5,701	5,479	6,711	5,723	6,678	5,578	5,564
New York	8,644	8,821	9,097	9,218	9,069	8,971	7,995	8,076	8,258	8,355	8,395	8,502
North Carolina	557	629	692	619	406	283	282	257	292	416	436	417
Ohio	1,883	1,946	2,116	2,191	2,103	2,028	2,039	2,307	2,374	2,049	1,983	2,011
Oregon	43	43	43	43	43	43	43	45	45	44	43	43
Pennsylvania	7,282	7,315	7,518	7,648	7,664	7,427	7,329	7,408	7,585	7,535	7,397	7,601
Rhode Island	234	236	239	241	234	231	201	261	263	261	247	254
South Carolina	2,876	2,993	2,985	1,537	808	776	744	741	787	1,443	2,766	2,824
Tennessee	675	772	868	656	464	444	331	520	887	614	365	384
Texas	32	29	38	42	35	47	59	81	57	57	50	48
Vermont	72	62	76	33	37	30	35	38	48	52	65	68
Virginia	2,036	2,375	2,500	2,186	1,958	1,982	1,993	2,000	1,930	1,984	2,278	2,149
West Virginia	85	83	84	83	87	88	88	86	87	85	104	83
Wisconsin	164	160	170	173	174	136	119	120	124	97	116	123
All other states	45	45	51	39	36	31	40	41	46	40	54	46

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	AVERAGE NUMBER OF WAGE-EARNERS, INCLUDING PIECEWORKERS—Continued. Women, 16 years and over.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
United States	1,911	2,000	2,066	2,063	2,052	1,986	1,823	1,830	1,876	1,945	1,944	1,927
Alabama	2	2	2	3	3	4	4	5	6	7	7	5
California	36	36	36	37	37	37	37	37	37	36	36	36
Colorado	4	4	4	4	4	4	4	4	4	4	4	4
Connecticut	27	29	32	34	36	27	30	31	37	37	36	27
Delaware	1	1	1	1	1	1	1	1	1	1	1	2
District of Columbia	....	....	....	....	....	....	....	....	....	....	....	....
Florida	....	....	....	....	....	....	....	....	....	....	....	....
Georgia	3	2	2	2	1	1	1	1	1	1	1	1
Illinois	185	193	197	199	188	180	155	155	157	169	176	192
Indiana	29	29	33	37	41	43	44	41	41	40	30	27
Iowa	6	7	7	9	8	14	3	3	3	3	3	3
Kansas	....	....	....	....	....	....	....	....	....	....	....	....
Kentucky	6	6	6	6	6	6	5	5	8	8	8	6
Louisiana	24	32	31	30	19	18	18	15	15	15	14	16
Maine	2	6	6	3	3	2	2	2	2	6	6	2
Maryland	19	19	19	19	20	24	21	20	20	17	16	17
Massachusetts	61	64	70	74	74	71	74	79	85	90	79	75
Michigan	169	175	173	176	151	125	113	103	106	137	152	165
Minnesota	10	11	11	11	11	11	8	7	8	8	11	11
Mississippi	....	....	....	....	....	....	....	....	....	....	....	....
Missouri	73	72	73	72	74	75	82	80	81	79	68	70
Nebraska	11	11	11	11	11	11	11	11	11	11	11	11
Nevada	1	1	2	2	2	2	2	2	2	1	2	1
New Jersey	359	404	392	369	410	441	420	428	435	423	417	395
New York	308	320	336	350	354	323	294	291	303	298	300	288
North Carolina	....	....	....	....	....	....	....	....	....	....	....	....
Ohio	122	131	153	174	157	129	98	105	110	135	117	117
Oregon	3	3	3	3	3	3	3	3	3	3	3	3
Pennsylvania	346	340	350	346	344	338	313	306	308	314	332	338
Rhode Island	18	17	18	17	15	13	1	11	15	16	24	27
South Carolina	....	....	....	....	....	....	....	....	....	....	....	....
Tennessee	2	2	2	3	3	3	3	3	3	3	3	2
Texas	....	....	....	....	....	....	....	....	....	....	....	....
Vermont	28	27	33	12	17	18	20	21	19	23	28	31
Virginia	30	30	35	31	31	36	30	35	30	35	35	35
West Virginia	....	....	....	....	....	....	....	....	....	....	....	....
Wisconsin	26	26	26	26	26	26	26	25	25	25	24	20
All other states	....	....	2	2	2	....	....	....	....	....	....	....

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	AVERAGE NUMBER OF WAGE-EARNERS, INCLUDING PIECEWORKERS—Continued.											
	Children, under 16 years.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
United States	177	180	191	186	178	174	174	183	180	165	166	182
Alabama												
California												
Colorado												
Connecticut												
Delaware	3	3	3	3	3	4	4	4	3	2	2	2
District of Columbia												
Florida	9	8	10	2	2	2	1	1	1	1	1	2
Georgia	13	13	13	13	3	3	3	3	3	3	13	13
Illinois	15	18	18	20	21	21	21	27	24	21	19	31
Indiana							1	2	1	4	2	2
Iowa	2	2	2	2	2	2	2	2	2	2	2	2
Kansas												
Kentucky												
Louisiana												
Maine												
Maryland	7	7	7	7	7	7	7	7	7	7	7	7
Massachusetts	3	3	4	7	3	6	5	6	7	4	4	4
Michigan	12	9	13	12	15	15	14	13	13	8	7	7
Minnesota												
Mississippi												
Missouri	49	54	49	50	47	45	47	54	56	51	45	48
Nebraska												
Nevada												
New Jersey	9	9	11	11	11	11	11	9	9	9	9	9
New York	11	11	13	13	14	12	12	12	11	11	11	11
North Carolina					1	1	1	1	2	2		
Ohio	4	4	3	4	5	4	4	4	2	1	1	1
Oregon												
Pennsylvania	25	25	29	26	25	25	22	21	24	23	26	28
Rhode Island												
South Carolina												
Tennessee	9	9	9	9	9	9	9	9	9	9	9	9
Texas												
Vermont												
Virginia	6	5	7	7	10	7	10	8	6	7	8	6
West Virginia												
Wisconsin												
All other states												

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	MATERIALS USED.												
	Aggregate cost.	Purchased in raw state.											
		Total cost.	Fish.		Gums.	Kainit.		Limestone.		Phosphate rock.		Pyrites.	
			Thousands.	Cost.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.
United States	$124,043,837	$15,702,216	4,589,632	$183,542	$3,817,112	54,700	$520,833	790,456	$717,910	816,290	$3,620,262	633,837	$3,101,075
Alabama	1,428,452	438,888				13,048	132,172			23,940	244,216	9,520	62,500
California	5,502,254	100,360			22,714			1,600	8,000	1,456	16,362	6,331	34,658
Colorado	158,716	15,597			3,597							4,800	12,000
Connecticut	1,615,099	680,308	17,560	25,189	109,668	200	7,500			17	143	2,597	13,585
Delaware	738,041	63,556	200,000	40,000		1,461	15,235	2,106	752	2,062	7,569		
District of Columbia	55,050	1,552				154	1,552						
Florida	341,681	62,290				723	8,640			8,040	32,177	3,177	17,473
Georgia	2,462,109	735,084			6,400	10,205	98,181			120,931	417,037	37,879	213,466
Illinois	7,981,328	542,974			455,359			9,250	1,330	10,480	60,320	4,337	25,965
Indiana	1,513,769	197,661			48,872							18,867	108,789
Iowa	519,376												
Kansas	521,979												
Kentucky	659,350	79,506			49,102					5,625	17,804		
Louisiana	700,380	95,158			640	1,858	17,416	21	54	15,180	64,015	2,457	13,033
Maine	214,666	20,000	5,000	1,500	12,000	150	1,500					1,000	5,000
Maryland	4,726,232	908,867	12,000	16,500	3,204	6,895	58,547			126,757	582,626	55,182	247,990
Massachusetts	4,996,442	563,863			232,861			38	133	18,722	131,734	34,894	147,470
Michigan	5,362,671	714,539			222,950			315,690	274,161	3,465	16,807	5,238	31,791
Minnesota	235,787	2,337			2,337								
Mississippi	349,689	85,800				3,234	35,800			9,000	22,000	4,000	28,000
Missouri	5,496,347	30,848			28,629	40	400			630	1,819		
Nebraska	572,898												
Nevada	9,500												
New Jersey	16,297,390	1,733,693	14,118	9,766	698,672	486	4,382			86,630	409,998	85,782	390,645
New York	24,756,424	2,942,580			1,344,871	1,263	15,075	324,919	316,745	22,104	155,401	54,379	227,458
North Carolina	1,057,430	287,849	4,215,500	18,668		967	9,587	1,815	2,400	38,858	160,554	16,684	88,818
Ohio	8,006,959	568,408	700	2,800	234,901	2,530	21,360	175	1,150	28,515	114,172	42,421	194,025
Oregon	163,143	5,480			5,480								
Pennsylvania	18,230,605	2,462,198			317,180	1,265	11,479	62,429	74,109	33,491	200,710	97,579	500,777
Rhode Island	631,859	118,105			5,450			168	728			4,183	25,470
South Carolina	3,107,710	1,026,097				9,114	71,226			141,464	555,861	83,272	399,010
Tennessee	1,054,022	284,770								36,431	118,067	20,668	155,428
Texas	64,524	9,261	15,000	9,169						10	92		
Vermont	320,287	1,200											
Virginia	3,055,220	803,350	104,754	57,451	12,000	1,107	10,781	72,245	38,348	82,482	290,778	35,988	147,312
West Virginia	205,200	106,900											
Wisconsin	862,991	225			225								
All other states	68,257	12,912	5,000	2,500								2,602	10,412

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	MATERIALS USED—Continued.													
	Purchased in raw state—Continued.				Purchased in partially manufactured form.									
	Wood.				Total cost.	Acids.						Acid phosphate.		Argols.
	For alcohol.		For extracts.			Sulphuric.		Nitric.		Mixed.				
	Cords.	Cost.	Tons.	Cost.		Tons.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Tons.	Cost.	Cost.
United States	495,073	$1,255,794	261,384	$2,485,688	$87,323,152	280,028	$1,946,742	3,131,894	$154,144	69,566,011	$1,560,133	287,147	$2,182,316	$2,204,800
Alabama					702,434	500	5,000			433,266	11,844	58,385	169,820	
California			3,172	18,626	4,283,386	2,961	56,418	319,987	13,359	12,498,500	151,904	1,550	27,000	245,000
Colorado					110,743									
Connecticut			18,801	524,223	659,230	231	1,736					3,226	28,248	
Delaware					525,778	1,972	11,824					21,262	154,292	
District of Columbia					47,555							1,550	14,500	
Florida			3,300	4,000	234,591	300	1,800					5,547	48,447	
Georgia					1,334,190	24,202	133,207					30,305	276,183	
Illinois					6,383,225	16,077	147,993	25,000	1,000			5,366	48,352	
Indiana	15,000	40,000			1,082,731	2,570	44,515			3,020,000	86,449	1,105	12,180	
Iowa					406,239									
Kansas					444,986	3,000	34,440					750	7,110	
Kentucky			600	12,600	514,155	4,314	32,187					1,910	20,700	
Louisiana					522,265							17,419	154,627	
Maine					150,946							330	4,500	
Maryland					3,088,179	28,119	164,658					29,571	237,541	
Massachusetts	880	6,480	4,477	45,185	3,753,550	4,138	54,103	774,930	31,416			6,553	62,368	
Michigan	82,694	124,830	15,450	44,000	2,994,372	3,869	47,921			6,694,964	189,276			
Minnesota					208,681									
Mississippi					204,564	500	5,000					7,892	67,178	
Missouri					4,993,443	1,054	9,714			5,966,091	251,600	175	1,748	
Nebraska					487,039									
Nevada					7,805									
New Jersey	3,208	12,364	12,326	207,867	12,198,674	75,317	436,625	1,692,610	97,496	21,526,726	380,970	12,551	119,061	1,044,800
New York	108,885	271,681	34,734	611,349	17,479,548	21,064	172,641	15,400	656	2,183,744	39,986	18,127	155,137	915,000
North Carolina	3,134	7,822			605,982	3,402	19,051					10,256	87,276	
Ohio					6,409,486	21,576	147,333	26,000	802	6,208,183	164,207	8,774	82,519	
Oregon					137,533									
Pennsylvania	280,872	791,417	74,899	566,526	12,193,055	42,836	283,697	193,600	6,641	9,926,537	249,454	15,795	141,167	
Rhode Island			3,277	86,457	421,950	554	2,853			100,000	7,000	200	1,696	
South Carolina					1,699,892	4,459	24,632					12,702	121,141	
Tennessee			6,433	11,276	487,503	310	2,412					1,200	9,000	
Texas					45,139	92	576							
Vermont	400	1,200			300,792									
Virginia			48,215	246,680	1,378,984	16,498	104,936	34,000	1,540			14,646	130,525	
West Virginia			35,700	106,900	66,062	113	1,470	50,367	1,234	1,008,000	27,443			
Wisconsin					723,801									
All other states					34,664									

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	MATERIALS USED—Continued.										
	Purchased in partially manufactured form—Continued.										
	Ammonia.				Alcohol.				Bones, tankage, and offal.	Common salt.	
	Aqua.		Sulphate.		Grain.		Wood.				
	Pounds.	Cost.	Pounds.	Cost.	Gallons.	Cost.	Gallons.	Cost.	Cost.	Tons.	Cost.
United States	417,488,626	$1,137,307	16,985,013	$657,726	331,207	$510,375	3,692,803	$1,751,345	$10,313,661	42,189	$142,398
Alabama									340,611		
California	89,158,596	12,542	2,502,000	64,959	8,652	19,500	2,773	3,766	232,955	454	1,639
Colorado	90,000	4,050			185	416	185	162		120	360
Connecticut			328	11	10,100	24,070	690	1,400	88,514	17	76
Delaware	1,492,366	60,277	1,127,729	28,193					51,708		
District of Columbia	3,258,864	2,444							24,123		
Florida			500,000	15,000	10	24			96,926	6	48
Georgia			30,000	900					534,781	40	100
Illinois			1,130,268	35,056	3,310	6,483	100,916	84,170	603,783	5,058	19,120
Indiana	127,703	3,788			601	1,396	591	591	123,705	3,048	10,494
Iowa									1,000	1	60
Kansas									296,496		
Kentucky									56,059		
Louisiana					53	103			215,218	140	560
Maine							1,965	2,161	5,580		
Maryland			478,521	13,939					1,160,985	190	950
Massachusetts	1,227,436	73,646	200,000	5,600	1,095	2,641	56,071	45,320	402,020	1,580	2,382
Michigan	29,431,188	490,162			9,434	21,698	200	200	415,154	1,462	6,014
Minnesota											
Mississippi									93,046		
Missouri	41,049,931	116,538	1,133,931	136,561	36,937	82,086	14,149	9,812	64,815	509	2,124
Nebraska									15,770		
Nevada											
New Jersey	99,289,132	56,140	5,025,724	138,678	160,624	127,156	311,229	204,658	1,104,361	6,547	28,677
New York	180,000	9,000	580,377	164,504	52,425	122,964	3,111,592	1,330,284	596,733	13,713	38,361
North Carolina			50,000	1,600					354,015		
Ohio	43,017,000	25,810	19,549	579	6,745	15,314	12,360	16,403	344,183	5,234	13,180
Oregon					300	696	217	184	1,893		
Pennsylvania	105,440,790	200,337	1,062,458	29,468	38,336	80,328	75,765	47,359	1,096,756	4,060	18,168
Rhode Island			2,414,128	1,078	2,400	5,500	1,600	2,800	204,401		
South Carolina									1,061,977		
Tennessee	1,964,640	2,400							141,576		
Texas									25,875		
Vermont	360	22									
Virginia	536,620	64,851	730,000	21,900					558,642	10	85
West Virginia	1,224,000	15,300									
Wisconsin							2,500	2,075			
All other states											

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	MATERIALS USED—Continued.													
	Purchased in partially manufactured form—Continued.													
	Cotton seed and meal.	Dry colors.	Glycerine.		Lead.		Lime.		Linseed oil.		Nitrate of potash.		Nitrate of soda.	
	Cost.	Cost.	Pounds.	Cost.	Tons.	Cost.	Bushels.	Cost.	Gallons.	Cost.	Tons.	Cost.	Tons.	Cost.
United States	$167,410	$9,476,333	34,635,822	$3,419,406	104,401	$8,618,097	7,428,885	$442,252	16,157,117	$7,495,196	6,084	$300,199	147,020	$4,899,622
Alabama	80,218		63,119	8,058									490	19,236
California		130,476	5,765,997	681,840	1,908	152,650	3,509	700	205,784	118,083			26,912	837,022
Colorado		33,367					1,318	224	75,042	37,521			180	6,300
Connecticut		23,666							71,496	34,963			2,577	91,099
Delaware		11,096					7,080	1,213	10,400	4,660			2,616	78,331
District of Columbia		245					1,190	203	800	600			15	675
Florida													269	9,619
Georgia	78,192	48,943							49,551	29,997			1,333	50,035
Illinois		1,772,237	617,195	57,642	11,866	991,042	4,459	546	2,121,711	935,511	257	19,826	3,172	106,444
Indiana		71,819	1,407,659	157,945			18,432	3,090	142,264	59,815			8,957	313,198
Iowa		84,170							182,856	73,947			4,795	150,101
Kansas		445							3,600	1,400			1,759	68,253
Kentucky		106,826					1,854	315	268,625	120,857			89	4,600
Louisiana	9,000	25,338					557	160	66,604	33,302			46	1,702
Maine		37,054							30,168	15,729	95	6,000	1,468	44,700
Maryland		88,474					190,000	22,000	112,376	54,943			3,669	132,450
Massachusetts		784,389			3,641	327,718	27,283	10,708	489,339	219,896	492	38,511	5,187	182,975
Michigan		431,054	1,152,501	142,873			134,256	22,452	913,022	417,099			2,203	76,342
Minnesota		75,449							164,519	80,159				
Mississippi		3,500							6,000	3,600			150	5,400
Missouri		684,637	1,787,311	199,741	15,447	1,332,088	50,474	8,095	1,201,716	526,632			2,530	90,263
Nebraska		92,510			2,901	242,666			213,779	102,773				
Nevada									1,800	1,080				
New Jersey		488,219	3,866,604	434,101	3,000	275,500	98,664	15,467	844,341	399,581	28	2,780	31,276	1,026,282
New York		2,252,254	10,073,575	839,197	29,389	2,152,933	5,805,537	255,271	4,199,414	1,970,463	633	54,453	7,663	254,274
North Carolina		1,180							750	300			745	28,609
Ohio		911,684	7,849,186	624,274	9,831	817,413	27,979	4,413	1,806,071	909,189	384	31,342	14,585	486,636
Oregon		37,271							95,452	45,218				
Pennsylvania		847,617	1,914,237	258,507	26,418	2,326,087	1,045,814	94,299	2,235,619	993,028	3,318	115,407	16,599	557,481
Rhode Island		51,812					6,085	1,826	34,338	15,182			229	7,524
South Carolina													2,169	82,569
Tennessee		47,902							48,093	24,047			2,550	88,098
Texas		11,434							11,822	5,811				
Vermont		6,378					3,425	1,086						
Virginia		46,649					357	62	27,737	13,868	877	31,880	1,786	65,246
West Virginia			138,438	15,228			612	122						
Wisconsin		256,949							493,575	236,945			857	26,250
All other states		11,279							28,553	9,097			144	7,903

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	MATERIALS USED—continued.											
	Purchased in partially manufactured form—Continued.							Fuel.	Rent of power and heat.	Mill supplies.	All other materials.	Freight.
	Potash salts.	Sulphur.		Tallow and fats.	Wood ashes.		All other components of products.					
	Cost.	Tons.	Cost.	Cost.	Bushels.	Cost.	Cost.	Cost.	Cost.	Cost.	Cost.	Cost.
United States	$3,891,818	83,530	$1,724,857	$380,517	801,047	$39,507	$23,906,991	$5,515,636	$297,568	$779,814	$11,281,479	$3,143,972
Alabama	31,270	827	18,690				17,687	20,284	1,032	10,886	136,102	118,826
California	106,984	10,199	235,383				1,191,206	275,557	9,302	63,481	484,502	285,666
Colorado							28,343	5,980	780	950	12,802	11,864
Connecticut	27,725	1,997	43,487				294,235	95,995	160	60,557	80,751	38,098
Delaware	62,906	516	10,937				50,341	13,364	262	4,854	87,978	42,249
District of Columbia	3,530						1,335	2,056	260	255	2,379	993
Florida	54,300						8,427	9,749	360	2,488	23,866	8,337
Georgia	136,905	350	8,750				36,197	53,185	460	11,706	200,007	127,477
Illinois	81,075	2,588	53,401				1,419,544	200,325	11,306	22,814	718,979	101,705
Indiana	1,628	198	6,773		25,200	1,280	184,065	65,565	51	4,296	133,908	29,557
Iowa		694	13,198				83,763	22,552		1,652	58,292	30,641
Kansas	17,647	281	9,218				9,977	21,643	13,500	3,767	38,083	
Kentucky	5,400						167,211	8,647	1,101	2,305	43,543	10,095
Louisiana	15,644	2,627	51,527				15,084	20,072	14	4,017	56,846	2,008
Maine	4,769	250	5,000	3	21,960	2,044	23,406	4,468	1,055	3,368	27,048	7,781
Maryland	568,019	7,214	162,581				481,639	153,866	350	67,366	377,230	130,374
Massachusetts	235,613	3,358	63,010				1,211,334	150,780	4,938	21,252	426,915	75,144
Michigan	67,905	51	1,002		584,617	29,440	635,780	863,430	813	27,785	544,325	217,407
Minnesota							53,073	3,726	1,020	596	14,808	4,619
Mississippi	18,560						8,280	3,375		5,150	34,200	16,600
Missouri	6,740	1,003	22,021				1,448,228	81,316	5,801	10,915	366,864	7,160
Nebraska							33,320	22,414		2,055	48,372	13,018
Nevada							6,725	535		130	1,030	
New Jersey	781,154	17,010	311,325				4,725,743	587,230	4,553	89,474	1,378,452	305,314
New York	337,931	14,986	307,581	9,700			5,500,215	1,355,502	228,897	146,813	2,509,999	93,085
North Carolina	105,866						8,185	23,703	600	13,683	89,827	35,786
Ohio	61,682	3,816	81,875	274,314	169,270	6,743	1,389,591	184,879	1,917	46,368	651,345	144,556
Oregon	1,900						50,371	820	820	250	11,790	6,450
Pennsylvania	517,046	13,956	282,929	96,500			3,950,779	826,449	2,758	115,856	1,858,441	771,848
Rhode Island	9,950	937	18,186				92,142	29,692	965	2,428	41,786	16,933
South Carolina	310,118						99,455	88,786		5,909	223,276	63,750
Tennessee	114,224	419	12,164				45,680	34,279		4,975	118,248	124,247
Texas							1,443	1,822	72	355	6,500	1,375
Vermont							293,306	3,632		1,425	12,622	616
Virginia	205,327						133,473	252,736	1,423	13,848	315,673	289,206
West Virginia							5,265	9,528	578	1,702	20,401	29
Wisconsin		142	3,694				197,888	11,136		3,803	116,179	7,847
All other states		111	2,125				4,255	6,558	2,420	280	8,110	3,313

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS CONSUMED.											
	Acids.			Acid phosphate (tons).	Charcoal (bushels).	Ether (pounds).	Lead oxides (pounds).	Nitrate of ammonia (pounds).	Nitroglycerine (pounds).	Pyroxyline (pounds).	White lead (pounds).	All other products consumed (pounds).
	Sulphuric (tons).	Nitric (pounds).	Mixed (pounds).									
United States	1,557,134	32,123,221	20,902,371	88,964	1,719,675	1,193,264	374,061	158,307	31,661,806	1,964,345	24,922,647	545,121,097
Alabama	22,020								135,324			18,230,512
California	27,153	3,600,000	12,000,000			799,579			10,895,803		162,000	3,374,875
Colorado	600											
Connecticut	1,210	570,139			16,798							21,000
Delaware					29,200							2,647,281
District of Columbia												
Florida	7,065											380,000
Georgia	78,655											
Illinois	6,594	155,484										1,317,031
Indiana	13,795	8,185,736	148,671					81,115	2,254,788	4,310		428,729
Iowa												1,426,207
Kansas												
Kentucky												
Louisiana	17,718			3,025								
Maine												
Maryland	98,240											5,823,200
Massachusetts	45,305	855,500	8,734,700							239,842		5,215,478
Michigan	10,205	586,105			267,825			77,192	2,547,820			55,817,010
Minnesota												
Mississippi	9,000			9,000								
Missouri	744	8,074							3,906,248			306,576
Nebraska											7,251,300	
Nevada												
New Jersey	62,775	13,787,691	19,000	17,527		393,125			8,877,764	1,720,193		21,079,070
New York	34,123	2,469,682			294,000				182,000			399,834,890
North Carolina	33,047			5,545	155,400							1,003,283
Ohio	10,314	953,422		13,050					105,350			1,463,080
Oregon												
Pennsylvania	835,157	951,388		35,746	939,500	560	374,061		2,756,709		17,509,347	24,312,375
Rhode Island												
South Carolina	138,973											
Tennessee	35,495			5,071	16,887							40,500
Texas												
Vermont					65							
Virginia	68,946											2,400,000
West Virginia												
Wisconsin												
All other states												

Table 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	MISCELLANEOUS EXPENSES.					PRODUCTS.							
							Group 1.—Acids.						
								Sulphuric.					
								50° Baumé.		60° Baumé.		66° Baumé.	
	Total.	Rent of works.	Taxes.	Rent of offices, interest, etc.	Contract work.	Aggregate value.	Total value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
United States	$14,825,112	$625,891	$973,585	$12,963,054	$262,582	$202,582,396	$12,757,012	187,879	$1,016,861	18,217	$256,557	416,017	$5,641,823
Alabama	97,677	1,100	22,969	72,850	758	2,123,102	25,000	2,934	25,000				
California	386,899	10,770	21,846	354,166	117	8,279,243	667,440	3,537	44,091	2,369	33,460	6,071	116,124
Colorado	28,649	1,370	3,749	23,530		299,954	74,800					3,000	60,000
Connecticut	175,944	5,160	10,439	159,945	400	2,544,714	279,804					9,126	162,815
Delaware	112,986	250	4,678	108,058		1,356,416							
District of Columbia	3,521	1,560	138	1,823		88,137							
Florida	34,890	1,545	2,397	30,948		533,789	833	90	623				
Georgia	416,841	6,981	37,534	372,201	125	3,549,632	5,436	856	5,436				
Illinois	743,905	58,636	43,353	640,096	1,820	12,422,227	407,263					12,450	224,130
Indiana	155,204	5,536	11,662	134,506	3,500	2,686,427	574,962					19,419	231,487
Iowa	49,311	20	3,402	45,889		696,022							
Kansas	59,144	280	2,644	56,220		733,818							
Kentucky	29,676	4,180	4,894	20,602		1,054,008							
Louisiana	123,352	265	1,961	121,126		1,049,653	25,910			149	5,960	208	8,736
Maine	17,431	500	3,229	13,702		389,631	17,542	402	3,214	1,034	14,328		
Maryland	483,898	45,030	44,884	393,984		7,260,580	294,754	51,555	294,754				
Massachusetts	649,776	37,658	51,604	555,514	5,000	8,088,698	900,968	37,395	35,110			27,634	414,211
Michigan	1,015,881	8,979	46,059	952,853	7,990	9,757,084							
Minnesota	64,650	7,415	843	54,192	2,200	403,101							
Mississippi	40,866		6,647	34,219		505,972							
Missouri	374,174	30,149	34,711	304,662	4,652	7,588,090	81,830					2,869	54,500
Nebraska	74,315	480	2,845	70,990		954,840							
Nevada	2,382	96	176	2,110		27,225							
New Jersey	1,604,323	48,320	107,506	1,415,215	33,282	26,763,856	3,452,871	9,123	60,564			123,236	1,474,011
New York	2,992,743	197,888	203,297	2,583,408	8,150	40,998,911	1,740,102	1,426	15,050	84	1,488	60,871	896,514
North Carolina	109,043	39	17,810	91,180	14	1,523,030							
Ohio	1,165,268	40,027	70,327	993,412	61,502	13,307,431	1,386,325					40,147	527,944
Oregon	8,313	2,940	794	4,579		239,359							
Pennsylvania	2,309,431	72,249	106,215	2,007,652	123,315	32,154,223	2,389,861	39,188	303,122	13,356	193,799	101,643	1,279,709
Rhode Island	104,859	8,319	5,116	83,636	7,788	1,127,329	153,994	28	2,500	20	292	7,092	148,952
South Carolina	675,589	1,050	53,200	621,339		4,882,506	225,698	41,036	225,698				
Tennessee	143,653	996	3,942	138,715		1,917,985							
Texas	4,089	1,540	215	2,334		125,170							
Vermont	39,591	265	200	39,126		408,737							
Virginia	421,586	12,325	37,871	369,579	1,811	5,059,465	8,929	309	1,699	1,205	7,230		
West Virginia	15,990	410	870	14,552	158	334,003							
Wisconsin	84,591	11,100	3,117	70,374		1,230,838							
All other states	4,671	463	441	3,767		117,190	42,690					2,251	42,690

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.													
	Group I.—Acids—Continued.									Group II.—Sodas.				
	Nitric.		Mixed.		Tartaric.		Acetic.		Other.	Total value.	Sal soda.		Soda ash.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Value.		Tons.	Value.	Tons.	Value.
United States	30,961,501	$1,454,909	36,468,819	$1,111,158	997,004	$294,603	16,356,680	$376,520	$2,604,581	$11,638,051	63,249	$779,443	386,361	$4,768,383
Alabama														
California	3,380,340	158,293			90,000	27,000			288,472	666,025	3,870	58,370	1,320	17,160
Colorado	180,000	10,800							4,000	3,500				
Connecticut	1,592,280	79,871	1,466,044	36,600					518	7,038				
Delaware														
District of Columbia														
Florida									210					
Georgia														
Illinois	508,758	35,600					867,920	11,120	136,413	303,771	6,061	67,489		
Indiana	491,454	18,344	6,434,418	240,610					84,621	299,463	3,487	34,874		
Iowa														
Kansas														
Kentucky														
Louisiana									11,214	840				
Maine														
Maryland										39,905	2,500	25,000		
Massachusetts	3,082,046	86,741							364,906	118,182	232	2,900		
Michigan										2,826,377			188,165	2,158,969
Minnesota														
Mississippi														
Missouri							652,573	10,650	16,680	30,129				
Nebraska														
Nevada										20,950			600	8,800
New Jersey	14,256,680	684,773	5,081,134	259,583			6,478,443	187,196	786,744	170,640	52	687		
New York	4,100,541	222,740	6,392,516	159,800	720,000	208,000	4,127,162	95,470	141,040	4,921,144	28,095	357,303	167,552	2,066,422
North Carolina														
Ohio	1,377,291	72,248	17,094,707	414,665					371,468	122,820	4,100	42,640		
Oregon														
Pennsylvania	1,972,111	83,999			187,004	59,603	4,230,582	72,084	397,545	1,010,167	12,756	132,990		
Rhode Island	20,000	1,500							750	1,800				
South Carolina														
Tennessee														
Texas														
Vermont														
Virginia										920,999			28,724	517,032
West Virginia														
Wisconsin										174,301	3,096	57,190		
All other states														

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.													
	Group II.—Sodas—Continued.							Group III.—Potashes.		Group IV.—Alums.		Group V.—Coal-tar products.		
	Bicarbonate of soda.		Caustic soda.		Borax.		Other soda products.	Pounds.	Value.	Pounds.	Value.	Total value.	Coal-tar distillery products.	Chemicals made from coal-tar distillery products.
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Value.						Value.	Value.
United States	68,185	$1,324,843	78,779	$2,917,955	5,637	$502,480	$1,344,947	3,764,806	$174,476	179,465,871	$2,446,576	$1,338,810	$826,546	$512,264
Alabama														
California	225	9,000	3	125	5,502	490,330	91,040					30,632	11,415	19,217
Colorado							3,500							
Connecticut							7,038							
Delaware														
District of Columbia														
Florida														
Georgia														
Illinois			2,458	221,325			14,957	820,000	53,349	10,130,000	95,600			
Indiana							264,589	135,200	6,350					
Iowa														
Kansas														
Kentucky														
Louisiana							840							
Maine								88,290	2,935					
Maryland							14,905							
Massachusetts							115,282			19,766,415	306,754	27,513	27,513	
Michigan	10,000	150,000	18,000	500,000			17,408	1,869,116	77,609	1,480,000	39,500			
Minnesota														
Mississippi														
Missouri			111	8,679			21,450					394,400	94,400	300,000
Nebraska														
Nevada					135	12,150								
New Jersey			20	820			169,133					231,000	227,400	3,600
New York	43,812	885,003	40,499	1,518,464			93,952			46,211,951	593,070	44,016	29,716	14,300
North Carolina														
Ohio							80,180	852,200	34,233			243,000	243,000	
Oregon														
Pennsylvania	7,700	154,000	11,754	460,845			262,332			101,877,505	1,411,652	354,249	179,102	175,147
Rhode Island							1,800							
South Carolina														
Tennessee												14,000	14,000	
Texas														
Vermont														
Virginia	6,425	122,079	5,934	207,697			74,191							
West Virginia														
Wisconsin	23	4,761					112,350							
All other states														

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.												
	Group VI.—Cyanides.						Group VII.—Wood distillation.						
	Total value.	Potassium cyanide.		Yellow prussiate of potash.		Other cyanides.	Total value.	Wood alcohol.				Acetate of lime.	
								Crude.		Refined.			
		Pounds.	Value.	Pounds.	Value.	Value.		Gallons.	Value.	Gallons.	Value.	Tons.	Value.
United States	$1,595,505	2,317,280	$601,362	6,165,406	$994,014	$129	$5,675,616	4,191,379	$1,660,061	3,038,218	$2,297,008	43,413	$981,286
Alabama													
California													
Colorado													
Connecticut													
Delaware													
District of Columbia													
Florida													
Georgia													
Illinois													
Indiana							125,000			100,000	65,000	1,000	30,000
Iowa													
Kansas													
Kentucky													
Louisiana													
Maine	120,700			700,000	120,700								
Maryland	13,020	50,000	13,020										
Massachusetts							38,607			29,652	35,973		
Michigan							514,106	116,010	32,225	504,196	319,553	3,396	43,265
Minnesota													
Mississippi	18,216	24,099	3,813	96,024	14,403								
Missouri													
Nebraska													
Nevada	1,053,472	2,235,945	582,482	2,847,556	470,990								
New Jersey							83,331			90,000	67,500		
New York							2,548,109	1,056,083	431,064	2,207,230	1,762,812	11,285	250,211
North Carolina	86,852			518,822	86,852		22,437	170,960	13,677	62,238	7,570		
Ohio							4,000			3,000	4,000		
Oregon	303,245	7,236	2,047	2,003,004	301,069	129							
Pennsylvania							2,339,066	2,848,326	1,183,095	41,902	34,600	27,732	657,810
Rhode Island													
South Carolina													
Tennessee													
Texas													
Vermont							960						
Virginia													
West Virginia													
Wisconsin													
All other states													

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.											
	Group VII—Continued.			Group VIII—Fertilizers.								
	Charcoal.		All other products in this group.	Total value.	Superphosphates.				Complete.		All other.	
					From minerals, bones, etc.		Ammoniated.					
	Bushels.	Value.	Value.		Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
United States	17,155,440	$726,809	$10,452	$40,914,685	925,008	$8,492,360	142,898	$2,349,388	1,454,389	$25,796,143	299,910	$4,276,794
Alabama				1,942,708	38,246	369,587	2,000	35,000	92,253	1,433,355	6,670	104,766
California				636,687					19,570	591,187	2,561	45,500
Colorado												
Connecticut				313,610			1,000	23,000	7,325	205,931	2,752	84,679
Delaware				634,213	2,385	28,250			17,180	283,873	30,377	322,090
District of Columbia				71,480					3,160	64,800	449	6,680
Florida				496,642	9,394	93,940			15,435	377,535	1,315	25,167
Georgia				3,240,304	131,503	1,075,581	14,603	229,271	101,219	1,563,653	26,605	371,799
Illinois				1,754,905	26,108	313,850	4,150	58,100	43,483	835,335	25,333	547,620
Indiana	750,000	30,000		235,836	365	10,006	27	500	5,750	116,280	5,431	109,050
Iowa				3,075							155	3,075
Kansas				549,943	8,978	160,498	6,858	125,745	10,000	200,000	4,535	63,700
Kentucky				295,520					17,315	295,520		
Louisiana				856,201	29,244	263,821	13,037	221,599	22,842	567,181	300	3,600
Maine				27,902					828	21,602	1,000	6,300
Maryland				5,188,925	124,696	1,178,367	48,608	690,671	184,095	2,985,015	27,734	334,872
Massachusetts	15,000	1,200	1,434	2,060,575	1,282	12,820			76,571	1,940,605	4,280	107,150
Michigan	2,831,120	119,063		353,608	1,528	17,699			14,753	279,588	2,767	56,321
Minnesota				7,285							1,471	7,285
Mississippi				492,772	7,200	50,400			30,504	442,372		
Missouri				139,395	2,766	44,248			2,774	39,039	2,354	56,108
Nebraska				58,914					4,532	58,914		
Nevada												
New Jersey	152,500	10,800	5,031	3,704,162	105,165	887,470	7,283	59,580	125,839	2,629,511	8,039	127,601
New York	2,310,653	103,390	632	2,445,375	9,810	105,645	10,300	338,400	87,862	1,623,638	45,814	377,692
North Carolina	1,138	137	1,053	1,487,333	48,820	397,397	3,400	51,000	53,528	841,632	14,345	197,304
Ohio				1,562,518	24,728	285,698	23,805	380,936	43,351	700,606	11,918	195,278
Oregon				6,500							120	6,500
Pennsylvania	11,079,029	461,259	2,302	2,712,767	22,975	310,273	2,846	53,271	120,715	2,178,334	11,272	170,889
Rhode Island				105,755			681	10,215	2,097	48,231	2,938	47,309
South Carolina				4,656,808	173,183	1,404,569			207,860	3,146,915	7,497	105,324
Tennessee				1,464,788	35,959	456,568			36,695	704,220	20,400	304,000
Texas				69,800	40	780			25	500	4,036	68,520
Vermont	16,000	960										
Virginia				3,324,979	120,633	1,024,893	4,300	72,100	106,828	1,820,771	26,692	407,215
West Virginia				5,400							350	5,400
Wisconsin												
All other states				8,000							400	8,000

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.									
	Group IX.—Bleaching materials.				Electro-chemical products.	Group XI.—Dyestuffs.				
	Total value.	Hypochlorites.		Other bleaching agents.		Total value.	Natural.		Artificial.	
		Tons.	Value.	Value.	Value.		Pounds.	Value.	Pounds.	Value.
United States	$492,086	2,143	$115,608	$376,478	$1,305,368	$4,914,686	49,019,074	$2,658,008	11,168,308	$2,256,678
Alabama										
California										
Colorado										
Connecticut						36,325	808,175	36,325		
Delaware										
District of Columbia										
Florida						5,650	59,325	5,650		
Georgia										
Illinois	38,649	297	38,649			13,894			11,200	13,894
Indiana										
Iowa										
Kansas										
Kentucky										
Louisiana										
Maine					9,631	30,000			4,412	30,000
Maryland										
Massachusetts	912			912		1,191,560	4,045,302	320,347	2,123,816	871,213
Michigan	62,387	1,782	62,387		193,256					
Minnesota										
Mississippi										
Missouri	21,196			21,196						
Nebraska										
Nevada										
New Jersey	12,972	56	12,972			668,068	6,160,000	206,240	3,846,908	461,828
New York	340,612			340,612	1,102,481	1,897,834	9,723,797	1,104,858	2,497,162	792,976
North Carolina										
Ohio	3,500			3,500						
Oregon										
Pennsylvania	11,858	8	1,600	10,258		889,213	23,831,150	816,135	1,162,450	73,078
Rhode Island						168,453	4,391,325	168,453		
South Carolina										
Tennessee										
Texas										
Vermont						2,300			230,000	2,300
Virginia										
West Virginia						11,389			1,292,360	11,389
Wisconsin										
All other states										

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.						
	Group XII.—Tanning materials.						
	Total value.	Natural.				Artificial.	
		Ground or chipped.		Extracts.			
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
United States	$1,790,118	49,002,037	$465,956	62,012,788	$1,259,007	2,454,084	$65,155
Alabama							
California	31,500	300,000	1,500	1,050,000	30,000		
Colorado							
Connecticut							
Delaware							
District of Columbia							
Florida	20,000			1,050,900	20,000		
Georgia							
Illinois	2,500			12,500	2,500		
Indiana							
Iowa							
Kansas							
Kentucky	21,000	1,344,000	21,000				
Louisiana							
Maine							
Maryland							
Massachusetts	16,000					376,470	16,000
Michigan	100,684			8,444,600	100,684		
Minnesota							
Mississippi							
Missouri							
Nebraska							
Nevada							
New Jersey	181,800	13,872,000	98,600	719,228	46,684	1,460,664	36,516
New York	300,756			7,024,440	295,356	36,000	5,400
North Carolina							
Ohio							
Oregon							
Pennsylvania	364,701	415,117	7,783	19,108,020	349,679	580,950	7,239
Rhode Island							
South Carolina							
Tennessee	48,589			2,776,500	48,589		
Texas							
Vermont							
Virginia	470,223	25,145,920	180,158	17,936,725	290,065		
West Virginia	232,365	7,925,000	156,915	3,889,875	75,450		
Wisconsin							
All other states							

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.									
	Group XIII.—Paints, colors, and varnishes.									
	Aggregate value.	A.—Pigments.								
		Total value.	White lead.		Oxides of lead.		Lamp and other blacks.		Fine colors.	
			Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
United States	$67,918,533	$13,824,773	116,102,316	$4,211,181	50,759,623	$2,550,340	7,519,345	$420,037	4,080,902	$1,028,754
Alabama										
California	969,779	278,825	4,800,000	237,180	500,000	25,895				
Colorado	188,500									
Connecticut	579,334	7,840					224,000	7,840		
Delaware	32,873	200							1,000	200
District of Columbia	2,500									
Florida										
Georgia	182,279									
Illinois	8,129,967	880,368	11,037,475	531,962					201,000	32,000
Indiana	403,327	18,250					365,000	18,250		
Iowa	335,367	96,316	250,000	24,750						
Kansas	4,875									
Kentucky	673,063									
Louisiana	140,102									
Maine	117,991									
Maryland	460,852	68,947	80,000	4,000						
Massachusetts	2,439,254	594,432	110,496	5,525	3,725,279	197,440	700,000	42,000	345,000	35,000
Michigan	3,391,773	40,737								
Minnesota	395,816									
Mississippi	13,200									
Missouri	4,338,644	509,364	4,942,814	243,681	3,581,604	183,189				
Nebraska	838,151	61,889			1,125,262	61,889				
Nevada	3,875									
New Jersey	5,984,881	1,540,921	14,471,171	717,047					1,135,284	190,893
New York	18,762,564	4,812,435	39,109,000	547,440	12,426,000	663,176	15,000	2,550	1,937,116	734,713
North Carolina	2,468									
Ohio	6,702,884	619,377	8,822,814	383,475	1,508,000	79,792	550,000	40,000	254,000	19,900
Oregon	186,931									
Pennsylvania	10,725,579	4,111,190	32,478,546	1,516,121	27,893,478	1,338,959	5,665,345	309,397	207,502	16,048
Rhode Island	131,818	500								
South Carolina										
Tennessee	147,790	30,640								
Texas	39,830									
Vermont	401,077									
Virginia	201,972	146,499								
West Virginia										
Wisconsin	881,717	6,043								
All other states	57,500									

Table 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.										
	Group XIII.—Paints, colors, and varnishes—Continued.										
	A.—Pigments—Continued.						B.—Paints.				
	Iron oxides and other earth colors.		Dry colors.		Pulp colors, sold moist.		Total value.	Paints in oil, in paste.		Paints already mixed for use.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.		Pounds.	Value.	Gallons.	Value.
United States	33,772,256	$324,902	167,734,241	$4,428,028	20,060,935	$861,531	$32,473,812	306,477,865	$17,603,127	16,900,350	$14,870,685
Alabama	......	......	......	......	......	......	......	......	......	......	......
California	......	......	2,100,000	15,750	......	......	557,149	2,411,622	207,797	355,837	349,352
Colorado	......	......	......	......	......	......	160,000	83,330	10,000	153,325	150,000
Connecticut	......	......	......	......	......	......	99,385	1,428,868	68,009	34,020	31,376
Delaware	......	......	......	......	......	......	21,876	215,846	8,496	16,725	13,380
District of Columbia	......	......					2,500	......	......	1,000	2,500
Florida	......	......	......	......	......	......	......	......	......	......	......
Georgia	......	......	......	......	......	......	149,779	870,683	56,065	91,394	93,714
Illinois	1,183,565	14,617	9,853,710	300,789	10,000	1,000	4,629,569	45,021,424	2,634,159	2,594,474	1,995,410
Indiana	......	......	......	......	......	......	153,215	1,734,600	121,136	34,612	32,079
Iowa			3,042,000	71,566	......	......	209,051	1,405,000	74,150	181,485	134,901
Kansas	......	......	......	......	......	......	4,875	......	......	6,500	4,875
Kentucky	......	......	......	......	......	......	353,135	1,022,640	70,610	387,575	282,525
Louisiana	......	......	......	......	......	......	132,102	189,834	50,686	94,017	81,416
Maine	......	......	......	......	......	......	60,406	822,600	47,133	13,000	13,273
Maryland	130,000	400	1,533,509	33,505	558,300	31,042	293,259	1,101,227	87,519	232,544	205,740
Massachusetts	2,278,000	28,435	3,445,701	218,607	739,312	67,425	1,103,380	10,402,389	635,551	479,011	467,829
Michigan	......	......	417,418	40,737	......	......	1,659,034	9,761,345	684,716	847,205	974,318
Minnesota	......	......	......	......	......	......	357,816	796,282	100,084	298,661	257,732
Mississippi	......	......	......	......	......	......	13,200	......	......	12,000	13,200
Missouri	......	......	8,455,000	82,494	......	......	3,578,173	45,796,923	2,282,924	1,542,268	1,295,249
Nebraska	......	......	......	......	......	......	773,662	8,850,306	553,950	221,712	219,712
Nevada	......	......	......	......	......	......	3,375	......	......	2,700	3,375
New Jersey	500,000	25,000	4,764,207	445,425	5,156,948	162,556	1,132,641	8,672,911	552,452	622,542	580,189
New York	15,602,000	127,134	42,933,177	2,156,799	12,941,596	580,623	6,918,338	68,999,820	4,009,897	2,922,134	2,908,441
North Carolina	......	......	......	......	......	......	2,377	2,803	2,377	......	......
Ohio	80,000	1,200	1,441,781	95,010	......	......	4,118,491	30,595,967	1,752,553	2,578,218	2,365,938
Oregon	......	......	......	......	......	......	135,731	30,576	7,644	114,991	128,087
Pennsylvania	6,318,691	96,976	63,817,766	820,847	594,379	12,842	4,562,252	59,138,990	3,052,644	2,174,014	1,509,608
Rhode Island	20,000	500	......	......	......	......	104,604	629,800	70,775	35,554	33,829
South Carolina	......	......	......	......	......	......	......	......	......	......	......
Tennessee	7,660,000	30,640	......	......	......	......	117,150	142,000	28,400	116,073	88,750
Texas	......	......	......	......	......	......	39,530	241,429	15,600	26,200	23,930
Vermont	......	......	......	......	......	......	170,207	108,650	5,300	232,059	164,907
Virginia	......	......	25,929,972	146,499	......	......	......	......	......	......	......
West Virginia	......	......	......	......	......	......	......	......	......	......	......
Wisconsin	......	......	......	......	60,400	6,043	800,050	6,000,000	412,500	430,000	387,550
All other states	......	......	......	......	......	......	57,500	......	......	48,500	57,500

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.											
	Group XIII.—Paints, colors, and varnishes—Continued.									Group XIV.—Explosives.		
	C.—Varnishes and japans.								All other products in this group.	Total value.	Gunpowder.	
	Total value.	Oil and turpentine varnishes.		Alcohol varnishes.		Pyroxyline varnishes.		Liquid dryers, japans, and lacquers.				
		Gallons.	Value.	Gallons.	Value.	Gallons.	Value.	Value.	Value.		Pounds.	Value.
United States	$18,602,796	14,286,758	$14,337,461	563,212	$943,069	204,069	$237,012	$3,085,254	$3,017,152	$17,036,897	123,314,103	$5,310,351
Alabama										54,940	247,525	8,511
California	130,805	123,670	120,392	2,670	5,300			5,113	3,000	4,274,553	500,000	80,000
Colorado	28,500	30,000	28,500									
Connecticut	390,092	137,679	307,462	175	404	28,810	36,012	46,214	82,017	312,400	7,282,750	312,400
Delaware	2,200			500	1,200			1,000	8,597	443,971	8,794,779	443,971
District of Columbia												
Florida												
Georgia	7,500							7,500	25,000			
Illinois	2,136,496	1,617,053	1,621,154	148,943	203,538	16,000	16,000	295,804	483,534	289,735	6,358,250	270,974
Indiana	221,372	263,624	195,260	1,210	3,569	383	594	21,949	10,490	970,944	4,925,000	214,324
Iowa									30,000	353,315	12,618,400	353,315
Kansas										179,000	4,477,575	179,000
Kentucky	316,978	454,550	314,603	100	145			1,230	3,950			
Louisiana	8,000	8,310	7,904					96				
Maine	46,000	50,000	46,000						11,586	170,000	4,000,000	170,000
Maryland	44,646	55,800	23,825					20,821	54,000			
Massachusetts	593,353	436,532	442,600	4,400	11,360			139,393	148,089	171,062	1,227,775	147,330
Michigan	1,668,549	1,632,963	1,629,437	3,575	8,451			30,661	23,453	691,766		
Minnesota	28,000	27,754	28,000						10,000			
Mississippi												
Missouri	227,468	110,169	127,640	2,106	3,277	6,500	16,000	80,551	23,639	992,842		
Nebraska									2,600			
Nevada									500			
New Jersey	2,826,391	1,668,752	2,258,228	67,673	124,743	49,308	69,181	374,239	484,928	3,493,197	5,477,900	240,027
New York	6,271,755	4,928,208	4,665,714	231,205	432,928	102,777	99,000	1,074,113	760,036	367,998	5,939,200	263,594
North Carolina	91							91				
Ohio	1,739,803	1,245,565	1,177,397	43,304	50,107			512,299	225,213	1,330,489	21,627,675	927,098
Oregon	51,200	32,000	51,200									
Pennsylvania	1,779,950	1,408,656	1,236,672	47,901	83,473	291	225	459,580	272,187	2,571,368	34,961,649	1,507,807
Rhode Island	11,250			6,950	11,250				65,464			
South Carolina												
Tennessee										220,318	2,500,000	100,000
Texas	300							300				
Vermont									230,870	1,400		
Virginia	55,473	56,473	55,473							3,600		
West Virginia										62,099		
Wisconsin	17,624			2,500	3,324			14,300	58,000	92,000	2,375,625	92,000
All other states												

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.											
	Group XIV.—Explosives—Continued.									Group XV.—Plastics.		
	Nitroglycerine.		Gun cotton, or pyroxyline.		Dynamite.		Smokeless powder.		All other explosives.	Total value.	Pyroxyline plastics.	All other products in this group.
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Value.		Value.	Value.
United States	3,618,692	$783,299	369,499	$189,623	85,846,456	$8,247,223	2,973,126	$1,655,948	$850,453	$2,099,400	$1,970,387	$129,013
Alabama					496,861	46,429						
California			50,000	30,000	27,055,910	2,895,703	1,361,000	816,600	452,250			
Colorado												
Connecticut												
Delaware												
District of Columbia												
Florida												
Georgia												
Illinois									18,761			
Indiana	675,000	118,750			6,456,041	614,934	68,938	22,936				
Iowa												
Kansas												
Kentucky												
Louisiana												
Maine												
Maryland												
Massachusetts									23,732	231,509	111,641	119,868
Michigan	4,000	2,000			6,648,975	652,174			37,592			
Minnesota												
Mississippi												
Missouri					10,464,235	992,842						
Nebraska												
Nevada												
New Jersey	14,199	2,191	284,499	124,623	25,550,543	2,185,365	1,477,633	765,991	175,000	1,862,496	1,858,746	3,750
New York			35,000	35,000	671,215	69,404						
North Carolina												
Ohio	1,455,113	351,970					61,555	49,021	2,400			
Oregon												
Pennsylvania	1,163,918	256,289			8,507,676	790,372			16,900	5,395		5,395
Rhode Island												
South Carolina												
Tennessee									120,318			
Texas												
Vermont							4,000	1,400				
Virginia									3,500			
West Virginia	306,462	52,099										
Wisconsin												
All other states												

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.														
	Group XVI.—Essential oils.						Group XVII.—Compressed and liquefied gases.				Group XVIII.—Fine chemicals.				
	Total value.	Natural.		Witch-hazel.		Artificial.	Total value.	Anhydrous ammonia.	Carbon dioxide.	Compressed and liquefied gases not otherwise enumerated.	Total value.	Alkaloids.		Gold salts.	
		Pounds.	Value.	Gallons.	Value.	Value.		Value.	Value.	Value.		Ounces.	Value.	Ounces.	Value.
United States	$846,605	882,554	$737,496	110,260	$54,649	$54,460	$1,215,011	$448,157	$696,164	$70,690	$4,229,431	3,387,522	$1,743,264	8,594	$90,145
Alabama															
California	2,490	3,330	2,490				44,488	20,488	24,000						
Colorado															
Connecticut	45,530	300	480	91,000	45,050										
Delaware							77,786	77,786							
District of Columbia															
Florida	500	400	500												
Georgia															
Illinois	110	32	100			10	180,350		180,350		100,060				
Indiana	14,180	17,683	14,180												
Iowa															
Kansas															
Kentucky															
Louisiana															
Maine															
Maryland											12,000				
Massachusetts	4,395	2,930	4,395				13,700		500	13,200	9,390				
Michigan	202,258	218,453	202,258				2,976	2,976							
Minnesota															
Mississippi															
Missouri							142,586	79,742	62,844		234,056			5,226	53,448
Nebraska															
Nevada															
New Jersey							151,600	92,375	59,225		406,854	288,672	98,213	803	9,917
New York	533,400	517,462	469,351	19,260	9,599	54,450	226,452		173,962	52,490	484,590			65	780
North Carolina	500	500	500												
Ohio							52,905	47,905		5,000	1,650				
Oregon															
Pennsylvania	2,595	1,993	2,595				239,713	126,885	112,828		2,930,831	3,098,850	1,645,051	2,500	26,000
Rhode Island											50,000				
South Carolina															
Tennessee															
Texas															
Vermont							3,000		3,000						
Virginia	37,772	117,721	37,772												
West Virginia															
Wisconsin	2,875	1,750	2,875				79,455		79,455						
All other states															

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.										
	Group XVIII.—Fine chemicals—Continued.										
	Silver salts.		Platinum salts.		Chloroform.		Ether.		Acetone.		All other.
	Ounces.	Value.	Ounces.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Value.
United States	1,252,604	$499,345	7,312	$54,600	396 540	$98,070	263,238	$129,876	1,638,715	$178,666	$1,435,465
Alabama											
California											
Colorado											
Connecticut											
Delaware											
District of Columbia											
Florida											
Georgia											
Illinois											100,060
Indiana											
Iowa											
Kansas											
Kentucky											
Louisiana											
Maine											
Maryland											12,000
Massachusetts											9,390
Michigan											
Minnesota											
Mississippi											
Missouri	103,576	37,719	6,380	46,678			116,350	56,211			40,000
Nebraska											
Nevada											
New Jersey	173,000	63,890	932	7,922	334,000	66,800	56,000	18,650	63,593	6,359	135,103
New York	325,121	120,104			62,540	31,270	74,500	45,700	1,455,865	158,712	128,024
North Carolina											
Ohio											1,650
Oregon											
Pennsylvania	650,907	277,632					16,388	9,315	119,257	13,595	959,238
Rhode Island											50,000
South Carolina											
Tennessee											
Texas											
Vermont											
Virginia											
West Virginia											
Wisconsin											
All other states											

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.												
	Group XIX.—Chemicals not otherwise specified.												
	Total value.	Glycerin.		Cream of tartar.		Epsom salts.		Blue vitriol.		Copperas.		Phosphates of soda.	
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
United States	$5,189,992	15,383,798	$2,012,886	10,620,000	$2,081,500	7,559,809	$57,966	7,500,000	$375,000	19,884,305	$87,927	3,478,350	$104,554
Alabama													
California	326,000			1,610,000	326,000								
Colorado													
Connecticut													
Delaware													
District of Columbia													
Florida													
Georgia													
Illinois	182,391	1,403,506	169,695							2,086,400	12,696		
Indiana													
Iowa													
Kansas													
Kentucky													
Louisiana													
Maine													
Maryland	116,215					1,421,500	14,215					3,400,000	102,000
Massachusetts	30,191												
Michigan													
Minnesota													
Mississippi													
Missouri	2,554											78,350	2,554
Nebraska	31,655	372,418	31,655										
Nevada													
New Jersey	1,120,977			4,210,000	795,500					871,902	5,231		
New York	2,133,275	8,000,000	1,120,000	4,800,000	960,000	20,000	1,000			67,403	675		
North Carolina													
Ohio	726,211	5,607,874	691,536							10,158,600	34,675		
Oregon													
Pennsylvania	520,523					6,118,309	42,751	7,500,000	375,000	6,700,000	34,650		
Rhode Island													
South Carolina													
Tennessee													
Texas													
Vermont													
Virginia													
West Virginia													
Wisconsin													
All other states													

Table 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	PRODUCTS—continued.			COMPARISON OF PRODUCTS.			POWER.							
	Group XIX.—Chemicals not otherwise specified—Continued.		All other.	Number of establishments reporting for both years.	Census year 1900.	Preceding business year	Number of establishments reporting.	Total horsepower.	Owned.					
	Tin salts.								Engines.				Water wheels.	
									Steam.		Gas or gasoline.			
	Pounds.	Value.	Value.		Value.	Value.			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
United States	4,677,471	$470,159	$19,003,538	1,473	$180,675,706	$156,604,049	1,354	198,338	2,682	158,646	86	1,669	311	9,273
Alabama			100,454	13	1,817,640	1,562,913	19	1,630	34	1,515				
California			629,649	48	7,863,041	6,981,138	42	3,653	65	2,553	6	47	7	200
Colorado			33,154	4	299,954	190,952	4	199	6	167				
Connecticut			970,673	26	2,485,964	2,313,213	21	2,692	38	1,731			33	911
Delaware			167,573	13	1,077,926	1,098,490	12	2,602	30	1,360			40	1,082
District of Columbia			14,157	7	85,637	83,855	3	94	1	65			1	9
Florida			10,164	10	533,789	469,492	7	527	10	515				
Georgia			121,613	23	1,516,461	1,409,770	36	3,913	56	3,855				
Illinois			869,683	74	10,886,616	9,567,420	66	6,726	76	6,086	8	139	1	15
Indiana			56,365	36	2,546,039	2,270,170	34	2,441	49	2,008	3	73		
Iowa			4,265	8	696,022	566,051	7	753	22	753				
Kansas				4	728,943	554,593	4	1,105	6	730	1	5		
Kentucky			64,425	15	953,730	829,686	15	969	17	902	1	10		
Louisiana			26,600	9	1,036,453	808,938	8	927	12	835	1	36		
Maine			13,630	10	366,000	374,600	8	2,644	10	196			17	2,420
Maryland			1,027,229	54	4,921,377	4,513,513	47	4,487	78	4,056	5	87	2	44
Massachusetts	179,587	30,191	515,106	79	8,027,083	6,526,099	60	6,190	89	4,890	1	10	6	470
Michigan			1,300,784	89	9,362,568	7,664,301	52	23,774	179	23,494			6	150
Minnesota				6	377,031	310,500	6	271	4	201				
Mississippi				4	505,972	441,000	3	415	4	415				
Missouri			1,192,242	36	7,026,687	6,868,038	29	2,805	49	2,599	3	37		
Nebraska			26,120	5	954,840	841,650	5	380	4	360				
Nevada			2,400	4	27,225	25,900	3	59	5	57	1	2		
New Jersey	3,130,578	320,246	4,185,535	131	23,823,809	20,281,702	120	17,817	321	16,293	3	47	2	30
New York	257,329	51,600	2,557,133	246	38,930,455	35,058,082	224	49,974	538	28,784	10	228	67	1,201
North Carolina			10,292	15	1,152,111	1,084,357	16	1,292	29	1,153	16	56		
Ohio			1,050,044	115	12,414,903	10,501,736	103	10,017	156	7,657	7	267	12	603
Oregon			45,928	5	239,359	158,794	4	90	2	60				
Pennsylvania	1,109,977	68,122	3,371,440	277	30,791,552	26,031,791	272	30,855	559	27,372	17	598	102	1,582
Rhode Island			465,509	12	1,127,329	999,561	5	730	15	647			2	60
South Carolina				7	865,429	792,863	18	3,940	36	3,940				
Tennessee			22,500	13	1,577,587	971,818	11	2,105	23	1,833	1	22	6	250
Texas			15,540	5	39,830	28,060	6	180	6	175				
Vermont				3	404,337	267,368	4	380	6	380				
Virginia			91,091	47	3,756,967	3,129,320	57	9,782	127	9,292	1	2	7	246
West Virginia			32,750	7	303,503	257,168	8	550	8	500				
Wisconsin			490	9	1,074,347	694,383	11	1,090	11	1,087	1	3		
All other states			9,000	5	77,190	74,764	4	280	1	130				

TABLE 9.—CHEMICALS AND ALLIED PRODUCTS: DETAILED STATEMENT BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	POWER—continued.							FACTORIES.									
	Owned—Continued.				Rented.		Furnished to other establishments.	Total number of establishments.	No employees.	Under 5.	5 to 20.	21 to 50.	51 to 100.	101 to 250.	251 to 500.	501 to 1,000.	Over 1,000.
	Electric motors.		Other power.														
	Number.	Horsepower.	Number.	Horsepower.	Electric, horsepower.	Other kind, horsepower.	Horsepower.										
United States	399	6,849	15	542	19,445	1,914	875	1,740	43	413	655	319	143	122	34	6	5
Alabama	1	25			30	60		19		1	6	5	4	3			
California	37	570	2	45	173	65	40	53		12	23	9	4	4		1	
Colorado			3	15	15	2		4			2	1	1				
Connecticut	2	8	1	25	17			31		9	13	4	3	1	1		
Delaware	5	140				20		15		1	10	1	1	1	1		
District of Columbia						20		8		3	4	1					
Florida					12			10	1	1	1	6		1			
Georgia	2	28			30			46		3	18	10	8	6	1		
Illinois	9	159			23	304	161	88		19	31	22	10	5	1		
Indiana	35	337			23			42		9	22	7	2	2			
Iowa								8	2	2	1	2		1			
Kansas	3	70				300		5		2			1	2			
Kentucky					57			18		6	6	3	3				
Louisiana	2	31				25		10	1		4	2	1	2			
Maine	3	19			9			13	2	2	5	3	1				
Maryland	8	210				90		63		10	23	17	3	8	2		
Massachusetts	26	645	1	50	30	95		83	1	27	37	10	4	2	2		
Michigan	15	115			5	10	140	97	6	48	19	10	5	6	1		2
Minnesota					70			8		1	5	2					
Mississippi								4			1	2	1				
Missouri	3	6			123	40		39		10	13	10	2	2	2		
Nebraska					20			5			2		3				
Nevada								4		1	2	1					
New Jersey	74	1,171	2	55	20	201	10	160	5	36	56	27	12	18	5		1
New York	63	989			18,435	337	146	285	5	67	106	56	28	14	6	2	1
North Carolina					83			23	3	4	7	3	3	3			
Ohio	66	1,376			57	57	208	137	6	33	61	22	6	6	3		
Oregon					30			5		1	3	1					
Pennsylvania	40	893	4	302	28	80	155	306	9	70	126	66	17	13	2	2	1
Rhode Island	1	15				8	15	12		4	3	1	3	1			
South Carolina								22		2	3	1	2	11	3		
Tennessee								14	1	1	5	3	2		2		
Texas					5			7		3	3		1				
Vermont								5		1	3			1			
Virginia	3	27	1	40		175		64		15	20	7	11	8	2	1	
West Virginia	1	15	1	10		25		9		4	4		1				
Wisconsin								12	1	3	4	3		1			
All other states					150			6		2	3	1					

APPENDIX.

CONTENTS.

DIGEST OF UNITED STATES PATENTS RELATING TO THE CHEMICAL INDUSTRIES.

(Products and processes.)

DIGEST OF UNITED STATES PATENTS.

Prepared by Story B. Ladd, under the direction of Charles E. Munroe.

GROUP I.—ACIDS.

SULPHURIC ACID.

8,308—August 26, 1851. E. L. SEYMOUR. *Improvement in process of reducing ores by zinc compounds.*

Sulphurous gas from the calcination of sulphuret ores with air and steam is passed through feldspathic rock, magnesian limestone, sulphurets of metals or the like, converting the same into their sulphates, and the surplus gas is converted into dilute sulphuric acid. The gases remaining or evolved are combined with crude or raw ammonia or other alkaline substance producing fertilizers; or the sulphurous gases of the first operation are passed into water in the presence of metallic zinc, forming sulphate of zinc, which is converted into white oxide of zinc.

41,647—February 16, 1864. J. SMITH AND J. R. SAVAGE. *Improvement in the manufacture of sulphuric acid.*

Sulphuric acid is heated for concentration by steam coils in leaden pans and still.

42,985—May 31, 1864. L. CHANDOR. *Improvement in the manufacture of sulphuric acid.*

Columns of stoneware or clay flasks are used in lieu of lead chambers, and the sulphurous acid is passed through masses of porous bodies, such as coke or pumice stone.

43,157—June 14, 1864. R. G. LOFTUS. *Improved process of recovering the acid used in refining petroleum.*

The spent acid is, first, diluted with 50 per cent of water, subjected to agitation and then repose in a leaden-lined tank, and the oily matters subsequently drawn off; second, the diluted acid is concentrated by evaporation to from 1.650 to 1.700 and subjected to further dilution and repose; third, the clear liquid is siphoned off from the heavier impurities and again concentrated to from 1.650 to 1.700; and, fourth, it is concentrated in glass, porcelain, or other suitable vessels to a specific gravity of 1.845.

52,090—January 16, 1866. A. H. TAIT AND J. W. AVIS. *Improved apparatus for desulphurizing ores.*

Air heated to from 260° to 315° C. is forced through sulphuret ore in a closed chamber under a pressure of 20 to 40 pounds. The admission of a small quantity of nitric oxide gas is advantageous.

62,919—March 19, 1867. D. ASHWORTH AND R. B. EATON. *Improvement in concentrating sulphuric acid.*

A series of glass retorts is used in combination with a heating apparatus.

78,352—May 26, 1868. D. ASHWORTH AND R. B. EATON. *Improved apparatus for concentrating sulphuric acid.*

The hot concentrated acid is cooled and the fresh acid heated by flowing the latter through an encasing jacket of a vessel of the former. It also relates to structural details.

86,881—February 9, 1869. A. H. TAIT. *Improvement in the manufacture of sulphuric acid.*

Sulphurous acid is freed from nitrogen by liquefying the sulphurous acid and allowing the nitrogen gas to escape. Arsenic is removed by refrigerating the sulphurous-acid vapors. Sulphurous-acid gas is exposed to the action of nitric oxide, air, and steam under pressure, forming sulphuric acid, which is concentrated by injecting hot air.

97,182—November 23, 1869. L. S. FALES. *Improved mode of recovering the spent acid from oil refineries.*

To effect the separation of the tarry matter from the spent acid of oil refineries, etc., the spent acid, either with or without the addition of sulphate of potash or of ammonia, and diluted with water, is subjected to the action of ammoniacal vapors from gas liquor, and then allowed to stand, when the tarry matter is removed, leaving a clear solution, which is then concentrated by evaporation, sulphate of soda being first added.

127,350—May 28, 1872. J. HUGHES. *Improvement in the manufacture of acids and paints from the materials used to purify gas.*

Saturated or spent gas-purifying materials are used as a base for the manufacture of acids. The resultant oxide, in the case of iron materials, is available as a base for paints.

129,204—July 16, 1872. W. ARCHDEACON. *Improvement in preparing wooden vessels for holding acids.*

The interior of the vessel is impregnated with a composition of glue 1 part and beeswax 3 parts, applied under pressure.

137,692—April 8, 1873. J. KIRCHER. *Improvement in obtaining sulphur, sulphuric acid, and sulphurets of sodium and potassium from gas lime, etc.*

Saturated gas-purifying material—lime or iron—is heated with superheated steam to evolve sulphureted hydrogen for the manufacture of sulphuric acid. Flowers of sulphur is produced by mixing gas lime with loam and sublimating the excess of sulphur; lac sulphur by mixing the gas lime with water and acid; sulphuret of sodium or potassium by subjecting the gas lime to the action of caustic soda or other alkali or salt.

143,202—September 23, 1873. E. THOMSON AND W. H. GREENE. *Improvement in the manufacture of sulphuric acid.*

It relates to details of structure and arrangement, including subjecting the nitrous gases evolved from the reaction of sulphurous acid and nitric acid to the action of cold water and air currents in a chamber with porous packing, to form nitric acid.

144,928—November 25, 1873. J. SAUNDERS. *Improvement in the manufacture of sulphuric acid.*

Hollow glass balls with one or more openings are used for filling sulphuric-acid condensing towers.

150,095—April 21, 1874. H. SPRENGEL. *Improvement in the manufacture of sulphuric acid.*

Very fine spray or mist of water or acidified aqueous solutions are used in place of steam. Sulphuric acid is sprayed to absorb the nitrous fumes in the gases from the sulphuric-acid chambers, and the acid containing the absorbed fumes is sprayed in the leaden chambers.

175,734—April 4, 1876. W. H. NICHOLS. *Improvement in sulphuric-acid packages.*

They are made of sheet iron, with the surfaces and edges coated with lead and united by melted lead.

204,244—May 28, 1878. A. PÉNISSAT. *Improvement in processes for recovering waste sulphuric acid.*

Sulphuric acid is recovered from the refuse in the treatment of coal oil by washing the acid from the tar, evaporating down to about 60° Baumé, and then vaporizing, condensing, and producing the white sulphuric acid and concentrating.

206,309—July 23, 1878. F. F. FARRAR AND F. P. GILL. *Improvement in processes and apparatus for recovering waste sulphuric acid.*

Acid is reclaimed from the residuum tar of refineries by mixing the tar with hot water and steeping with heat, then allowing it to cool and settle, when the acid and tar are drawn off from below. The acid water is then heated and the purer liquor withdrawn from the bottom and the water evaporated.

223,571—January 13, 1880. J. A. W. WOLTERS. *Manufacture of anhydrous sulphuric acid.*

Anhydrous sulphuric acid is obtained by the distillation of a mixture of anhydrous bisulphate of soda (or potash) and anhydrous sulphate of magnesia, or compounds of the other so-called vitriols and alkaline earths.

230,171—July 20, 1880. H. BOWER. *Process of and apparatus for treating residuum from petroleum refineries.*

Sulphuric acid is recovered by washing the sludge acid with water in covered tanks, mechanically separating the sulphuric-acid solution and carbonaceous matters from the oily ingredients, as by centrifugal machines (for redistillation), separating the acid solution from the carbonaceous matters by heating in a series of concentrators, and finally concentrating and distilling the separated sulphuric-acid solution.

232,685—September 28, 1880. E. CLARK. *Recovering sulphuric acid from sludge acid.*

In the recovery of sulphuric acid from the sludge acid of oil refineries, the offensive vapors are conducted off by an exhaust produced by an induced steam blast while the sludge is being agitated by steam.

233,680—October 26, 1880. E. C. E. AND L. L. LABOIS. *Manufacture of carbon bisulphide and sulphuric acid from pyrites, and apparatus therefor.*

A limited proportion of sulphur is first extracted from a determined quantity of pyrites and combined with carbon in a separate retort, while the hot pyritic residue is conducted to a separate furnace for the manufacture of sulphuric acid.

240,248—April 19, 1881. J. GRIDLEY. *Process of and apparatus for concentrating sulphuric acid.*

A strong heat is applied to the under surface of a thin body of dilute acid, and at the same time a blast of superheated steam or hot air is applied to the upper surface, and the vapors removed as they rise.

246,396—August 30, 1881. C. KOLBE AND T. LINDFORS. *Apparatus for concentrating sulphuric acid.*

A series of platinum retorts is arranged on a plane and connected by pipes from the bottom of one to a higher point of the next, giving an equilibrium of level in all the retorts.

250,416—December 6, 1881. F. BENKER AND H. LASNE. *Manufacture of sulphuric acid.*

Nitrous compounds are economized, in the manufacture of sulphuric acid, by mixing sulphurous-acid gas with the gases which enter the Gay-Lussac tower.

252,287—January 10, 1882. H. WURTZ. *Process of treating mineral pyrites and sulphides for the manufacture of sulphurous and sulphuric acids.*

A new product for use in the manufacture of sulphuric acid is made by granulating sulphurets and mixing same with comminuted metallic iron and forming into cakes or lumps. The iron in the lumps is oxidized by moistening with a saline solution. Asbestus or mica may be incorporated as a binder.

265,495—October 3, 1882. J. GRIDLEY. *Process of and apparatus for concentrating sulphuric acid.*

A small stream of dilute acid from the evaporating pan, of about 60° Baumé, is continuously introduced into a large quantity of acid of 66° Baumé in a concentrating pan and kept at the boiling point, with a proportionate constant discharge therefrom. The pan of cast iron has its walls above the weak acid line protected.

267,582—November 14, 1882. R. N. R. PHELPS AND W. A. CLARK, Jr. *Process of treating the waste pickle liquor of ironworks.*

Ferric oxide, sulphuric acid, and other products are recovered from pickle liquor by evaporating the liquor, drying and pulverizing the crystals of sulphate of iron, heating them in a retort, say to 710° C., with air in regulated quantities, and condensing the sulphuric and sulphurous acid vapors.

268,793—December 12, 1882. E. HAWORTH. *Manufacture of sulphuric acid.*

Sulphurous-acid gas—as from lead smelters—is first passed through water, which dissolves the gas and condenses any metallic fumes. The water is then passed to a heating tank and the sulphurous-acid gas there evolved conveyed to a leaden chamber while the water is returned to the dissolving chamber.

291,821—January 8, 1884. M. A. WALSH. *Process of concentrating sulphuric acid.*

Monohydrated sulphuric acid is produced by first concentrating up to 93 per cent of monohydrated acid in the usual way and then transferring it, while hot, to an iron or steel vessel and therein completing the concentration.

306,897—October 21, 1884. R. M. BREINIG. *Process of the treatment of sludge acid.*

A soap compound adapted to unite with the sludge tar is mixed with the sludge, and the free acid is then readily separated from the tarry mass.

310,147—December 30, 1884. A. B. NOBEL AND G. FEHRENBACH. *Manufacture of anhydrous sulphuric acid.*

Sulphuric anhydride is produced by subjecting sulphuric acid to the dehydrating influence of hydrated phosphoric acid.

314,548—March 24, 1885. G. THOMSON AND W. KEMP. *Purifying sulphuric acid.*

Sulphuric acid is purified by treating with ammonium sulphide, filtering, and finally concentrating by heat.

323,583—August 4, 1885. E. D. KENDALL. *Process of recovering sulphuric anhydride.*

Sulphuric anhydride is recovered from a compound containing an excess of fuming sulphuric acid by heating the compound in a partial vacuum and condensing the volatilized sulphuric anhydride.

325,262—September 1, 1885. J. McNAB. *Process of manufacturing sulphuric acid.*

Sick or pale acid chambers are restored by injecting thereinto nitrous vapors.

339,552—April 6, 1886. J. HUGHES. *Apparatus for concentrating acids.*

An evaporating pan is made of porcelain with a transparent glass cover.

342,785—June 1, 1886. U. CUMMINGS. *Manufacture of sulphuric acid.*

Sulphuric acid is produced by calcining a mixture of clay and sulphate of lime, the proportions being such as will give hydraulic cement as a by-product.

345,140—July 6, 1886. J. HUGHES. *Process of making sulphuric acid.*

Hot sulphur and nitric fumes from a sulphur furnace are projected through a spray of water, in an intermediate chamber, and then passed into a condensing chamber.

357,107—February 1, 1887. H. J. P. SPRENGEL. *Obtaining sulphuric acid by the aid of waste steam.*

The exhaust steam from the engine is employed for the leaden chambers. The engine boiler pressure may be raised—say 10 pounds—for the leaden chambers, and the engine exhaust provided with a corresponding back pressure.

357,528—February 8, 1887. J. B. F. HERRESHOFF. *Process of concentrating sulphuric acid.*

Sulphuric acid is first concentrated to about 86 per cent, then concentrated in a separate vessel to about 95 per cent, and this is evaporated in another vessel to produce a residual strong acid of 98 per cent and a condensed pure acid of 93.5 per cent.

378,774—February 28, 1888. H. DE GROUSILLIERS. *Process of treating sludge acid.*

Sulphuric acid is recovered from sludge acid by first removing the petroleum or tarry impurities by floating them, then adding to the waste sulphate of soda or potash and precipitating the bisulphate formed by boiling and evaporation, then depriving the precipitate of its aqueous substance by heating to a moderate red heat, and finally vaporizing and condensing the sulphuric acid.

384,841—June 19, 1888. E. HÄNISCH AND M. SCHROEDER. *Process of producing sulphuric anhydride.*

Sulphuric anhydride is produced by reducing the volume of a gaseous mixture of sulphurous acid and oxygen (air 75 per cent, SO_2 25 per cent) by compression and subjecting the mixture under pressure to the converting action of a suitable contact surface, as a platinized substance, at red heat.

469,439—February 23, 1892. R. S. PENNIMAN. *Apparatus for the final concentration of oil of vitriol.*

A continuous-process apparatus has a series of coupled glass retorts with the contents agitated by injected air or otherwise.

475,586—May 24, 1892. P. MAURO. *Process of solidifying liquid acids.*

Liquid acids are solidified by adding thereto a soluble salt adapted to crystallize with the water, as sulphate of sodium or of calcium for sulphuric acid, or chloride of calcium or of magnesium for hydrochloric acid. The mixture is preferably heated and agitated, and then cooled.

484,546—October 18, 1892. E. J. BARBIER. *Process of treating bisulphate of soda.*

Neutral sulphate of soda and sulphuric acid are obtained from bisulphate of soda (35° to 45° Baumé) by refrigerating the bisulphate to about 10° C. until decomposition takes place, separating the crystalized neutral sulphate from the sulphuric acid and concentrating the same.

509,664—November 28, 1893. H. HOWARD. *Method of and apparatus for concentrating sulphuric acid.*

The flow of sulphuric acid to the still is governed by an automatic valve controlled by the specific gravity of the distillate.

514,983—February 20, 1894. W. WOLTERS. *Process of concentrating sulphuric acid.*

Sulphate of lead is added to the acid during concentration to prevent corrosion of the leaden vessels.

535,882—March 19, 1895. E. J. BARBIER. *Process of and apparatus for making sulphuric acid.*

The vapor of sulphurous acid circulates through a series of towers in succession wherein it is subjected to the action of a divided stream of sulpho-nitric, or diluted nitric acid, in the upper part of each tower, and to the action of nitrous and aqueous vapors in the lower part.

541,041—June 11, 1895. F. J. FALDING. *Process of and apparatus for making concentrated sulphuric acid.*

The hot sulphurous gases are conducted through a concentrating tower, and a denitrating tower to the lead chambers, and the acid there formed is returned in downward flow through the denitrating tower and the concentrating tower and from thence to storage tanks, whereby the denitrated acid is exposed to the action of the hot sulphurous gases.

541,597—June 25, 1895. J. D. DARLING. *Method of and apparatus for manufacturing sulphuric acid and by-products.*

See Group X, Electro-chemistry.

546,596—September 17, 1895. N. P. PRATT. *Process of and apparatus for making sulphuric acid.*

In the manufacture of sulphuric acid the gases in the acid chamber are commingled and agitated by withdrawing a portion of the gases at one point and reintroducing them at another.

590,826—September 28, 1897. J. D. DARLING. *Porous diaphragm for electrolytic apparatus.*

See Group X, Electro-chemistry.

591,730—October 12, 1897. W. BAIN. *Process of and apparatus for electrolyzing.*

See Group X, Electro-chemistry.

598,351—February 1, 1898. A. STAUB. *Apparatus for making sulphuric acid.*

The towers are filled with acid-resisting bodies, each having an inverted cup or open depression on the under side.

636,924—November 14, 1899. M. SCHROEDER. *Process of combining gases by contact process.*

Sulphuric acid or sulphuric anhydride is recovered from gases containing SO_2 and O by passing said gases through a mass comprising a catalytic agent and soluble salts. When the efficiency of the mass has become impaired by the action of the impurities the soluble carried salts are dissolved out. The catalytic mass is formed by evaporating a mixture of a liquid, a platinum salt, and a suitable soluble salt, and then reducing the platinum salt to the metallic state.

636,925—November 14, 1899. M. SCHROEDER. *Catalytic material.*

It consists of a catalytic substance, as platinum, distributed through a mass of one or more soluble salts, which, serving as a carrier therefor, are stable in the presence of hot sulphuric anhydride. An alkali salt is dissolved in water, mixed with a platinum salt solution, evaporated, and the resulting salt crusts dried and granulated. (See 636,924.)

640,037—December 26, 1899. J. V. SKOGLUND. *Apparatus for making acids.*

A tower or chamber for acid vapors is coated on the inside with an acid-resisting material and silicate of potash or soda, and treated with an acid to remove from the silica any alkaline material.

641,276—January 16, 1900. J. D. DARLING. *Porous diaphragm for cells employing fused electrolytes.*

See Group X, Electro-chemistry.

642,390—January 30, 1900. F. P. VANDENBERGH. *Process of making sulphuric acid.*

See Group X, Electro-chemistry.

643,578—February 13, 1900. W. WARING AND J. E. BRECKENRIDGE. *Process of purifying sludge acids.*

About 4 per cent of sodium nitrate is mixed with sludge acid, at a temperature between 60° and 180° F., to purify it and permit the recovery of the sulphuric acid. One per cent of sodium nitrate suffices to remove offensive odors.

652,119—June 19, 1900. R. KNIETSCH. *Method of making sulphuric anhydride.*

A gas containing sulphur dioxide and oxygen is passed through a contact substance, as platinized asbestus, while maintaining therein a temperature, at the hottest part, between the composing and decomposing temperature of sulphuric anhydride. The inflowing gas is heated by contact with the catalytic chamber and the latter cooled, and the temperature is regulated by adjustments of the gas and air currents, without external heating, except in special cases.

NITRIC ACID.

94,969—September 21, 1869. G. W. MOWBRAY. *Purifying nitric acid.*

Warm air is passed through nitric acid to purify it of the red fumes of nitrous acid.

125,635—April 9, 1872. C. W. VOLNEY. *Improvement in apparatus for the treatment of liquids with nitric acid.*

Liquids, as alcoholic substances, to be treated with nitric acid are repeatedly withdrawn from the vessel where nitric acid is added, cooled, and returned.

176,813—May 2, 1876. R. E. ROGERS. *Improvement in methods of recovering nitric acid used in separating gold and silver.*

Nitric acid is recovered from nitrate of silver solutions by precipitating the silver with hydrochloric acid in liquid or gaseous form.

198,776—January 1, 1878. B. C. MOLLOY. *Improvement in recovery of waste nitrous gases.*

A hot-water spray is used in towers or other suitable apparatus to absorb peroxide of nitrogen and recover nitric acid from its lower oxides.

477,375—June 21, 1892. J. LANG. *Process of making nitric acid.*

The mixed vapors of nitric acid, nitrous acid, and impurities are passed from the generator into a receiver and subjected to a heat high enough to keep the impurities vaporized, but not so high as to keep the pure nitric acid vaporized (for concentrated nitric acid the temperature should be at least 80° C.), and the vaporized impurities with any nitric-acid vapor are then passed into a cooler kept at a temperature low enough to condense the nitric-acid vapors (40° to 60° C.), which flow back into the receiver, while the vaporized impurities pass off uncondensed.

491,481—February 7, 1893. O. GUTTMANN. *Process of making nitric acid.*

An air blast is introduced into the tube between the distilling chamber and the condenser, to act upon the gaseous nitric acid and convert the low oxides before condensation.

500,786—July 4, 1893. C. O. VOLZ. *Process of making nitric acid.*

Pure and highly concentrated nitric acid is produced by placing the raw materials, as saltpeter and sulphuric acid, in an air-tight receptacle, establishing a vacuum, and condensing the vapor. Action is accelerated by heating the retort to 85° C.

514,124—February 6, 1894. G. LUNGE. *Process of making nitric acid and caustic alkali.*

An alkaline nitrate is mixed with crude ferric oxide in sufficient quantity to maintain the porosity of the mass, as two parts of ferric oxide to one of sodium nitrate, and the heated mass is subjected to the action of heated air and steam at a temperature sufficient to convert the whole of the alkaline base into an alkaline ferrite, with the evolution of nitrous fumes convertible into nitric acid. The alkaline ferrite is decomposed with hot water to recover the caustic alkali and ferric oxide.

517,001—March 20, 1894. J. D. DARLING. *Mode of producing nitric acid and metals from nitrates.*

See Group X, Electro-chemistry.

517,098—March 27, 1894. H. A. FRASCH. *Process of making concentrated nitric acid.*

Nitric-acid vapors are exposed to the action of sulphuric acid, or other dehydrating agent, and hot air at a temperature above the condensation point of the nitric acid to be obtained.

526,116—September 18, 1894. M. PRENTICE. *Process of making nitric acid.*

A mixture formed by dissolving sodium nitrate in sulphuric acid by heat is successively passed through a series of heated compartments and the vapors collected and condensed, whereby nitric acid is continuously produced. The liquid matter under distillation seals the passages between the series of chambers.

527,718—October 16, 1894. M. PRENTICE. *Still for obtaining nitric acid, etc.*

Still for process No. 526,116.

577,523—February 23, 1897. G. J. ANDERSSON AND J. C. DITTRICH. *Process of manufacturing ozone and by-products.*

See Group X, Electro-chemistry.

590,143—September 14, 1897. W. GARROWAY. *Process of making alkaline silicates and nitric acid.*

See Group II, Sodium Compounds, Silicates.

591,087—October 5, 1897. J. V. SKOGLUND. *Process of manufacturing nitric acid.*

Nitric-acid vapors are conveyed into a chamber packed with pieces of acid-proof material, the temperature of the chamber being maintained equal to or higher than the boiling point of the nitric acid and at a point that the watery materials will be condensed; the vapors are condensed and the nitric acid is allowed to run in thin films over the pieces of acid-proof material, being exposed to oxidizing action of air.

599,743—March 1, 1898. E. A. STARKE. *Compound nitrate and method of making same.*

A new product, a fused compound consisting of an alkaline-earth-metal nitrate with an alkaline-metal nitrate, and suitable for the manufacture of nitric acid and explosives, is formed by converting an alkaline-earth-metal salt into a nitrate, as by contact with waste nitric acid and vapors of various manufacturing processes, and then dehydrating the nitrate by fusing with an alkaline-metal nitrate.

603,508—May 3, 1898. E. HART. *Apparatus for distilling acids.*

The still has a series of small distillation tubes, closed at bottom, depending from the receiver and presenting an extended heated surface. They may be of glass.

632,394—September 5, 1899. H. K. BAYNES. *Process of decomposing alkali nitrates.*

A pulverulent mixture of alkali nitrate and ferric oxide is furnaced at about 650° C. in a revolving inclined cylinder retort, which is subjected to intermittent jarring and has longitudinal ribs to lift and shower the charge, the nitrous fumes being led off; whereby, in a continuous operation, the material is subjected in streams or films to repeated contact with heated surfaces and the solid products are carried out of the path of the undecomposed particles. The alkaline ferrite is subsequently converted into ferric oxide and caustic alkali.

648,322—April 24, 1900. J. F. WHITE. *Process of making nitric acid.*

In the manufacture of nitric acid from sodium nitrate and sulphuric acid, the weak nitric acid is converted into strong nitric acid by adding it to the succeeding charge of sodium nitrate and sulphuric acid, preferably by mixing it with the sulphuric acid.

MIXED ACIDS.

164,260—June 8, 1875. P. CASTELLANOS. *Improvement in the manufacture of nitrosulphuric acid for manufacturing nitroglycerine.*

A mixture of nitric acid and sulphuric acid is produced by condensing vaporized nitric acid in liquid sulphuric acid.

164,261—June 8, 1875. P. CASTELLANOS. *Improvement in recovering acids from residuum of nitroglycerine manufacture.*

The dilute residuum, dropped in small quantities through a heated column filled with obstructions, is treated with sulphurous-acid gas, the resulting nitric acid collected, and the sulphuric acid drawn off.

164,262—June 8, 1875. P. CASTELLANOS. *Improvement in apparatus for recovering acids from the residuum of nitroglycerine manufacture.*

Apparatus for process No. 164,261.

251,938—January 3, 1882. F. V. POOL. *Process of removing flocculent matter from spent acids.*

Flocculent matter, in spent acid used in the treatment of soluble fiber, is removed by introducing powdered barium sulphate—30 pounds per 650 gallons of solution—and permitting it to stand from thirty-six to seventy hours.

284,742—September 11, 1883. F. JENSSEN. *Separation of nitric acid from a mixture of nitric and sulphuric acid.*

A continuous stream of the mixed acids is passed through a connected series of retorts to which are given separate degrees of heat, and the nitric acid is distilled over from each retort into separate receivers, the acid in each of the receivers being of a different strength.

306,519—October 14, 1884. F. V. POOL. *Manufacture of soluble nitrocellulose.*

See Group XIV, Explosives.

336,822—February 23, 1886. F. V. POOL. *Art of manufacturing nitrocellulose.*

See Group XIV, Explosives.

343,850—June 15, 1886. F. V. POOL. *Art of making nitrocellulose.*

See Group XIV, Explosives.

350,497—October 12, 1886. G. M. MOWBRAY. *Manufacture of pyroxyline.*

See Group XIV, Explosives.

350,498—October 12, 1886. G. M. MOWBRAY. *Manufacture of pyroxyline.*

See Group XIV, Explosives.

479,988—August 2, 1892. H. MAXIM. *Method of restoring nitrating acids.*

See Group XIV, Explosives.

526,752—October 2, 1894. R. C. SCHUPPHAUS. *Process of nitrating cellulose.*

See Group XIV, Explosives.

HYDROCHLORIC ACID.

240,196—April 12, 1881. E. SOLVAY. *Preparation of hydrochloric acid.*

Hydrochloric acid is obtained in a dry state by absorbing it, or the vapors thereof, in a solution of calcium chloride, and then vaporizing the acid which is alone evolved.

299,830—June 3, 1884. L. MOND. *Process of obtaining hydrochloric acid from the residues of ammonia-soda manufacture.*

The liquors obtained in the manufacture of soda by the ammonia process are evaporated, and after separating therefrom the chloride of sodium, which salts out, the remaining product is treated with sulphuric acid yielding hydrochloric-acid gas, which is condensed or utilized, and, as a secondary product, sulphate of ammonia.

308,511—November 25, 1884. L. MOND. *Process of making hydrochloric acid.*

Chloride of ammonium is treated with an excess of sulphuric acid—say with double the quantity necessary to form the neutral sulphate—and the mixture heated until all of the hydrochloric acid is disengaged.

316,300—April 21, 1885. E. SOLVAY. *Manufacture of hydrochloric acid.*

For the manufacture of hydrochloric acid a composition is used of chloride of calcium, silicious clays, and the residuum from the manufacture of hydrochloric acid by a previous operation.

361,026—April 12, 1887. G. RUMPF. *Process of obtaining muriatic acid.*

For the production of hydrochloric acid metallic oxides are chloridized by passing vapors of ammonic chloride through them in a heated state, and then subjecting the metallic chlorides to a mixed current of air and steam. When the metallic chlorides are decomposed the operation is repeated.

379,487—March 13, 1888. L. MOND. *Obtaining ammonia and hydrochloric acid.*

See Group XIX, Ammonia and Ammonium Salts.

453,986—June 9, 1891. E. SOLVAY. *Process of distilling hydrochloric acid.*

A current of dehydrating material—as sulphuric acid—is caused to flow in a continuous circuit through a distilling apparatus and an evaporator, the solution of hydrochloric acid being fed into the dehydrating solution within the still, whereby hydrochloric acid is liberated and after passing off is condensed.

503,557—August 15, 1893. E. SOLVAY. *Apparatus for the distillation of hydrochloric acid.*

Apparatus for process No. 453,986.

474,539—May 10, 1892. W. WALKER. *Process of and apparatus for making silicates and hydrochloric acid.*

Hydrochloric acid is obtained as a by-product in the production of pure silicates for glass making by mixing chloride of sodium and lime with pulverized sand, and heating the mass in the presence of moisture to drive off the hydrochloric acid, which is collected, and form a silicate of soda and lime.

605,369—June 7, 1898. J. R. WYLDE AND J. W. KYNASTON. *Process of making hydrochloric acid.*

Hydrochloric acid free from arsenic is made from gases, wherein hydrochloric-acid gas is present contaminated with arsenic, by cooling the gases and then passing them in the presence of chlorine through or in contact with coke in a "dry tower," in which the arsenic is retained, and thence to a wet tower, in which the hydrochloric acid is condensed.

612,009—October 11, 1898. G. B. BALDO. *Process of and apparatus for electrolyzing sea water.*

See Group X, Electro-chemistry.

618,772—January 31, 1899. H. S. BLACKMORE. *Process of making alkali aluminates.*

See Group XIX, Aluminates.

PHOSPHORIC ACID.

14,722—April 22, 1856. E. N. HORSFORD. *Improvement in preparing phosphoric acid as a substitute for other solid acids.*

"Pulverulent phosphoric acid" is produced by treating burned bones with diluted sulphuric acid for several days, then leaching the pasty mass and concentrating the extract to 25° Baumé, and adding perfectly white bone ashes and concentrating to one-half its original bulk. Flour or farinaceous material is then added, and the material is passed through a sieve and dried.

156,181—October 20, 1874. J. E. SIEBEL. *Improvement in recovering phosphoric acid and purifying ammonia.*

A solution of phosphate of lime, obtained in the treatment of bones, is saturated with ammonia, forming a solution of phosphate of ammonia, which is evaporated, heated in a retort, and the ammonia recovered as well as the phosphoric acid. Crude ammonia thus repeatedly used is purified.

194,050—August 14, 1877. N. B. RICE. *Improvement in processes of recovering phosphoric acid used in manufacture of gelatine.*

In obtaining gelatine from bone, etc., by means of phosphoric acid, the acid phosphate of lime is treated to recover the phosphoric acid by subjecting each lot to the action of sulphuric acid and then leaching a part or the whole of the next lot through the sediment.

229,705—July 6, 1880. E. N. HORSFORD. *Pulverulent preparation of phosphoric acid.*

Pulverulent phosphoric acid is formed by treating the acid liquor to bring it into the condition of free phosphoric acid, concentrating it, mixing it with starch as a neutral substance, drying, and pulverizing. It is then mixed with a dry alkaline carbonate to form a baking powder.

230,874—August 10, 1880. E. N. HORSFORD. *Pulverulent preparation of phosphoric acid.*

The liquor resulting from the action of sulphuric acid upon bone-ash is taken directly from the leach, boiled down and mixed with starch, dried, and pulverized; forming a pulverulent product of free phosphoric acid and monocalcic phosphate direct from the liquid. It is mixed with a dry alkaline carbonate to form a baking powder.

239,394—March 29, 1881. H. S. MAXIM. *Process of and apparatus for manufacturing phosphoric anhydride.*

Phosphoric anhydride is produced by bringing together a jet of vapor of phosphorous and a blast of air of sufficient volume to oxidize the phosphorous to its highest equivalency.

258,423—May 23, 1882. W. H. HUGHES AND P. O'RIELLY. *Process of preparing phosphoric acid from bones.*

Liquid acid phosphates are treated with chlorate of potassa and the compound subjected to a high degree of heat to eradicate organic impurities. The process as a whole involves washing, calcining, leaching with sulphuric acid, filtering, treating with hot air or steam and then with chlorate of potassa and heat, and dissolving in water, with successive filtrations at different stages.

306,664—October 14, 1884. S. G. THOMAS AND T. TWYNAM. *Process of obtaining phosphoric acid from metallurgical slags.*

The slag is dissolved in dilute hydrochloric acid, a lime salt added in just sufficient quantity to precipitate the iron as ferric phosphate, and the solution of free phosphoric acid separated.

312,904—February 24, 1885. C. SCHEIBLER. *Process of treating phosphatic slag.*

The fluid slag is allowed to cool very slowly, whereby a concentration of the phosphoric acid takes place on the one part and of the iron and manganese on the other, so as to permit of their being separately removed.

393,428—November 27, 1888. W. B. GILES AND A. SHEARER. *Manufacture of phosphoric acid.*

Phosphoric acid is separated from impurities by distilling impure phosphoric acid at a high temperature—say a red heat—in the presence of a current of air, steam, or hydrochloric acid, and condensing the distillate in a partial vacuum.

459,575—September 15, 1891. C. GLASER. *Process of making phosphoric acid.*

Sulphuric acid is first diluted with phosphoric acid (instead of water), and then successive charges of phosphatic material are treated with sulphuric acid diluted with phosphoric acid of increasing degrees, using the phosphoric acid derived from each charge as a diluent to the sulphuric acid used in treating the succeeding charge.

527,670—October 16, 1894. G. DESCAMPS. *Phosphoric acid with an absorbent.*

Phosphoric acid in a dry form is provided by charging a vegetable cellulose, as sawdust or cane bagasse, with phosphoric acid and drying, the operation being repeated to increase the percentage of phosphoric acid in the absorbing material.

540,124—May 28, 1895. J. VAN RUYMBEKE. *Process of making phosphoric acid.*

A mixture of natural phosphate and clay is submitted to the action of heat in the presence of a reducing agent, as by fusing with coke, and the phosphorus vapors, produced and carried off with the products of combustion, are subjected to the action of air in sufficient quantity to oxidize the vapors into phosphorus pentoxide, which is collected in water, and concentrated to the desired density.

OTHER INORGANIC ACIDS.

76,678—April 14, 1868. D. P. WEBSTER. *Improvement in bottles for holding hydrofluoric acid.*

They are made of wood, papier-maché, or like material, coated inside with asphalt and outside with a compound of india rubber and gum shellac. A bottle may be made of two sections fitted together.

137,072—March 25, 1873. F. GUTZKOW. *Improvement in the manufacture of boracic acid.*

Boracic acid is separated from borate of lime by distillation with superheated steam.

160,761—March 16, 1875. F. FORMHALS. *Improvement in processes of obtaining boracic acid from borate of lime.*

Sulphurous acid is passed through borate of lime while the latter is in a state of suspension in water.

274,660—March 27, 1883. W. B. ROBERTSON, Jr. *Process of and apparatus for obtaining boracic acid from borates.*

Nitrous and sulphurous vapors are formed and introduced, together with air, into a borate solution, or borate in suspension in water, forming boracic acid.

289,836—December 11, 1883. J. B. HOBSON. *Process of and apparatus for obtaining boracic acid from native borate of lime.*

Borate of lime is boiled with water and sulphuric acid gradually added, not, however, in excess. The solution is allowed to settle and the liquor is drawn off, filtered, cooled, and the boracic acid crystallized out and pressed to remove the remaining mother liquor and expel its impurities.

650,187—May 22, 1900. C. C. MOORE. *Process of making boracic acid and chlorates.*

Powdered crude borate is suspended in water, or the mother liquor of a previous operation—say three pounds to the gallon—chlorine is passed therethrough with agitation, and the boracic acid precipitated by refrigerating to 15° to 20° C.

322,011—July 14, 1885. W. A. ROWELL. *Manufacture of chromic acid.*

Chromic acid is produced by first producing in a solution of a chromate a precipitate of chromate of strontium, then completing the precipitation of the chromate solution by means of barium; afterwards decomposing the chromate of barium with excess of sulphuric acid and finally applying the same acid to decompose the chromate of strontium.

630,612—August 8, 1899. M. Le BLANC AND H. REISENEGGER. *Process of producing chromic acid by electrolysis.*

See Group X, Electro-chemistry.

394,387—December 11, 1888. E. W. PARNELL AND J. SIMPSON. *Obtaining hydrogen sulphide.*

Ammonium sulphide is first treated with dilute carbonic acid and the evolved gases permitted to escape; then the ammonium sulphide is given a second treatment with carbonic acid, yielding pure hydrogen sulphide.

403,249—May 14, 1889. A. M. AND J. F. CHANCE. *Obtaining hydrogen sulphide from alkali waste.*

Gases containing carbonic acid are passed through alkali waste and the resultant gases, containing hydrogen sulphide, are then passed through fresh alkali waste so that the hydrogen sulphide unites therewith. The waste so enriched is then treated with gases containing carbonic acid, yielding a gas rich in hydrogen sulphide, which is collected.

461,665—October 20, 1891. T. W. CAPPON. *Process of producing hydrofluosilicic acid.*

Hydrofluosilicic acid is produced by passing fluoride of silicon into an aqueous solution containing free hydrofluoric acid—from 10 per cent to 20 per cent or more—during the presence of which free acid the silica is dissolved.

465,607—December 22, 1891. M. W. BEYLIKGY. *Manufacture of hydrofluosilicic acid.*

Hydrofluosilicic acid is produced by heating a mixture of sulphate of iron and an equivalent proportion of finely powdered fluorspar to incipient redness in a closed vessel, passing steam over it to produce fluohydric acid charged with vapor of water, and finally passing the said acid condensed with water through silica.

626,511—June 6, 1899. E. TEISLER. *Process of obtaining silicic and hydrofluosilicic acids.*

An aqueous solution of fluorine compounds, resulting from the purification of graphite, is heated to evolve a mixture of steam and gasiform fluosilicate, and the mixture is then cooled so as to cause the fluosilicate to decompose into silicic acid and hydrofluosilicic acid, and the two compounds are separated.

489,633—January 10, 1893. F. GRUESSNER. *Process of recovering metastannic acid.*

Metastannic acid combined with arsenic is recovered by dissolving the compound in concentrated hot sulphuric acid, then adding an oxidizing agent, as nitric acid, and then diluting until free metastannic acid is precipitated.

529,100—November 13, 1894. I. A. F. BANG AND M. C. A. RUFFIN. *Manufacture of anhydrous stannic acid.*

A solution of an alkaline bicarbonate is added to a solution of an alkaline stannate to precipitate metastannic acid, which precipitate is mixed with sulphuric acid, dried and calcined at a red-white heat.

575,240—January 12, 1897. A. K. HUNTINGTON. *Process of making hydrocyanic acid.*

A mixture of acetylene and nitric oxide is ignited and rapidly burned in a closed chamber—as in a gas engine. The products, hydrogen and hydrocyanic-acid gases, are passed through solutions of substances which combine with hydrocyanic acid—as soda or potash—producing cyanides. The carbonic oxide and hydrogen may be used for combustion.

101,011—March 22, 1870. M. HATSCHEK. *Improved apparatus for producing sulphurous acid.*

A solution of sulphurous acid is produced by spraying water through the ascending fumes of sulphur.

123,713—February 13, 1872. P. MARCELIN. *Improvement in the manufacture of sulphurous acid.*

Pure sulphurous acid is produced by the decomposition of sulphate of iron with sulphur in a retort at a bright cherry-red heat.

268,530—December 5, 1882. R. P. PICTET. *Production and dehydration of sulphurous oxide and apparatus therefor.*

Sulphurous acid gas is passed through a refrigerator in which pure anhydrous sulphurous acid is undergoing vaporization, whereby at the low temperature (at least −10° C.) the hydrate of the sulphurous acid crystallizes out.

308,289—November 18, 1884. T. TERRELL. *Making ferric oxide and sulphurous acid from ferric sulphate.*

The ferric sulphate is decomposed by heat; free sulphur (about 10 per cent) being mixed therewith to assist the decomposition.

311,595—February 3, 1885. I. S. McDOUGALL. *Production of sulphurous acid.*

In the production of sulphurous acid air is forced under pressure into a closed vessel containing ignited sulphur or sulphur-bearing material, the vessel being water jacketed or cooled to maintain a temperature below that of volatilization of sulphur; the sulphurous gases are conducted from said retort into and below the surface of an absorbing liquid.

363,457—May 24, 1887. H. B. FORD. *Apparatus for and process of the manufacture of sulphurous oxide.*

In the manufacture of sulphurous oxide in liquid form all moisture is removed from the air before it is supplied to the sulphur furnace.

378,673—February 28, 1888. C. E. GETCHELL. *Apparatus for making sulphurous acid.*

A combining chamber has thin sinuous or zigzag passages for the acid fumes, with water inlet at the upper part, thus affording an intimate contact with one another.

197,574—November 27, 1877. C. R. STUNTZ. *Improvement in compositions for producing sulphureted hydrogen.*

A powder consisting of an intimate mixture of coal tar and sulphur, the latter being equivalent to or in excess of the hydrogen of the coal tar. If the gas is prepared in fragile vessels, the powder is diluted with sand to make the coke friable.

224,426—February 10, 1880. W. E. A. HARTMANN. *Manufacture of hydrogen sulphide.*

Hydrogen sulphide is produced by bringing together at a red heat, in a converter, sulphurous acid (or the vapor of sulphur or of sulphuric acid), carbon (coke), and steam.

ACETIC ACID.

93,817—August 17, 1869. L. D. GALE AND I. M. GATTMAN. *Improvement in the manufacture of sugar of lead and acetic acid.*

Lead is corroded by vapors of vinegar mixed with atmospheric air, the vinegar concentrated by means of chloride of sodium and the sugar-of-lead solution bleached with sulphureted hydrogen. Acetic acid, free from pyroligneous odor and color, is obtained by the distillation of acetate of lime with sulphuric acid.

121,586—December 5, 1871. J. F. CAVARLY. *Improvement in purifying acetic acid.*

Acetic acid is deodorized and purified by mixing therewith a small quantity of any of the alcohols included in the formula $C_{2n}H_2\ _{(2n+1)}\ O_2$.

118,788—September 12, 1871. C. J. T. BURCEY. *Improvement in the manufacture of acetic acid.*

Acetate of lime and concentrated sulphuric acid are introduced into a boiler while under direct agitation, and the vapors condensed.

209,978—November 19, 1878. A. PIRZ. *Improvement in the manufacture of acetic acid.*

A solution of permanganate of potash is added to impure acetic acid and the product distilled to remove impurities (1 pound of permanganate to 100 pounds of acid).

209,979—November 19, 1878. A. PIRZ. *Improvement in the manufacture of acetic acid.*

Acetic acid is extracted from acetate of lime by leaching with sulphuric acid in gradually weakened solutions, using the weak acetic acid as a diluent for the sulphuric acid.

401,992—April 23, 1889. I. A. F. BANG AND M. C. A. RUFFIN. *Process of purifying acetic acid.*

Crude acetic acid in the liquid state is purified from pyroligneous matter by bringing into intimate contact with a carbon compound, such as a hydrocarbon of the benzene series, whereby the impurities are dissolved, and the acid then separated from the purifying agent. Air is first blown through the crude acid to oxidize the tarry matters.

414,277—November 5, 1889. I. A. F. BANG AND M. C. A. RUFFIN. *Process of purifying acetic acid.*

In the purification of crude acetic acid a small quantity of an oxidizing agent, such as binoxide of manganese, is introduced as well as a heavy hydrocarbon, the former to oxidize the impurities insoluble in hydrocarbons and not affected by the air. The acid is heated to ebullition and the vapors caused to pass through the hydrocarbon purifying ageut to the air, and the condensed particles to fall back through the purifying agent.

431,243—July 1, 1890. F. C. ALKIER. *Obtaining acetic acid and methyl alcohol.*

Wood-pulp lyes are concentrated by repeated use; the concentrated solution neutralized by an alkali; the methyl alcohol recovered by distillation; the residuary liquor evaporated to dryness; and the acetate distilled with an acid to obtain the acetic acid.

432,926—July 22, 1890. I. A. F. BANG AND M. C. A. RUFFIN. *Process of making acetic acid.*

In the manufacture of acetic acid a hot solution of acetate of lime is acted upon by hot sulphuric acid and the aqueous acetic acid drawn off from the crystalline product. A concentrated solution of acetic acid is formed by dissolving the acetate of lime in a weak solution of acetic acid and decomposing the resulting solution while hot by means of hot sulphuric acid.

485,461—November 1, 1892. F. P. DEWEY. *Process of obtaining alumina and acetic acid.*

A solution of acetate of alumina, which may be formed from sulphate of alumina and acetate of lime, is subjected to destructive distillation; the acetic-acid vapor is collected in a condenser, and the precipitated alumina recovered.

595,787—December 21, 1897. A. SCHMIDT. *Purification of crude acetic acid.*

Acetic acid is filtered in a finely divided state through coal or coke, pure oxygen gas being forced up through the coal in an opposite direction.

634,271—October 3, 1899. H. PLATER-SYBERG. *Process of extracting acetic acid from alkaline acetates.*

See Group X, Electro-chemistry.

LACTIC ACID.

243,827—July 5, 1881. C. E. AVERY. *Manufacture of lactates.*

Lactic acid and lactates are produced by the fermentation of a sugar of vegetable origin with a lactic ferment in the presence of nitrogenous matters, chiefly of vegetable origin, and of a substance suitable to gradually neutralize the acid as formed.

290,252—December 18, 1883. G. A. MARSH. *Manufacture of lactates and lactic acid.*

In the manufacture of lactic acid and the lactates by the fermentation of dextrine or like gums with an active lactic ferment and an acid neutralizing substance, agitation is prevented during fermentation to avoid butyric and other destructive fermentations.

290,253—December 18, 1883. G. A. MARSH. *Manufacture of lactates for the production of lactic acid.*

Lactic acid an the lactates are produced by the fermentation of any amylaceous substance, as corn meal, in its original form, in water, with an active lactic ferment charged with an acid neutralizing substance, as carbonate of lime.

290, 34—December 18, 1883. C. O. THOMPSON. *Manufacture of lactic acid and lactates.*

Neutral calcium-lactate crystals are obtained by digesting amylaceous matter, converting a portion into glucose, and adding to the glucose liquor, still mixed with the nitrogenous matters and residues, pure white glucose, fermenting with lactic ferment and neutralizing the acid as it forms with carbonate of lime. Acid crystals are obtained from the neutral crystals by digesting same in hot water, filtering, treating with sulphuric acid, again filtering, concentrating, and crystallizing.

321,925—July 7, 1885. C. N. WAITE. *Process of distilling lactic acid.*

It is distilled and purified by the aid of free steam; the steam takes up the pure lactic acid and is then condensed.

330,815—November 17, 1885. C. E. AVERY. *Manufacture of laclates.*

A lactic ferment is purified and preserved by adding it to a medium specially favorable to its growth and less favorable to the growth of other ferments. A pure reagent is prepared by successive impregnations of a series of culture baths with lactic ferment, the impregnation of each solution from the preceding one being effected at the point of full height of fermentation, as evidenced by the evolution of carbonic acid gas at its first maximum. A culture bath is formed by adding 1,000 parts of starch sugar, dextrine, glucose, or milk sugar to 6,000 parts of water, then 500 parts of carbonate of lime, and finally 100 parts of vegetable nitrogenous matter, the mixture being kept at a heat of 35° to 45° C.

365,655—June 28, 1887. C. N. WAITE. *Manufacture of lactic acid.*

In the lactic fermentation of a fermentable sugar with lactic ferment and a neutralizer, glue is added to supply soluble nitrogenous matter.

368,032—August 9, 1887. C. N. WAITE. *Process of lactic fermentation.*

A pure lactate of lime is produced by the fermentation of sugar, glucose, or pure starch with a minute quantity of nitrogen in the form of ammonia, and a minute quantity of phosphoric acid, and lactic ferment in a closed vessel in the absence of air.

455,078—June 30, 1891. C. N. WAITE. *Process of manufacturing lactic acid.*

Crude salts, such as zinc lactate, are dissolved in boiling water, an excess of milk of lime is added to the solution, the precipitate removed by filtration, and sulphuric acid added to the filtrate, which is then again filtered to remove the sulphate of lime.

584,707—June 15, 1897. P. ROOSEN. *Process of making lactic acid.*

Carbohydrates are heated with milk of lime in a closed vessel at not less than 130° C., by which the carbohydrates are hydrolyzed to lactic acid.

TARTARIC ACID.

199,039—January 8, 1878. F. DIETRICH. *Improvement in the manufacture of tartaric acid.*

Argols and residues of wine making are exposed in a dry state to a temperature of 140° to 170° C., to facilitate the purifying of the tartaric acid salts.

221,297—November 4, 1879. H. GOLDENBERG. *Improvement in the manufacture of tartaric acid.*

In the manufacture of tartaric acid, potassium hydrate is recovered by mixing neutralized tartrate of potassium, 226 parts, and water 8 times as much, with quick lime, 112 parts, slacked in 16 times the quantity of water, and pouring into the mixture while stirring a solution of tartrate of potassium.

455,768—July 14, 1891. R. W. SCHEDLER. *Manufacture of tartaric acid.*

Sulphuric acid, from 5 to 15 per cent, is added to solutions of tartaric acid concentrated to the point of crystallization to increase the quantity of crystallized tartaric acid. The mother liquor is used to treat tartrate of lime.

CITRIC ACID.

515,033—February 20, 1894. C. WEHMER. *Process of making citric acid.*

A sugar solution of from 10 to 20 per cent, acidulated with from 2 to 5 per cent of citric acid, is exposed to the air until a fungous growth forms thereon, when the spores of fungi are cultivated in a sterilized sugar solution, and the pure culture thus obtained is introduced into other sugar solutions and allowed to stand eight to fourteen days until citric acid is formed. The acid is converted into a lime salt with carbonate of lime from which citric acid is prepared.

SALICYLIC ACID.

150,867—May 12, 1874. H. KOLBE. *Improvement in the processes of preparing salicylic and other acids.*

Salicylic acid, as well as the isomeric and homologous acids, is produced by the action of carbonic acid on carbolic acid, or cressolic acids, or on a mixture of them, in presence of alkalies or alkaline earths.

166,863—August 17, 1875. W. E. GRAF. *Improvement in processes of producing salicylic acid.*

Salicylic acid is produced by conducting carbonic acid from a generator into a closed, heated still, containing carbolic acid and alkali. (Apparatus No. 166,862.)

196,254—October 16, 1877. E. SCHERING. *Improvement in purifying salicylic acid by dialysis.*

Salicylic acid is purified by filtering it through animal membrane.

334,290—January 12, 1886. R. SCHMITT. *Manufacture of salicylic acid.*

Salicylic acid and its homologues are produced by subjecting the phenolates of the alkalies and earthy alkalies to the action of dry carbonic acid under pressure at low temperatures, to produce phenyl carbonic alkaline and earthy alkaline salts, and then converting these salts into salicylates and their homologues by heating in hermetically closed vessels at from 120° to 140° C.

355,875—January 11, 1887. T. KEMPF. *Manufacture of salicylic acid and substitutes thereof.*

Salicylic acid, or the substitutes and homologues thereof, is produced in one operation by subjecting the phenolates of the alkalis and earthy alkalis, and the substituted phenolates of said alkalis and earthy alkalis, to the action of carbonic acid under pressure at from 120° to 145° C.

416,318—December 3, 1889. H. BAUM. *Dithiosalicylic acid.*

A new product, having the general formula $C_{14}H_{10}S_2O_6$, and which melts as a resin. It is formed by heating protochloride of sulphur (or the bromide or iodide) with salicylic acid.

529,182—November 13, 1894. S. MARASSE. *Process of making salicylic acid.*

A dry mixture of phenol and potassium carbonate in excess is treated at a gradually increasing temperature with carbonic-acid gas under pressure until the reaction is completed and potassium salicylate is obtained. Salicylic acid is then produced from the potassium salicylate in the well-known way.

611,014—September 20, 1898. L. LIMPACH. *Process of making salicylo-acetic acid.*

Monochloracetates are caused to act on salts of salicylamid, and the product is saponified.

644,077—February 27, 1900. F. HOFFMANN. *Acetyl salicylic acid.*

A new product, soluble in benzene, alcohol, and glacial acetic acid, M. P. 135° C., is obtained by heating salicylic acid with acetic anhydride.

TANNIC ACID.

231,489—August 24, 1880. J. HOLTZ. *Obtaining tannic acid.*

Tannin or tannic acid is produced in acicular form by passing the inspissated tannin extract through a fine sieve and breaking up the dried threads.

263,797—September 5, 1882. A. MITSCHERLICH. *Manufacture of tannic acid.*

Wood is first subjected to the action of steam under pressure, and then to the action of an aqueous solution of bisulphite of lime at a temperature above the boiling point; and the tannic acid solution and a solution of bisulphite of lime are simultaneously produced by exposing small pieces of carbonate of lime to the joint action of a spray of water from above and the fumes of the aforesaid solution from below.

OTHER ORGANIC ACIDS.

276,888—May 1, 1883. C. RUDOLPH. *Manufacture of cinnamic acid.*

Benzylideacetone is heated with bromine dissolved in soda lye and diluted sulphuric acid added when the bromoform generated has separated from the aqueous solution. The cinnamic acid is purified by recrystallization with alcohol or water.

284,862—September 11, 1883. M. H. LACKERSTEEN. *Process of treating fats and oils.*

See Group X, Electro-chemistry.

353,566—November 30, 1886. M. H. LACKERSTEEN. *Process of manufacturing soap and glycerine.*

See Group X, Electro-chemistry.

407,906—July 30, 1889. B. R. SEIFERT. *Process of making paraoxybenzoic acid.*

In the manufacture of this acid the heating of potassium phenate and dry carbonic acid is done in a closed vessel under a superatmospheric pressure to 180° C. or more.

470,920—March 15, 1892. B. R. SEIFERT. *Process of making oxymethoxybenzoic acids.*

Guaiacol acid and eugetinic acid are produced by evaporating an aqueous solution of guaiacol or eugenol and an alkali or earthy alkali, and saturating the dry salt with carbon dioxide under pressure and heating to over 100° C.

488,290—December 20, 1892. B. R. SEIFERT. *Process of making oxyuvitic acid.*

Alkaline or earthy alkaline salts of cresol are subjected to the action of carbonic acid at a temperature of from 160° to 220° C. The product is dissolved in water and alpha oxyuvitic acid is precipitated by means of hydrochloric acid. It has a M. P. of 290° C. It may be purified from any cresotinic acid by partial precipitation of the solution of a salt of the acid.

511,450—December 26, 1893. A. A. NOYES AND A. A. CLEMENT. *Process for the manufacture of paraamidophenol sulphonic acid.*

See Group X, Electro-chemistry.

547,611—October 8, 1895. L. LEDERER. *Process of making aromatic oxycarbon acids.*

The homologous phenoxacetic acids are melted with caustic alkalis; as ortho-cresoxacetic acid one part and caustic soda two parts, and heated to 270° C. with the addition of a little water. The aqueous solution of the melt is decomposed by dilute sulphuric acid.

555,711—March 3, 1896. B. R. SEIFERT. *Citricphenetidin acid and process of obtaining it.*

New products, having the form of white crystalline powders, of acid reaction, soluble in water, in alcohol, and in soda solutions, are produced by heating para-amido-phenetol with citric acid or its derivatives; treating the product with hot water or with solutions of soda or caustic soda, and of a mineral acid successively, and crystallizing.

557,410—March 31, 1896. W. MAJERT. *Pyrocatechin mono-acetic acid and process of making same.*

A new compound, M. P. 131° C., is produced by subjecting one molecule of pyrocatechin to the action of one molecule of chloracetic acid in the presence of an alkali or alkali carbonate.

563,076—June 30, 1896. B. R. SEIFERT. *Paraphenetidin succinic acid and process of making same.*

New products, derived from the dicarbon acids of the fatty series and paraphenetidin, soluble in water, M. P. 163° to 195° C., are produced by heating paraphenetidin with one of the dicarbon acids of the fatty series, boiling the product with soda solution and adding a mineral acid, and purifying by crystallization.

598,790—February 8, 1898. A. KREFTING. *Process of treating seaweed (tang acid).*

The lime is extracted by means of dilute sulphuric acid before the seaweed is otherwise chemically treated, the liquid filtered, and the nonnitrogenous and pure tang acid precipitated.

644,331—February 27, 1900. E. SAPPER. *Process of making phthalic acid.*

A substance whose formula contains that of the naphthalene nucleus is heated with sulphuric acid in the presence of mercuric sulphate.

335,962—February 9, 1886. E. SCHAAL. *Converting petroleum and similar hydrocarbons into acids.*

Petroleum and other hydrocarbons of the series $C_nH_{2n}+2$ are converted into organic acids by subjecting them in the presence of alkaline substances—caustic alkalis, alkaline earths or their carbonates—to the action of an oxidizing agent, separating out the alkaline salts produced and decomposing them with a mineral acid, and finally separating the organic acids into liquid acids and solid acids by distillation.

GROUP II.—SODAS.

CAUSTIC SODA.

16,111—November 25, 1856. C. BICKELL. *Process of treating feldspar for manure.*

Potash or soda is obtained either in the caustic or carbonated state.

See Group VIII, Fertilizers, Processes.

22,888—February 8, 1859. H. PEMBERTON. *Improvement in the process of manufacturing caustic soda and other caustic alkalis.*

The solution of caustic soda or other caustic alkalies is separated from the carbonate of lime or other precipitate by filtration through fire brick or other porous substance capable of resisting the caustic action of the alkaline liquors.

152,845—July 7, 1874. C. AND J. JURON AND A. AND L. IMBERT. *Improvement in the production of caustic alkalis from carbonates.*

Superheated steam is passed through the mass of alkaline carbonates to be converted.

169,800—November 9, 1875. H. GASKELL, JR. *Improvement in processes of manufacturing caustic soda.*

A heated revolving furnace is first charged with salt cake, or with cake and coal slack, and when the salt cake has become fluxed or softened the chalk or lime is added and the balance of the slack.

201,028—March 5, 1878. C. LÖWIG. *Improvement in manufacture of caustic alkalis and preparations of alumina.*

Carbonate of soda or potassa is heated to a red heat with so much alumina, or alumina ore, or oxide of iron, as to present one equivalent of alkali to one equivalent of alumina. By subsequent lixiviation aluminate of soda is obtained free of carbonate of alkali. The product is decomposed by the addition of a paste of hydrate of lime, of hydrate of strontia, or of hydrate of magnesia, forming the aluminates of said earths as precipitates, the caustic alkali remaining in solution. Gelatinous hydrate of alumina is produced by the formation of chloride of aluminium from the aluminates of the earths prepared according to this process, and the decomposition of the same by means of the earths, or their carbonic-acid salts, or the aluminates.

203,761—May 14, 1878. E. W. PARNELL. *Improvement in the manufacture of caustic alkalis.*

Carbonates of soda and potassa of a greater specific gravity than 1,200° are heated with caustic lime in a closed vessel under pressure.

241,383—May 10, 1881. G. T. LEWIS. *Perfumed caustic soda.*

An essential oil is added to granulated or pulverized caustic soda while in a dry state.

254,918—March 14, 1882. E. CAREY, H. GASKELL, JR., AND F. HURTER. *Purification of alkaline solutions.*

Alumina in solution is added to alkaline solutions containing an excess of silica to precipitate the same.

258,850—May 30, 1882. E. CAREY, H. GASKELL, JR., AND F. HURTER. *Purification of alkaline solutions obtained in the manufacture of soda.*

The sulphur compounds are oxidized with the aid of manganese oxide or sodium nitrate, and the liquor is then heated to at least 176° C. to cause the double decomposition of the oxidized sulphur compounds and the cyanogen compounds. Ammonia is recovered.

272,127—February 13, 1883. C. B. DUDLEY. *Method of making soda-lime.*

Sal soda is mixed with caustic lime—without extraneous heat—in such proportions that the water of crystallization will be taken up by the caustic lime.

274,619—March 27, 1883. C. LÖWIG. *Process of manufacturing caustic alkalis.*

A mixture of carbonate of soda—or of potash—and oxide of iron is furnaced, and subsequently lixiviated.

362,677—May 10, 1887. E. SOLVAY. *Manufacture of caustic soda.*

Sodium bicarbonate obtained by the ammonia-soda process is mixed directly with oxide of iron, heated in a closed apparatus and then transferred to another furnace and heated to the temperature necessary to drive out the remaining carbonic acid so as to obtain caustic soda.

402,226—April 30, 1889. J. A. BRADBURN. *Process of manufacturing caustic soda.*

Sodium chloride, or potassium chloride, is treated with nitric acid and peroxide of manganese in a still. The spent liquor is treated with caustic soda or potash, the precipitated manganese oxidized and removed, and the nitrate solution evaporated, mixed with ferric oxide, furnaced, and the mass then lixiviated.

442,334; 442,396; 442,594—December 9, 1890. I. L. ROBERTS. *Electrolytic apparatus.*

See Group X, Electro-chemistry.

450,103—April 7, 1891. E. A. LE SUEUR. *Electrolytic apparatus.*

See Group X, Electro-chemistry.

454,136—June 16, 1891. A. KAYSER. *Manufacture of caustic alkali, etc.*

A mixture of an alkaline chloride with a clay containing silica—in the proportions of 1½ pounds of silica to 1 pound of alumina—is heated to a white heat in a converter by the direct action of highly heated gas containing steam; then melted with an alkali, leached, and the residue ground to release the alkali. The gaseous products from one converter, combined with additional highly heated gases, are applied to a second mixture of the chloride with clay.

458,563—September 1, 1891. F. ELLERSHAUSEN. *Process of making caustic alkali.*

In the manufacture of caustic soda and potash from solutions of their respective sulphides, the solutions are filtered through granulated ferrate of sodium or potassium.

459,688—September 15, 1891. G. H. GRAY. *Process of making soda with strontium salts.*

Sodium, or potassium, hydrate is produced by treatment of sodium sulphate with strontium hydrate, followed by treatment of the strontium sulphate thus produced with magnesium carbonate and sodium, or potassium, salts, thus producing strontium carbonate to be afterwards converted into strontium hydrate.

462,366—November 3, 1891. J. SIMPSON. *Process of making caustic soda.*

Calcic phosphate is treated with hydrochloric acid, sulphate of soda is added, the liquor is drawn off and concentrated, and the concentrated mass is subjected to a red heat, fused, and the fused mass dissolved. The phosphate of soda and sodium chloride contained in the solution are separated, the former treated with caustic lime, and the resulting phosphate of lime and caustic soda separated.

481,407—August 23, 1892. F. M. LYTE. *Production of caustic alkalis and chlorine.*

See Group X, Electro-chemistry.

484,990—October 25, 1892. H. BLACKMAN. *Electrolytic process and apparatus.*

See Group X, Electro-chemistry.

491,700—February 14, 1893. E. B. CUTTEN. *Method of electrolytically producing soda and chlorine.*

See Group X, Electro-chemistry.

498,769—June 6, 1893. T. CRANEY. *Method of electrolyzing salts.*

See Group X, Electro-chemistry.

501,121—July 11, 1893. C. N. WAITE. *Art of manufacturing chlorine or caustic alkali by electrolysis.*

See Group X, Electro-chemistry.

501,783—July 18, 1893. E. HERMITE AND A. DUBOSC. *Method of and apparatus for electrolyzing solutions.*

See Group X, Electro-chemistry.

504,703—September 12, 1893. A. BREUER. *Electrolytic diaphragm.*

See Group X, Electro-chemistry.

508,804—November 14, 1893. H. S. BLACKMORE. *Process of and apparatus for dissociating salts of alkalis by electrolysis.*

See Group X, Electro-chemistry.

510,979—December 19, 1893. G. LUNGE AND C. H. M. LYTE. *Process of making basic lead salts and caustic alkali.*

Crude pig lead is oxidized and the oxide dissolved in nitric acid; the lead nitrate decomposed by soda carbonate and caustic soda to form basic lead carbonate and pure sodic nitrate. Nitric acid, for use over again, and ferrite of soda is then formed by double decomposition of the sodic nitrate with ferric oxide, and the ferrite of soda is decomposed into ferric oxide and caustic soda. Silver, if any, is precipitated from the lead nitrate with finely divided lead.

514,125—February 6, 1894. F. M. LYTE AND G. LUNGE. *Process of making caustic alkali and lead chloride.*

An alkaline nitrate is first formed by the double decomposition of nitrate of lead and an alkaline chloride, and the alkaline chloride is then decomposed, while in admixture with ferric oxide in sufficient proportion to maintain the porosity of the mass, by the action of heated air and steam at a temperature sufficient to convert the whole of the base of the alkaline nitrate into a ferrite of the alkali with the evolution of nitrous fumes, which are converted into nitric acid.

518,065—April 10, 1894. C. HOEPFNER. *Electrolytic apparatus.*
See Group X, Electro-chemistry.

518,135—April 10, 1894. H. Y. CASTNER. *Electrolytic apparatus.*
See Group X, Electro-chemistry.

518,710—April 24, 1894. H. CARMICHAEL. *Method of and apparatus for electro-chemical decomposition.*
See Group X, Electro-chemistry.

522,614—July 10, 1894. I. L. ROBERTS. *Electrolytic diaphragm.*
See Group X, Electro-chemistry.

522,616—July 10, 1894. I. L. ROBERTS. *Method of electrolytic decomposition of salts.*
See Group X, Electro-chemistry.

523,026—July 17, 1894. C. N. WAITE. *Diaphragm for electrolytic cells.*
See Group X, Electro-chemistry.

528,322—October 30, 1894. H. Y. CASTNER. *Process of and apparatus for electrolytic decomposition of alkaline salts.*
See Group X, Electro-chemistry.

531,235—December 18, 1894. C. T. J. VAUTIN. *Process of and apparatus for the production of caustic alkali.*
See Group X, Electro-chemistry.

534,033—February 12, 1895. T. CRANEY. *Apparatus for manufacturing caustic soda.*
See Group X, Electro-chemistry.

541,146—June 18, 1895. H. BLACKMAN. *Electrolytic process and apparatus.*
See Group X, Electro-chemistry.

541,597—June 25, 1895. J. D. DARLING. *Method of and apparatus for manufacturing sulphuric acid and by-products.*
See Group X, Electro-chemistry.

546,328—September 17, 1895. C. HOEPFNER. *Anode for electrolytic apparatus.*
See Group X, Electro-chemistry.

556,038—March 10, 1896. M. H. WILSON. *Electrolytic apparatus.*
See Group X, Electro-chemistry.

568,231—September 22, 1896. H. BLACKMAN. *Electrolytic anode and apparatus.*
See Group X, Electro-chemistry.

572,472—December 1, 1896. H. Y. CASTNER. *Anode for electrolytic processes.*
See Group X, Electro-chemistry.

578,457—March 9, 1897. C. KELLNER. *Process of and apparatus for simultaneously producing ammonia, sodium hydroxide, and chlorine.*
See Group X, Electro-chemistry.

583,330—May 25, 1897. E. A. LE SUEUR. *Process of electrolysis.*
See Group X, Electro-chemistry.

585,387—June 29, 1897. C. KELLNER. *Electrolytic diaphragm.*
See Group X, Electro-chemistry.

586,236—July 13, 1897. L. P. HULIN. *Process of electrolytic decomposition of solutions.*
See Group X, Electro-chemistry.

586,729—July 20, 1897. C. KELLNER. *Method of and apparatus for effecting electrolysis.*
See Group X, Electro-chemistry.

587,830—August 10, 1897. L. P. HULIN. *Process of and apparatus for manufacturing metallic peroxids and caustic alkalis.*
See Group X, Electro-chemistry.

588,276—August 17, 1897. C. KELLNER. *Electrolytic process and apparatus therefor.*
See Group X, Electro-chemistry.

590,548—September 21, 1897. C. KELLNER. *Process of producing hydrates or other salts of alkaline metals.*
See Group X, Electro-chemistry.

590,826—September 28, 1897. J. D. DARLING. *Porous diaphragm for electrolytic apparatus.*
See Group X, Electro-chemistry.

591,730—October 12, 1897. W. BEIN. *Process of and apparatus for electrolyzing.*
See Group X, Electro-chemistry.

592,802—November 2, 1897. N. MARCHAL. *Electric diaphragm.*
See Group X, Electro-chemistry.

606,981—July 5, 1898. W. S. ROMME. *Process of and apparatus for decomposing solid substances.*
See Group X, Electro-chemistry.

609,745—August 23, 1898. W. G. LUXTON. *Diaphragm for electrolytic purposes.*
See Group X, Electro-chemistry.

612,009—October 11, 1898. G. B. BALDO. *Process of and apparatus for electrolyzing sea water.*
See Group X, Electro-chemistry.

623,693—April 25, 1899. C. E. ACKER. *Process of and apparatus for making caustic alkalis.*

A fused alloy, containing an alkali metal, is submitted to the direct action of steam from below the surface, by means of a converter having an inverted bell with steam inlet, whereby the steam is decomposed and hydrogen gas and an alkaline hydrate are formed, the hydrate being immediately removed as formed.

623,918—April 25, 1899. W. LANG, C. PISTOR, AND M. OTTO. *Process of purifying caustic alkalis.*

The diffusiveness of a solution of the lyes, mixed with other solutions of a similar diffusiveness, is increased by increasing the degree of concentration, and the lyes are then separated from the mixture by diffusion into water through a diaphragm.

631,468—August 22, 1899. C. KELLNER. *Method of and apparatus for producing alkali salts.*
See Group X, Electro-chemistry.

636,234—November 7, 1899. E. BAKER. *Process of and apparatus for electrolytic decomposition of saline solutions.*
See Group X, Electro-chemistry.

637,410—November 21, 1899. G. H. POND. *Process of and apparatus for dissociating substances by electrolysis.*
See Group X, Electro-chemistry.

641,276—January 16, 1900. J. D. DARLING. *Porous diaphragm for cells employing fused electrolytes.*
See Group X, Electro-chemistry.

649,565—May 15, 1900. C. E. ACKER. *Process of manufacturing alkali and halogen gas.*
See Group X, Electro-chemistry.

652,611—June 26, 1900. J. HARGREAVES. *Combined diaphragm and electrode.*
See Group X, Electro-chemistry.

652,761—July 3, 1900. J. B. ENTZ. *Electrolytic production of caustic soda, etc.*
See Group X, Electro-chemistry.

SODIUM CARBONATES.

1,191—June 24, 1839. H. G. DYER AND J. HEMMING. *Improvement in the manufacture of carbonate of soda.*

Carbonate or bicarbonate of ammonia is used in converting common salt into a carbonate of soda, with recovery of the ammonia for use in subsequent operations.

9,346—October 19, 1852. H. PEMBERTON. *Improvement in making soda-ash and carbonates of soda.*

A mixture of sulphate of soda and carbonaceous matter is melted, without the addition of lime or other matter. An aqueous solution of the product is treated with carbonic acid and evaporated to dryness and again treated in the dry state by carbonic acid to form bicarbonate of soda.

39,213—July 14, 1863. L. CHANDOR. *Improvement in the manufacture of alkaline carbonates.*

Potassium and sodium sulphurets in solution are transformed into carbonates by the action of cream of lime and a current of carbonic acid. By the reaction of solutions of sulphuret of barium and sulphate of soda, sulphuret of sodium is obtained and sulphate of baryta. To free the sulphohydric acid from carbonic acid it is passed through a solution of sulphuret of barium, producing carbonate of baryta.

49,597—August 22, 1865. T. MACFARLANE. *Improved process of preparing chlorine, bleaching powder, carbonate of soda, and other products.*

Chlorine is produced by heating a mixture of calcined green vitriol, common salt, and peroxide of iron in a current of air, and the residue used for the manufacture of carbonate of soda and soda ash. A mixture of burnt lime and slag is used for the furnace hearths. In the manufacture of carbonate of soda and soda ash the deep green alkaline solution is decolorized by the application of heat and the passage of the flame and carbonic acid produced by combustion over the solution, the gases being absorbed. The artificial sulphuret of iron is converted into the sulphate by the action of the air and moisture, the sulphate being washed out with hot water and the solution concentrated.

55,600—June 19, 1866. H. M. BAKER. *Improvement in the manufacture of carbonate of soda, etc.*

Bicarbonate of magnesia, produced by charging carbonate of magnesia with carbonic acid under heat and pressure, is mixed with one equivalent proportion of sodium chloride, giving bicarbonate of soda and magnesium chloride. The latter is decomposed by heat, yielding muriatic acid, which is distilled out, and magnesia, which latter is bicarbonated and again used.

64,385—April 30, 1867. A. P. VON PÖHRNHOFF. *Improved process in the manufacture of bicarbonate of soda.*

Hydrate of soda is treated with carbonic gas and steam.

90,140—May 18, 1869. I. WALZ AND J. M. PENDLETON. *Improvement in the manufacture of carbonate of soda and other chemicals.*

A mixture of carbonate of lime and sodium nitrate in chemical proportions is heated in a retort with admission of steam to regenerate nitric acid. The product is available for caustic soda solutions.

116,664—July 4, 1871. W. H. BALMAIN. *Improvement in the manufacture of bicarbonate of soda.*

Bicarbonate of soda, being insoluble in a saturated solution of salt or of sulphate of soda, is washed and purified by allowing water to filter through it.

130,174—August 6, 1872. J. YOUNG. *Improvement in processes and apparatus for the manufacture of carbonate of soda.*

Bicarbonate of soda mixed with compounds of ammonia is boiled to reduce to carbonate of ammonia by driving off a portion of the carbonic acid and the residual compounds of ammonia, which are recovered.

136,463—March 4, 1873. E. SOLVAY. *Improvement in processes and apparatus for the manufacture of carbonate of soda.*

Carbonic acid gas is forced into the bottom of a high column of a solution of salt and ammonia, the liquor being fed into the column midway of its height. The ammonia is regenerated with magnesia or basic magnesium chloride, the residue being boiled down with steam and the chlorine condensed.

143,755—October 21, 1873. H. DE GROUSILLIERS. *Improvement in the manufacture of alkaline carbonates.*

They are produced from their haloid salts by treating same with carbonate of ammonia dissolved in strong alcohol or wood spirit.

195,142—September 11, 1877. J. MACTEAR. *Improvement in manufacture of granulated crystalline carbonate of soda.*

The "vat," or "red," or similar liquor is first carbonated and then concentrated, and cooled under agitation. The residuary liquor is boiled down to dryness and the salts decomposed in a furnace, as practiced with fresh soda-sulphate.

198,293—December 18, 1877. F. GUTZKOW. *Improvement in the manufacture of soda from its sulphate.*

Sulphate of lime is dissolved in water with the aid of sulphurous acid and sulphate of soda added, and the precipitated sulphate of lime removed. The solution of bisulphite of soda is then heated and converted into a neutral sulphite solution and treated with quicklime to form caustic soda and sulphite of lime. The caustic soda is exposed to the action of carbonic acid to convert it into a carbonate.

202,356—April 16, 1878. G. T. LEWIS AND W. J. MENZIES. *Improvement in manufacture of bicarbonate of soda.*

Bicarbonate of soda is produced by passing carbonic-acid gas through a mixture of sal soda and carbonate of soda by the ammonia process.

222,152—December 2, 1879. C. V. PETRAEUS. *Improvement in processes for manufacturing alumina and carbonate of soda.*

Hydrated alumina and carbonate of soda are manufactured from cryolite and bauxite, by roasting together crushed cryolite and caustic lime, adding crushed bauxite, and boiling the mixture in water and treating the solution with carbonic-acid gas.

222,153—December 2, 1879. C. V. PETRAEUS. *Improvement in processes for manufacturing alumina and carbonate of soda.*

A roasted mixture of cryolite and caustic lime is treated with water, the solution separated from the sediment, the liquor boiled with bauxite, and the liquor last formed separated from the sediment and treated with carbonic-acid gas, producing hydrated alumina precipitate and carbonate of soda in solution.

222,154—December 2, 1879. C. V. PETRAEUS. *Improvement in processes for manufacturing alumina and carbonate of soda.*

A mixture of bauxite and cryolite is boiled with milk of lime, the solution separated, and the clear liquor treated with carbonic-acid gas to form a precipitate of alumina and solution of carbonate of soda.

224,240—February 3, 1880. A. STEARNS. *Manufacture of carbonates and bicarbonates.*

The substance to be charged with gas is molded into perforated blocks and then exposed to the gas.

227,032—April 27, 1880. W. J. MENZIES. *Manufacture of bicarbonate of soda.*

Soda ash of commerce is dissolved in water; any free soda is neutralized with carbonic acid or bicarbonate of soda; chloride of lime is added to oxidize any sulphur compounds, and the solution is finally treated with carbonic acid.

227,561—May 11, 1880. W. J. MENZIES. *Manufacture of bicarbonate of soda.*

Bicarbonate of soda is purified of ammonia and organic coloring matter by passing a current of carbonic acid over or through dry bicarbonate of soda while under heat and pressure.

229,090—June 22, 1880. H. BURGESS. *Concentrating alkaline solutions.*

The liquid trickles downward through a tower in the presence of hot air or products of combustion which are induced to take the same downward course.

243,991—July 5, 1881. E. SOLVAY. *Manufacture of soda.*

About 50 per cent of soda, already decomposed or calcined, is mixed with bicarbonate of soda previous to introduction of same into the decomposing apparatus, to prevent incrustation.

251,962—January 3, 1882. E. SOLVAY. *Manufacture of soda.*

Waters obtained from the distillation of ammonia in the manufacture of ammonia soda are heated in a vessel which is heated to a higher temperature in its upper than in its lower portion, the salt being precipitated in the cooler portion and driven into a nonheated portion of the apparatus and separated out. The concentrated solution of calcium chloride is decanted from the remaining water and from the salt.

254,919—March 14, 1882. E. CAREY, H. GASKELL, JR., AND F. HURTER. *Purification of alkaline solutions.*

The solutions are submitted to the action of sulphur or sulphur compounds added to or produced in the alkaline solution, and of carbonic acid, the solution thus treated being then subjected to an elevated temperature to separate contained iron.

263,821—September 5, 1882. E. SOLVAY. *Manufacture of soda.*

Bicarbonate of soda is calcined under violent agitation so as to maintain it as a cloud of dust and secure contact of every particle with the heated walls.

263,981—September 5, 1882. E. SOLVAY. *Manufacture of soda by the ammonia process.*

A continuous supply of both brine and ammonia is fed to the saturating vessel, from which the overflow is conducted to a vessel in which precipitation of the sludge takes place before carbonating and during the continuous flow of the ammoniacal brine.

264,044—September 5, 1882. J. McCRODDEN. *Soda block.*

A block of soda has its surface grooved or furrowed to give a large surface for the action of heat and impregnating gases.

265,367—October 3, 1882. B. T. BABBITT. *Manufacture of bicarbonate of soda.*

Soda ash is blown against an abutment by a blast of carbonic-acid gas induced by a jet of superheated steam.

265,368—October 3, 1882. B. T. BABBITT. *Manufacture of bicarbonate of soda.*

Soda ash is treated with carbonic-acid gas under a super-atmospheric pressure.

270,668—January 16, 1883. E. N. HORSFORD AND C. A. CATLIN. *Preparing alkaline bicarbonates.*

Alkaline bicarbonates are moistened with solutions of salts of magnesium or with solutions of other salts which by double decomposition with the bicarbonates will form a superficial inert or less active carbonate—as by moistening with a solution of sulphate of magnesium—and then dried.

271,366—January 30, 1883. E. H. RUSSELL. *Process of purifying soda ash.*

Sodium carbonate is purified of sodium sulphide by dissolving in water containing hyposulphite of soda or potash and adding sulphate of copper.

276,020—April 17, 1883. H. GASKELL, JR., AND F. HURTER. *Manufacture of bicarbonate of soda.*

Anhydrous carbonate of soda is subjected to the action of aqueous vapor and carbonic-acid gas, the aqueous vapor being so proportioned as to produce a dry bicarbonate.

276,990—May 1, 1883. E. CAREY, H. GASKELL, JR., AND F. HURTER. *Manufacture of bicarbonate of soda.*

Salts, obtained by the evaporation of solutions of carbonate of soda, are mechanically agitated and treated with carbonic-acid gas, the excess being removed, and moisture removed or added as required.

283,508—August 21, 1883. E. W. PARNELL. *Manufacture of alkalis.*

Crude alkaline solutions obtained by the Le Blanc process are purified of sulphurets by adding zinc or zinc oxide dissolved in a caustic alkali solution.

287,551—October 30, 1883. C. KNAB. *Process of making sodium carbonate.*

A mixture of chloride of lead and caustic soda or potash is produced by the decomposition of chloride of sodium or potassium by the oxide of lead in water, and the caustic alkali is then dissolved out with alcohol, the alcoholic solution treated with carbonic acid, and the lead recovered in the moist way by precipitating with white cast-iron and subsequent oxidation.

298,256—May 6, 1884. J. TOWNSEND. *Process of obtaining soda.*

A mixture of kainit and silica, or silica and alumina, is heated to from 540° to 815° C., then air or steam is passed through or over it, whereby chlorine or hydrochloric acid is evolved. The sulphates in the residue are then mixed with carbonaceous material, heated and reduced to sulphides, and the latter treated with carbonic acid to form carbonates of soda and potash.

308,512—November 25, 1884. L. MOND AND G. JÁRMAY. *Manufacture of sodium bicarbonate.*

The crude soda is dissolved under pressure in water heated to near the decomposing point of sodium bicarbonate at that pressure; the insoluble matters separated; the solution cooled below 65° C.; the pressure removed; the solution cooled by passing through pans; and the pure sodium bicarbonate separated. The mother liquor is used for dissolving fresh crude salt.

320,256—June 16, 1885. A. KAYSER. *Process of making sodium carbonate.*

Sodium sulphate is heated to a low red heat below the smelting point of the sulphate and a current of carbonic-acid gas and carbon monoxide—one equivalent of each—is passed through the heated sulphate, forming carbonate of soda and sulphurous acid. The sulphurous-acid gas is employed for the conversion of sodium chloride into sodium sulphate.

326,423—September 15, 1885. H. GASKELL, JR. *Process of purifying ammonia soda.*

Bicarbonate of soda contaminated with ammonia is heated in an atmosphere of carbonic acid, to volatilize the ammonia without decomposing the bicarbonate, the gases withdrawn, and the ammonia condensed.

343,673—June 15, 1886. E. W. PARNELL AND J. SIMPSON. *Ammonia-soda process.*

The ammonium chloride obtained in the ammonia-alkali process is mixed with the alkali waste of the Le Blanc process, and the sulphide of ammonium so produced is employed for admixture with the sodium-chloride solution in the ammonia-alkali process, the hydrogen sulphide produced being collected and utilized.

357,824—February 15, 1887. J. HAWLICZEK. *Manufacture of bicarbonate of soda.*

A solution of a chloride or sulphate of sodium or other alkali metal is mixed with a crude carbonate or sulphide of sodium solution, and then treated with carbonic-acid gas in two stages, the impurities deposited in the first stage being separated, and bicarbonate of soda deposited in the second stage.

361,355—April 19, 1887. H. FRASCH. *Manufacture of soda by the ammonia process.*

The ammoniacal solution is passed through a succession of vessels, and treated with mixed live steam and exhaust steam. The ammoniacal vapors of the successive distillations are taken off separately. A large body of brine is maintained in the absorbing apparatus, and the ammonia is brought in contact with a part only of the same. The salt strength of the ammoniated brine is restored by passage through a vessel in which a body of salt is suspended near the upper part.

361,622—April 19, 1887. H. FRASCH. *Process of and apparatus for the manufacture of soda by ammonia.*

Limekiln gases are washed with a solution of soda, potash, or ammonia, or a carbonate thereof—such as the decomposed ammonium-chloride solution from which sodium carbonate has been separated—to remove sooty matters without absorption of carbonic acid, and then forced directly into the ammoniated brine. The brine is given a preliminary carbonation, then cooled, and then again carbonated to precipitate sodium bicarbonate. Ammoniated brine and an ammonium-chloride solution are introduced into the precipitating apparatus, so that in the early stages the formation of sodium bicarbonate in a liquid containing a considerable proportion of ammonium chloride is insured. Clogging of openings is prevented by artificially heating the walls of the openings.

363,952—May 31, 1887. H. FRASCH. *Process of and apparatus for making sodium carbonate by ammonia.*

The brine is treated with magnesium carbonate to precipitate calcium, then with sodium carbonate to precipitate the magnesium, and afterwards with ammonia and carbonic acid. The brine, under a continuous flow, is beaten into a spray in one or more tubes containing an atmosphere of ammonia. After saturation with ammonia the brine flows or percolates through a mass of solid salt to regenerate the solution. The brine is super-ammoniated, and its strength then reduced by addition of other brine. Revolving brackets carry compressed carbonic acid from above a body of ammoniated brine down into it and there discharge it. Ammoniated brine is treated with the gases obtained from burning lime with hydrocarbon oil or similar clear fluid fuel. A continuous filter employs a moving filter cloth.

364,552—June 7, 1887. E. SOLVAY. *Process of and apparatus for making sodium bicarbonate.*

Crude bicarbonate is decomposed by heat, the carbonic-acid gas evolved is cooled and lixiviated, the soda solution decanted and cooled, and then treated with the purified gas and the resulting carbonate filtered and dried.

376,409—January 10, 1888. A. KAYSER. *Process of making alkaline silicates and carbonates.*

Chloride of sodium (or potassium) is mixed with clay, and the mixture heated in a converter directly by passing highly-heated gases containing steam through the converter, converting the chloride into oxide and generating muriatic-acid gas. The converted material is smelted with an alkali and the sodium, or potassium, combinations extracted by lixiviation.

382,551—May 8, 1888. E. W. PARNELL AND J. SIMPSON. *Making sodium carbonates by sulphides of the alkaline earths.*

A mixture of ground sulphate of lime or baryta and carbonaceous matter is roasted in a nonoxidizing atmosphere; the sulphuret produced is mixed with chloride of ammonium and heated, and the sulphuret of ammonium evolved, together with carbonic-acid gas, is conducted into a solution of sodium chloride.

384,884—June 19, 1888. M. R. WOOD. *Manufacture of bicarbonate of soda.*

Crude bicarbonate mixed with water to a cream-like consistency is heated to 88° to 99° C. while subjected to pressure by forcing air into and through it to expel the excess of ammoniacal impurities. Carbonic acid is afterwards forced through it to replace any carbonic acid that may have been driven off by the air.

387,613—August 7, 1888. L. F. J. WRINKLE. *Process of treating native soda.*

A saturated solution of the crude soda in hot water is cleared by settling, strained while hot, partially cooled and crystallized, and run off into other vessels and further cooled and crystallized.

399,175—March 5, 1889. J. I. WATTS AND W. A. RICHARDS. *Salt of sodium.*

A new product, a salt, "sesquicarbonate of soda," containing one equivalent of bicarbonate of soda, one equivalent of monocarbonate of soda, and two equivalents of water, in chemical combination ($NaHCO_3Na_2CO_32H_2O$), produced by process No. 399,176.

399,176—March 5, 1889. J. I. WATTS AND W. A. RICHARDS. *Process of making a sodium salt.*

Sodium sesquicarbonate is produced by crystallizing at above 35° C. an aqueous solution containing not less than 3 equivalents of soda (Na_2O) to 4 equivalents of carbonic acid (CO_2).

401,699—April 16, 1889. F. H. GOSSAGE. *Process of making soda.*

In the manufacture of sulphide of sodium or potassium, to prevent destruction of the furnace lining, 8 parts by weight of sodium chloride is added to the mixture for every 20 parts of the sulphate.

415,644—November 19, 1889. G. KERNER AND J. MARX. *Process of electrolyzing salts of the alkalis.*

See Group X, Electro-chemistry.

430,734—June 24, 1890. F. W. A. FRERICHS. *Process of making alkaline carbonates and acetone.*

The acetate of an alkaline earth, as acetate of lime, is treated with the sulphate of the desired alkali to make an acetate of the same, which is then subjected to distillation, together with the anhydride of acetic acid.

439,330—October 28, 1890. L. A. STAUB. *Process of and apparatus for decomposing bicarbonate of soda.*

The bicarbonate is mixed with water at about 60° C. and treated with steam and ammonia in a closed chamber; carbonic acid is drawn off at the top and the monocarbonate, as a semiliquid mud, at the bottom.

446,267—February 10, 1891. B. PEITZSCH. *Process of treating Stassfurt salts.*

Potassic raw salts are treated with sulphuric acid, the sulphates thus obtained mixed with milk of lime, the gypsum thus formed and the magnesia being separated by filtering from the resulting solution of the alkaline sulphate, and the latter mixed with sulphide of barium and converted into a solution of sulphide of alkali and treated in a concentrated condition with carbonic acid. Separation of the bicarbonates of potassium and sodium is effected by their different degrees of solubility in water, and potash is obtained from its bicarbonate by roasting, and soda by calcination.

462,567—November 3, 1891. F. M. LYTE. *Process of making alkaline carbonate and chlorine.*

See Group X, Electro-chemistry.

492,929—March 7, 1893. K. J. SUNDSTROM. *Manufacture of soda.*

Bicarbonate mud is first treated with a solvent of the ammonia combinations, such as concentrated salt brine, and then water in fine spray is passed through the mud to remove the sodium chloride.

516,075—March 6, 1894. H. R. BROWNE. *Process of making soda crystals.*

Bicarbonate of soda obtained by the ammonia-soda process is heated until it is converted into a mixture of monocarbonate and bicarbonate of soda and the ammonia has been driven off; and the mixture thus obtained is then dissolved in caustic-soda liquor obtained by the electrolysis of brine, and the monocarbonate of soda crystallized out.

552,895—January 14, 1896. T. CRANEY. *Process of and apparatus for making carbonates of soda.*

See Group X, Electro-chemistry.

552,955—January 14, 1896. T. CRANEY. *Process of and apparatus for manufacture of sodium bicarbonate.*

See Group X, Electro-chemistry.

560,518—May 19, 1896. J. MEYRUEIS. *Treatment of sodium chloride.*

See Group X, Electro-chemistry.

579,317—March 23, 1897. E. J. CONSTAM AND A. VON HANSEN. *Process of manufacturing percarbonates.*

See Group X, Electro-chemistry.

636,448—November 7, 1899. W. D. PATTEN. *Process of making cakes of bicarbonate of soda.*

Moist carbonate of soda is formed into small cakes, and then treated with carbonic-acid gas, converting them into bicarbonate of soda and making them rigid.

BORATES.

449,064—March 24, 1891. N. M. BELL. *Art of manufacturing borax.*

Borate of lime is boiled with a carbonate of soda solution under pressure, with constant agitation or circulation, and then run into settlers and crystallizers. In the manufacture, the material is sorted into coarse and fine, and the coarse particles are first charged into the solution of the full strength required for the full charge of borates, and the finer particles added during the boiling.

476,592—June 7, 1892. J. ASCOUGH. *Process of making borax.*

The component parts—crystal sodium carbonate 71 pounds and boracic acid 62 pounds—are placed in a suitable vessel with a small quantity of water, in the shape of steam, and subjected to heat to drive off the superfluous moisture, then agitated in other vessels during process of cooling.

RECOVERY PROCESSES.

33,953—December 17, 1861. H. LOWE. *Improvement in processes of recovering soda used in the manufacture of paper stock.*

The spent solution of caustic soda is charged with carbonic-acid gas to precipitate the organic matter.

46,244—February 7, 1865. M. L. KEEN AND H. BURGESS (*Reissue: 7,485—January 30, 1877*). *Improvement in processes and apparatus for evaporating and calcining alkaline solutions.*

The solution is evaporated to dryness and calcined, being continuously subjected to flame and hot gases, whereby the vegetable matter is consumed.

53,839—April 10, 1866. T. F. LEHMANN. *Improved method of recovering waste alkali used in the manufacture of paper.*

The unspent caustic alkali of alkaline solutions is converted into a carbonate by carbonic-acid gas.

54,093—April 24, 1866. H. M. BAKER. *Improved process for recovering waste alkali.*

The waste liquor is evaporated to dryness and the residue subjected to destructive distillation.

83,733—November 3, 1868. C. D. J. SEITZ. *Improvement in recovering waste alkalies from paper stock and other fibers.*

The waste liquor is evaporated down to from one-half to one-fourth; soda is added (caustic soda or soda ash) and the hot solution run over quicklime, which disposes of the remaining water; and the mixture furnaced.

101,003—March 22, 1870. W. GOODAIRE AND G. STEAD. *Improvement in restoring waste alkali used in oil refineries.*

Spent alkali liquor is evaporated to a paste, and then calcined to consume the oleaginous portions, leaving black ash, which is leached, and the hot filtrated liquid treated with hydrated lime.

132,452—October 22, 1872. C. M. TESSIÉ DU MOTAY. *Improvement in recovering waste alkalis used in treating paper pulp.*

The hot liquor is treated with carbonic-acid gas and sulphuret of sodium, or a bicarbonate, after which it is boiled and then recaustified and the precipitated matter removed.

156,483—November 3, 1874. D. HANNA. *Improvement in processes for restoring and purifying caustic alkali.*

The spent liquor is agitated, filtered, heated to boiling with agitation, and then treated with quicklime, with or without ammonia.

157,919—December 22, 1874. A. S. LYMAN. *Improvement in restoring spent alkalis.*

Spent alkali is exposed to air currents for evaporation by means of revolving disks. The gases from the incinerating furnace pass through a filter stack that is kept moistened with dilute alkali.

181,405—August 22, 1876. S. BROWN. *Improvement in the process of saving caustic alkali in the manufacture of paper pulp.*

Straw is boiled in a weak solution of lime, crushed and reduced in a rag-engine to "half-stuff," and then subjected under steam pressure to the action of caustic alkali.

191,759—June 12, 1877. W. W. HARDING. *Improvement in restoring and recovering alkaline wastes.*

To recover alkali from the waste liquor used in disintegrating paper stock, it is first reduced to a dry, porous, or flocculent substance, by exposing the liquid in thin layers to the action of heated cylinders or plates and removing the dried material by scrapers or brushes as fast as formed, and then incinerating the porous mass in the hearth of a reverberatory furnace.

194,141—August 14, 1877. H. H. FURBISH. *Improvement in processes for recovering alkalis used for the reduction of wood to paper pulp.*

The spent lees are washed from the cooked mass in water heated by steam from the digester, evaporated, the ash recovered in a recovery furnace and boiled and rendered caustic by lime, and the same evaporated and reduced to proper strength.

229,264—June 29, 1880. C. C. MARKLE AND J. JORDAN. *Recovering soda from spent liquors after treating vegetable fiber.*

In incinerating the residue of the waste liquor, air-slaked lime is added to and burned with the residue to render the lime again caustic.

366,956—July 19, 1887. P. HOGAN. *Process of and apparatus for recovering alkali.*

Dry peat is saturated with spent liquor from the manufacture of wood pulp and other materials and heated in a slowly revolving cylinder, the vapor being conveyed off and forced into a convoluted condensing flue by a fan blower.

391,459—October 23, 1888. J. W. DIXON. *Process of concentrating liquids.*

The liquor is heated *in vacuo* by interior heating coils while passing through a cylinder, a vapor space being preserved above the liquor with constant exhaust of the vapors, and also continuous withdrawal of the liquor by suction.

403,869—May 21, 1889. V. G. BLOEDE. *Recovering spent alkali.*

Spent alkaline lyes are first saturated with phosphoric acid to precipitate the fatty and coloring matters; then decanted or filtered, any residuary color being destroyed with chlorine; and the clarified liquor is then treated with lime, barium, or like compound capable of forming an insoluble combination with the phosphoric acid and liberating the soda or potash in an available form.

403,870—May 21, 1889. V. G. BLOEDE. *Recovering alkali.*

Spent alkaline lyes are saturated with sulphurous acid, effecting a separation of the impurities, and the sulphites or bisulphites of the alkali are then converted into hydrates or carbonates by the action of caustic or carbonate of lime, barium or equivalent compounds.

405,754—June 25, 1889. S. WOLF. *Recovering soda.*

In the sulphate cellulose process there is added to the brown lye of the process acid sulphate of soda which has previously been treated with the lime mud of the said process, transforming the latter into gypsum, a well-known manure, the unwashed alkalis being recovered out of the calcareous mud.

418,265—December 31, 1889. E. N. ATWOOD. *Process of recovering soda.*

Spent soda liquor of wood-pulp mills is atomized and burnt as fuel under pressure. The products of combustion pass through water to catch floating particles of alkali.

418,274—December 31, 1889. F. A. CLOUDMAN. *Process of recovering soda.*

Chemicals, such as soda of spent soda liquors, are recovered by spraying liquor containing the chemical by means of steam and oil into a combustion chamber and burning the mixture as fuel.

424,756—April 1, 1890. H. BLACKMAN. *Process of recovering soda.*

The liquor is atomized by a gaseous blast, subsequently superheated, and the mixture is then injected into a furnace.

478,981—July 19, 1892. H. BLACKMAN. *Apparatus for and process of recovering alkali.*

The concentrated liquor is introduced in a bath on the calcining hearth and subjected to the heat of gases of combustion, the material being moved from said bath along the calcining hearth until its combustible constituents are calcined out, and the material is finally fused and allowed to flow off.

480,109—August 2, 1892. G. LUNGE AND J. DEWAR. *Process of recovering sulphur, carbonate of soda, and iron oxide.*

The residue obtained by decomposing sodium sulphide with a ferrite is acted on, in a moist condition, with a suitable mixture of carbonic acid and oxygen.

558,970—April 28, 1896. O. LUGO AND H. T. JACKSON. *Method of electrolytic treatment of soap-lyes.*

See Group X—Electro-chemistry.

620,751—March 7, 1899. L. J. DORENFELDT. *Process of utilizing sulphite lyes.*

The concentrated waste liquors of sulphite wood pulp mills are utilized as fuel by heating to liquidize, filtering under pressure, and then spraying into the combustion chamber.

620,755—March 7, 1899. V. DREWSEN AND L. J. DORENFELDT. *Process of utilizing sulphite lyes.*

The waste liquor is neutralized with sodium carbonate; evaporated with addition of calcium carbonate; the residuum burned; the sodium carbonate in the product leached out, and the insoluble calcium sulphide treated with carbonic acid, producing calcium carbonate and hydrogen sulphide, which latter is converted into sulphurous acid or sulphur.

PACKING PROCESSES.

15,957—October 21, 1856. G. THOMPSON. (*Reissue: 654—February 1, 1859; 2,569—April 16, 1867; 5,886—May 26, 1874.*) *Improvement in the manufacture of caustic alkali.*

A block of caustic alkali is inclosed in resin, beeswax, or other similar saponifiable material.

18,214—September 15, 1857. G. THOMPSON. *Improvement in boxes for preserving alkalis.*

A metallic box has the top and bottom united to the cylinder side with an infusible cement made of fire clay moistened with linseed oil.

52,465—February 6, 1866. T. C. TAYLOR. *Improvement in putting up caustic alkali.*

Metal cylinders are stood on end in sand, nearly filled with molten alkali, the top sealed with cement, then reversed and the bottom sealed with cement.

52,466—February 6, 1866. T. C. TAYLOR. *Improvement in putting up and preserving caustic potassa and soda.*

To prevent melting the solder a small quantity of alkali is poured into a case and allowed to partially cool, and the case is then filled by installments.

52,910—February 27, 1866. T. C. TAYLOR. *Improved method of putting up caustic alkali.*

Blocks of alkali are packed in a case, and oil, grease, or like material poured in to fill the interstices.

86,319—January 26, 1869. J. REAKIRT. *Improvement in putting up caustic alkalis.*

They are packed in glazed stone jars having a shoulder to receive a disk, the whole sealed with cement.

89,704—May 4, 1869. T. C. TAYLOR. *Improved mode of putting up caustic soda for the manufacture of soap.*

Caustic alkali is comminuted, then mixed with oil or grease and packed in barrels or vessels. It can be cut out as required for use.

110,189—December 20, 1870. W. H. BALMAIN. *Improvement in packing caustic alkalis.*

They are granulated or pulverized and packed in cases without the admixture of other materials. When in powdered form a corrosive liquid is not formed, but the moisture is absorbed until a protective coating of carbonate forms on each particle.

123,544—February 6, 1872. J. H. SEIBERT. *Improvement in packages for caustic alkalis, acids, and salts.*

They are made of a plastic compound, as plaster of paris, with one-tenth flour or marble dust, cast in a protecting wrapper. The heads are cast on to combine and form a solid casing.

124,859—March 19, 1872. J. H. SEIBERT. *Improvement in packages for alkalis, acids, etc.*

The package is formed by casting a plastic substance, as a mixture of glycerine, wax, and paper pulp between an inside and an outside protecting wrapper.

128,176—June 18, 1872. J. H. SEIBERT. *Improvement in packages for putting up caustic alkalis, acids, etc.*

It is cast of a plastic composition and coated with a resinous or protective coating. The alkali is congealed to conform to the package and then placed therein.

137,137—March 25, 1873. G. W. HUMPHREY. *Improvement in incasing caustic alkali.*

It is put up in india-rubber envelopes or coverings.

139,955—June 17, 1873. H. B. HALL. *Improvement in packages for caustic soda or alkali.*

The alkali is packed in a spun or stamped metal cup with a cover of resin poured in in a liquid state.

150,508—May 5, 1874. B. T. BABBITT. *Improvement in caustic-alkali packages.*

A block of caustic alkali hermetically sealed and protected from atmospheric influence by a coating or envelope of turpentine.

150,509—May 5, 1874. B. T. BABBITT. *Improvement in the processes for coating caustic alkalis.*

Balls or blocks of caustic alkali are submerged in melted turpentine in a vessel in which a vacuum is produced.

158,094—December 22, 1874. A. K. LEE. *Improvement in putting up caustic alkalis.*

Paper and wood as a carrier for caustic alkalis, etc., is first coated with a cement formed of white lead ground in oil, sulphur, and black oxide of manganese; then with a composition of asphaltum, paraffin, black oxide of manganese, and soapstone; the asphaltum, paraffin, and black oxide of manganese being reduced to a fluid by a product obtained from crude turpentine distilled at not exceeding 225° and from which the pyroligneous-acid water has been separated while the turpentine is in vapor.

164,405—June 15, 1875. T. C. TAYLOR. *Improvement in compositions for coating blocks of caustic alkali.*

It consists of a mixture of a fine earth and oil.

184,925—November 28, 1876. T. C. TAYLOR. *Improvement in methods of packing caustic alkali.*

It is inclosed in a solid molded form in a can, with a surrounding envelope of any mineral powder which will absorb the lye.

193,330—July 24, 1877. H. B. HALL AND E. HINE. *Improvement in processes and apparatus for putting up caustic alkali.*

Dry granulated caustic alkali is compressed into air-tight packages.

206,891—August 13, 1878. A. MENDLESON. *Improvement in compositions for coating alkali balls.*

It consists of Burgundy pitch 16 parts, plaster of paris 2 to 4 parts, and oil one-half part.

229,161—June 22, 1880. A. MENDLESON. *Coated caustic-alkali ball.*

A coated alkali ball has a sealing-boss formed of the coating over the spruespot.

238,064—February 22, 1881. M. M. SMITH. *Manufacture of alkali balls.*

A series of alkali balls is cast on a common wire and coated.

243,939—July 5, 1881. W. J. MENZIES. (*Reissue: May 9, 1882, No. 10,108 for the process; No. 10,109 for the product.*) *Grinding and sieving caustic alkali.*

Caustic alkali is ground and sieved while hot or in a temperature sufficiently high to prevent deliquesence.

256,095—April 4, 1882. B. T. BABBITT. *Method of putting up caustic alkali.*

The molten alkali is run into cans with soldered heads, which are set in water or otherwise cooled during the process of filling.

260,272—June 27, 1882. B. T. BABBITT. *Method of putting up caustic alkali.*

Cans formed of a cylindrical body and a head with an outwardly turned flange inserted into the body are filled with the molten alkali, and the heads are then inserted while the alkali is still molten, and pressed down upon the alkali, and finally, after the alkali has hardened, soldered to the can.

261,228—July 18, 1882. C. HEMJE AND T. C. BRECHT. *Process of and apparatus for compressing plastic and other materials.*

Compressed cakes of plastic or other material, as bicarbonate of soda, have a cemented crust or film of the same material formed thereon, as by subjecting them to a bath of steam. The steam may be impregnated with gum arabic.

270,997—January 23, 1883. T. C. TAYLOR. *Packing caustic alkali.*

Pulverized alkali is mixed with resinous or fatty matter—about 20 per cent—and compressed into balls or blocks, and finally given a suitable coating to prevent deliquescence.

270,998—January 23, 1883. T. C. TAYLOR. *Packing caustic alkali.*

A fatty or resinous matter is added to caustic alkali during the process of grinding or preparation to prevent the giving off of caustic dust.

275,498—April 10, 1883. E. KIRK. *Treatment of caustic soda.*

A new composition, consisting of a mixture of powdered caustic soda and powdered sand.

282,633—August 7, 1883. T. S. HARRISON. *Process of producing a perfumed soap alkali.*

A package of soap-making alkali contains a soluble or fusible capsule of perfume.

286,132—October 2, 1883. F. P. HARNED. *Process of grinding caustic soda.*

One or 2 per cent of carbonate of soda or soda ash is added to caustic alkali, and it is then ground and bolted without deliquescence.

287,128—October 23, 1883. C. HEMJE. *Method of compressing pulverized material.*

In the formation of compressed cakes of pulverized material, as of bicarbonate of soda, the molds are subjected to a jet of steam prior to filling, which condenses on the sides of the mold, and the cakes formed have a glazed exterior shell composed of the same material as the body of the cake.

318,044—May 19, 1885. C. SEMPER. *Process of grinding caustic soda.*

Ground salt cake or dried sulphate of soda—say 4 per cent—is added to caustic soda, and the mixture ground and bolted.

338,924—March 30, 1886. J. W. CARSON AND F. P. HARNED. *Manufacture of blocks of bicarbonate of soda.*

It is compressed into blocks immediately on removing it from the carbonating chambers or the washing tables, and before drying or grinding.

624,972—May 16, 1899. H. PRECHT. *Process of packing caustic alkalies.*

The caustic alkali is cast in blocks and packed in casks, with an alkaline carbonate packed in between the caustic-alkali blocks and the walls of the cask.

GROUP III.—POTASH.

POTASHES, CARBONATES.

228—June 10, 1837. G. CLEMENT. *Improvement in the process of leaching ashes.*

In setting up the leach a small quantity of hot unslaked lime and hot ashes is placed in the middle of the ashes.

1,697—July 18, 1840. J. OSBORN. *Improvement in the mode of extracting the alkali from ashes in the manufacture of potash.*

A little alum with lime and salt is added to the leaching solution.

3,733—September 7, 1844. E. CHAMBERLIN. *Improvement in the manufacture of saleratus.*

The volatile products of the combustion of anthracite coal, purified only of dust in connection with steam, are employed for the conversion of pearlash.

124,964—March 26, 1872. M. B. MANWARING AND R. DE WITT BIRCH. *Improvement in the manufacture of potash and phosphate of lime.*

Potash is extracted from the ashes of cotton-seed hulls by boiling in water and adding lime.

130,613—August 20, 1872. W. WENTWORTH AND G. W. CLEAVELAND. *Improvement in the manufacture of pearlashes.*

Ground bark, preferably spent tan bark, is mixed with the lye, the liquor evaporated, and the residuum incinerated.

216,483—June 10, 1879. J. AND R. H. WOODRUM. *Improvement in separating potash from ashes.*

Water at boiling heat is percolated through the ashes heated to a red heat.

252,653—January 24, 1882. C. R. ENGEL. *Manufacture of carbonate of potassium.*

A double carbonate of magnesium and potassium is first formed by treating a mixture of carbonate of magnesium, or free magnesia, and an aqueous solution of a potassium salt with carbonic-acid gas. Carbonate of potassium is then separated out of the double carbonate by boiling or heating in a dry state.

376,366—January 10, 1888. F. BRÜNJES. *Process of obtaining potassium carbonate.*

A mixture of potassium chloride and ammonia-magnesium carbonate is dissolved in water and the precipitate which forms is removed and digested in water to separate the potassium chloride which goes into solution, the other carbonates being less soluble.

484,921—October 25, 1892. P. RÖMER. *Process of making potassium carbonate.*

A mixture of equal molecules of potassium sulphate and potassium bichromate in aqueous solution is converted by means of calcium hydrate or barium or strontium hydrate into potassium chromate, the solution saturated with carbonic acid, the precipitated potassium bichromate separated from the potassium bicarbonate produced, the potassium bichromate remaining in solution is separated, and lastly a potassium carbonate containing chromium is obtained from the lye by further evaporation.

GROUP IV.—ALUMS.

AMMONIA ALUM.

308,623—December 2, 1884. W. J. MENZIES. *Manufacture of burnt alum.*

Concentrated solutions of sulphate of ammonia and sulphate of alumina are mixed in the proportion of 1 part of the former to 4 parts of the latter and evaporated to dryness.

POTASH ALUM.

328,477—October 20, 1885. H. C. FREIST. *Manufacture of crystal alum.*

Crystal alum free from iron is produced by treating a solution of sulphate of alumina containing iron with chlorate of potash or like oxidizing agent to convert the ferrous oxide into ferric oxide, and adding, either before or after the impurities have been removed, sulphate of potash, sulphate of ammonia, or sulphate of soda, and crystallizing the alum.

521,712—June 19, 1894. J. HEIBLING. *Process of making potash alum and alumina.*

A mixture of clay, sulphate of potash, and sulphate of ammonia (in the proportion of the alumina of the clay and sulphate of potash each 1 part, sulphate of ammonia 3 parts) molded into bricks is heated to from 275° to 300° C., until the ammonia is driven off, when it is dissolved, the iron eliminated, and the ammonia previously removed is added, whereby the alumina is precipitated and the sulphate of ammonia and sulphate of potash are regenerated.

SODA ALUM.

267,610—November 14, 1882. P. & F. M. SPENCE. *Manufacture of alum.*

In the manufacture of soda alum, cold saturated solutions are mixed with stronger solutions—as of sp. gr. 1.55—of a higher temperature, to prevent solidification with crystallization, or, if solidified, to change into the crystalline form.

420,488—February 4, 1890. E. AUGÉ. *Process of making soda alum.*

A solution of sodium sulphate combined with a solution of aluminum sulphate is condensed by evaporating in vacuo at a temperature not exceeding 60° C., cooled and crystallized.

435,129—August 26, 1890. E. AUGÉ. *Process of crystallizing soda alum.*

A solution of sulphate of alumina and sulphate of soda is concentrated to between 1.32 and 1.42 sp. gr., cooled to a pasty form, and then exposed in layers upon inclined surfaces at a temperature of 15° to 20° C. till the mother liquors are separated.

454,189—June 16, 1891. F. M. & D. D. SPENCE AND A. ESILMAN. *Process of making soda alum.*

Sufficient sulphate of soda is dissolved in a boiling concentrated solution of sulphate of alumina, or alumino-ferric sulphate, of a sp. gr. not exceeding 1.3, to form with the sulphate of alumina soda alum; the impurities settled in a closed vessel; the solution evaporated to a sp. gr. of from 1.425 to 1.450, then agitated and cooled until a magma is formed, which is stirred and turned over from time to time until it is converted into crystals of soda alum and mother liquor.

456,294—July 21, 1891. F. M. & D. D. SPENCE. *Manufacture of soda alum.*

To a boiling concentrated solution of soda alum, prepared from sulphate of alumina and sulphate of soda, or from alumino-ferric and sulphate of soda, of a sp. gr. of 1.450, there is added a small quantity of a cold saturated solution of soda alum sufficient to yield on cooling of the mixture a magma not too stiff to be freely stirred and turned over until transformed into crystals of soda alum and mother liquor.

497,570—May 16, 1893. T. S. HARRISON AND C. SEMPER. *Aluminous compound.*

A compound of sulphate of alumina and double sulphate of alumina and soda; a hard, dry compound, readily ground, but highly soluble; the product of process No. 497,571.

497,571—May 16, 1893. T. S. HARRISON AND C. SEMPER. *Process of making aluminous compounds.*

An aluminous solution is hardened by adding powdered sulphate of soda, say 20 per cent, to the concentrated aluminous solution ready to run off.

CONCENTRATED ALUM.

1,945—January 23, 1841. M. J. FUNCKE. *Improvement in the manner or process of manufacturing sulphate of alumina.*

The clay is prepared by desiccation, reduced to a powder, and treated with sulphuric acid, dried, then treated with water to dissolve the salt, settled, and any free acid neutralized with lime water. The clear liquor is drawn off and the iron precipitated with prussiate of potash, the exact quantity required being ascertained by a test sample.

60,780—January 1, 1867. H. PEMBERTON. *Improvement in the manufacture of sulphate of alumina, alum, and other aluminous compounds.*

In place of sulphuric acid, the acid solution obtained from the tarry acid residuum resulting from the refining of petroleum, etc. (impure sulphuric acid), is used.

191,160—May 22, 1877. C. LENNIG. *Improvement in processes of manufacturing aluminic sulphate and alum.*

The alumina in clay or kaolin is dissolved by sulphuric acid under pressure in a closed vessel.

196,043—October 9, 1877. G. P. ROCKWELL. *Improvement in manufacture of alum.*

Aluminic sulphate and alum are manufactured by the decomposition of the mineral indianaite, a practically pure silicate of alumina, by means of sulphuric acid, and the elimination of the separated silica. For alum the equivalent of alkali is added prior to crystallization.

208,615—October 1, 1878. F. LAUR. (*Reissue: 8,882—September 2, 1879; 9,340—August 10, 1880.*) *Improvement in manufacture of sulphate of alumina.*

In the process of manufacturing sulphates of alumina a neutral solution is made and then pieces of zinc ore introduced to convert the iron into a colorless compound of iron prior to concentration.

221,787—November 18, 1879. A. A. CROLL. *Improvement in the manufacture of sulphate of alumina.*

The saturating vessel is jacketed to prevent the escape of heat and maintain the fluidity of the mass, and the charge is drawn off successively from different levels, producing batches of different grades.

230,106—July 20, 1880. W., T., & J. CHADWICK AND J. W. KYNASTON. *Process of making and purifying sulphate of alumina or alum.*

In the manufacture of alumina, alum cake, or alum, the iron is precipitated out of the solution by treating with arsenious acid and neutralizing with carbonate of lime. The remaining arsenic is then precipitated by hydrogen sulphide.

237,816—February 15, 1881. W., T., & J. CHADWICK AND J. W. KYNASTON. *Purifying sulphate of alumina.*

Iron is removed from the aluminous solution by the addition of ferrocyanide of calcium, and the arsenic then precipitated by a soluble sulphide, as hydrogen sulphide, by this means carrying down the suspended ferrocyanide. A small quantity of sulphate of copper or sulphate of zinc is used when arsenic is not employed to remove the suspended ferrocyanide.

239,089—March 22, 1881. J. H. EASTWICK. *Manufacture of sulphate of alumina.*

Halloysite (Indianaite) is ground and bolted—roasting being dispensed with—mixed with sulphuric acid, and then treated with hydrate of alumina, producing spontaneous ebullition and decomposition of the halloysite.

243,949—July 5, 1881. B. E. R. NEWLANDS. *Manufacture of sulphate of alumina.*

Sulphate of alumina is purified of sulphuric acid and iron by evaporating a solution of impure salt to the point of crystallization on cooling, or by adding sufficient water to the salt to obtain the impurities in solution and leave the sulphate pure, and then separating the mother liquor containing the impurities by pressure or centrifugal action.

245,750—August 16, 1881. C. SEMPER. *Manufacture of sulphate of alumina.*

A solution of ferruginous sulphate of alumina is treated in a finely divided state or in spray with sulphurous acid or hydrogen sulphide to decolorize it.

257,567—May 9, 1882. C. FAHLBERG AND C. SEMPER. *Method of removing iron from ferruginous saline solutions.*

The ferruginous solution is treated with plumbic dioxide either by adding same to the solution or by converting a neutral monobasic or polybasic salt of lead, or an oxide of lead into plumbic dioxide in said solution. Ferrous oxides are first converted into ferric oxides.

257,568—May 9, 1882. C. FAHLBERG AND C. SEMPER. *Recovery of plumbic dioxide from ferruginous solutions.*

The waste plumbic dioxide and ferric plumbate is treated with nitric acid, or other acid or acid salt, to recover the iron.

264,773—September 19, 1882. C. SEMPER. *Removing iron from ferruginous solutions.*

The solution is treated with manganese dioxide or manganic sesquioxide. Ferrous oxide when present should first be converted into ferric oxide and the solution should be basic or neutral. The spent manganic dioxide is revived by treatment with dilute sulphuric acid.

264,774—September 19, 1882. C. SEMPER. *Process of removing iron and manganese from certain solutions.*

Iron and manganese are both removed by a single operation from ferruginous solutions (of such salts as are not decomposed in the operation of the process) containing manganous salts by treatment with a permanganate and heat.

266,451—October 24, 1882. R. A. FISHER. *Sizing for paper makers.*

An aluminous compound containing sodium or zinc, a new product of a viscid or creamy consistency is produced by neutralizing a portion of the acid of an acid solution of aluminum sulphate by means of sodic or zincic oxide or zinc, evaporating the solution to about 37° Baumé, and then cooling under agitation.

266,452—October 24, 1882. R. A. FISHER. *Sizing for paper makers' use.*

Sulphate of alumina of a viscous or creamy consistency, a new product, is made by cooling under agitation a solution of sulphate of alumina evaporated to about 37° Baumé when boiling.

280,088—June 26, 1883. C. SEMPER. *Manufacture of sulphate of alumina.*

A neutral porous alumina sulphate containing magnesia sulphate is produced by treating a hot solution of alumina sulphate of such degree of concentration that it will harden when cold, with carbonate or bicarbonate of magnesia.

280,089—June 26, 1883. C. SEMPER. *Manufacture of sulphate of alumina.*

A neutral or basic alumino-magnesian compound is formed by treating a hot acid solution of sulphate of alumina with magnesic carbonate, bicarbonate, or oxide.

280,090—June 26, 1883. C. SEMPER. *Manufacture of sulphate of alumina.*

Porous alumina sulphate containing zinc is produced by adding zinc sulphite to a hot solution of alumina sulphate from which silica has been removed, and which is of such degree of concentration as to harden when cold.

321,092—June 30, 1885. R. A. FISHER. *Neutral sizing material for paper makers' use.*

A solution of sulphate of alumina free from iron is made neutral or slightly basic with oxide of zinc, or other suitable neutralizing material; insoluble matter, if any, is removed; the clear solution concentrated to about 65° Baumé; bicarbonate of soda added to the hot viscid mass to produce a porous or vesicular structure, and the mass cooled and broken into lumps.

321,093—June 30, 1885. R. A. FISHER. *Neutral sizing material for paper makers' use.*

For the production of a white sizing material from ferruginous aluminous sulphate a solution of sulphate of alumina containing iron is prepared, the ferric sulphate reduced to ferrous sulphate, and the solution made neutral, etc., as per No. 321,092.

321,094—June 30, 1885. R. A. FISHER. *Manufacture of an aluminous sizing material for paper makers' use.*

For the production from any ferruginous sulphate of alumina solution of a porous sizing material free from iron, nearly all of the iron is first converted into insoluble prussian blue by means of a slight excess of yellow prussiate of potash, the incidently formed soluble prussian blue removed and the excess of yellow prussiate of potash by means of oxide of zinc; when the solution of sulphate of ammonia is freed from prussian blue and other insoluble matter by subsidence, filtration, or otherwise, and concentrated to about 65° Baumé, etc., as in No. 321,092.

321,095—June 30, 1885. R. A. FISHER. *Manufacture of a sizing material for paper makers' use.*

For the manufacture of a porous sulphate of alumina containing magnesia, but free from iron and excess of alumina and acid, artificial hydrate of alumina free from iron is dissolved in sulphuric acid and water; then magnesia or carbonate of magnesia is added to the hot fluid, which is then cooled until it begins to thicken, when bicarbonate of soda is added to produce a porous or vesicular structure.

321,096—June 30, 1885. R. A. FISHER. *Sizing material to be used in the manufacture of paper.*

For the manufacture of a sizing material containing both zinc and iron, but free from an objectionable buff color, hot sulphuric acid is mixed into any ferruginous alum clay, water being added from time to time to prevent overflow; the liquor is then drawn off, settled, decanted, and treated with zinc and bicarbonate of soda.

321,097—June 30, 1885. R. A. FISHER. *Manufacture of sizing for paper makers' use.*

For the manufacture of a porous sizing material free from iron direct from ferruginous aluminous mineral, hot sulphuric acid is mixed with finely ground ferruginous alum clay; all or nearly all of the iron is removed by means of a plumbic oxide, manganese dioxide or sesquioxide, or potassium permanganate or other precipitate of iron from aluminous solutions, and the solution is cleared and concentrated and bicarbonate of soda added.

321,098—June 30, 1885. R. A. FISHER. *Manufacture of sizing material for paper makers' use.*

In the production of a porous sizing material direct from ferruginous aluminous minerals, hot sulphuric acid is mixed with ferruginous alum clay, the ferric oxide reduced to ferrous oxide by the addition of zinc, and the clear liquor decanted, concentrated, and treated with bicarbonate of soda.

333,680—January 5, 1886. C. SEMPER. *Manufacture of sizing compounds for paper makers' use.*

Plumbic oxide, or other substance which will precipitate iron, is added to a neutral ferruginous solution of sulphate of alumina, which is then filtered, and either before or after treatment with plumbic oxide, oxide of zinc is added to make the solution sufficiently basic not to act upon ultramarine blue. Bicarbonate of soda is finally added to make the product porous.

345,604—July 13, 1886. C. SEMPER. *Process of making porous alum.*

A ferruginous solution of sulphate of alumina is treated with plumbic dioxide or other precipitant of iron from aluminous solutions, the insoluble matter is removed, and bicarbonate of soda is added to the solution in a sufficiently cool and concentrated condition, and the vesicular mass is crushed or broken into lumps.

345,605—July 13, 1886. C. SEMPER. *Process of making porous alum.*

A ferruginous solution of sulphate of alumina is treated with zinc to reduce ferric oxide to ferrous oxide, the insoluble impurities removed, and the clear liquor in a sufficiently cool and concentrated condition treated with bicarbonate of soda, and finally the mass is crushed into lumps.

351,210—October 19, 1886. C. SEMPER. *Sizing material for paper makers' use.*

A solution of sulphate of alumina free from iron is treated with oxide of zinc, either before or after the removal of any insoluble matter, and then, when sufficiently concentrated and cooled, bicarbonate of soda is added.

351,211—October 19, 1886. C. SEMPER. *Sizing material for paper makers' use.*

A solution of sulphate of alumina containing iron is treated with a reducing agent to convert ferric sulphate into ferrous sulphate, and it is then treated with oxide of zinc to render it neutral or basic; any insoluble matter is removed, and, when sufficiently concentrated and cooled, bicarbonate of soda is added.

503,901—August 22, 1893. W. E. CASE. *Process of making aluminum compounds.*

An insoluble aluminum compound, free from iron, is obtained by treating an aqueous solution of crude aluminum sulphate with nitric and sulphuric acids, adding calcium fluoride, then adding a solution of an alkali carbonate, as sodium carbonate, to precipitate iron, and mechanically separating the liquid from the solid products of the reaction. The solution is then treated with a further quantity of the alkali carbonate to precipitate the aluminum compound.

520,416—May 29, 1894. J. ENEQUIST. *Process of making porous sulphate of alumina.*

A hot concentrated solution of sulphate of alumina is run off and solidified on a zinc or aluminum surface, whereby the hydrogen given off makes the material porous.

ALUM CAKE.

209,488—October 29, 1878. G. T. LEWIS. *Improvement in manufacture of alum cake and sulphate of alumina.*

The aluminous materials are ground and mixed with sulphuric acid in one operation, and the mixture afterwards heated from 82° to 126° C.

217,460—July 15, 1879. T. S. HARRISON. *Improvement in manufacture of aluminous cake.*

Fibrous aluminous cake, a new article of manufacture, has fibrous silicate of magnesia, or fibrous sulphate of lime or equivalent material, substituted for the silica of alum cake.

220,720—October 21, 1879. F. LAUR. *Improvement in the manufacture of aluminous cake.*

Zinc is introduced into an acidulated ferruginous solution of sulphate of alumina to neutralize the free acid and convert the iron into a colorless iron compound prior to concentration.

225,300—March 9, 1880. C. V. PETRAEUS. *Manufacture of aluminous cake.*

White aluminous cake is made from ferruginous aluminous sulphate by treating the aluminous sulphate in solution with alkaline sulphides, sulphides of alkaline earths, or metallic sulphides, such as finely ground zinc blende or galena.

225,301—March 9, 1880. C. V. PETRAEUS. *Manufacture of aluminous cake.*

The peroxide of iron in ferruginous aluminous sulphate is reduced to the protoxide and decolorized by the addition of powdered or spongy lead, and then boiling or agitating the solution.

233,916—November 2, 1880. G. F. BIHN AND R. HEERLEIN. *Manufacture of aluminous cake.*

Aluminous sulphate in a semifluid condition is treated with sulphites, bisulphites or hyposulphites of the alkalis, alkaline earths, or the metallic bases to decolorize the iron and produce a white cake.

234,704—November 23, 1880. G. F. BIHN. *Manufacture of white aluminous cake.*

A pulverized mixture of halloysite and bauxite is treated with sulphuric acid and the mass decolorized as in No. 233,916.

238,613—March 8, 1881. C. SEMPER. *Manufacture of aluminous cake.*

A ferruginous aluminous sulphate is treated with oxalic acid, or oxalates of the alkalis, of the alkaline earths, or of the metallic bases to produce a colorless aluminous cake containing the iron salts.

240,597—April 26, 1881. G. T. LEWIS AND C. V. PETRAEUS. *Manufacture of aluminous cake.*

The last traces of prussian blue are removed from an aluminous-cake solution, to which yellow prussiate of potash has been previously added, by treating the liquor with metallic zinc, oxide of zinc, or zinc ore.

243,635—June 28, 1881. C. SEMPER. *Manufacture of aluminous cake.*

Ferruginous aluminous sulphate is decolorized by treating it in a semifused condition with zinc or zinc dust.

253,377—February 7, 1882. T. S. HARRISON. *Manufacture of aluminous cake.*

A blue aluminous cake containing ferrocyanide of iron is produced by precipitating the iron as prussiate of iron in a ferruginous aluminous sulphate solution and then concentrating the solution without removing the prussiate of iron.

271,371—January 30, 1883. C. SEMPER. *Manufacture of aluminous cake.*

The aluminous sulphate in a semifused condition is treated with sulphites, bisulphites, or hyposulphites of the alkalis, alkaline earths, or the metallic bases.

342,599—May 25, 1886. F. P. HARNED. *Process of making neutral aluminous compounds.*

In the manufacture of sulphate of alumina pulverized caustic soda or aluminate of soda is mechanically mixed with the product during the grinding to neutralize the free acid, the quantity required for the neutralization being ascertained by a test of the aluminous cake.

344,140—June 22, 1886. C. SEMPER. *Process of making a sulphate of alumina compound.*

A basic compound containing basic sulphate of alumina and sulphate of magnesia and water is produced by treating a neutral or slightly basic solution of sulphate of alumina with the oxide, carbonate, or bicarbonate of magnesia.

443,685—December 30, 1890. H. W. SHEPARD. *Process of making alum cake.*

Sufficient sulphuric acid is added to bauxite or other aluminous material to form basic sulphate of alumina, when an alkaline or alkaline earthy sulphide, as impure calcium sulphide, is added to the hot pasty mass and mixed therewith in quantity sufficient to reduce the soluble iron to the ferrous state. The mass is then diluted with water and the dissolved sulphate separated from the insoluble impurities and concentrated.

526,205—September 18, 1894. J. V. SKOGLUND. *Aluminous cake and process of making same.*

An aluminous cake free from ferric iron and consisting of sulphate of alumina, ferrous iron, an excess of a stannous compound, and a stannic compound, is produced by reducing the greater portion of the iron in a ferruginous sulphate of alumina solution by means of a weaker reducing agent, such as sulphurous acid or a sulphite, and then finishing the reduction with any stannous compound as stannic oxide.

OTHER ALUMS.

222,152—December 2, 1879. C. V. PETRAEUS. *Improvement in processes for manufacturing alumina and carbonate of soda.*

See Group II, Sodium Compounds.

223,442—January 13, 1880. R. A. FISHER. *Preparing a sizing material used by paper makers.*

A neutral compound consisting essentially of sulphate of alumina and zinc is made by treating a solution of sulphate of alumina with oxide of zinc.

223,443—*January 13, 1880.* R. A. FISHER. *Manufacture of a white compound for paper makers' use.*

A solution of sulphate of alumina, obtained from aluminous earths containing iron, is treated with a reducing agent to convert ferric into ferrous salts, and then with oxide of zinc to neutralize the free acid.

228,867—*June 15, 1880.* W., T., & J. CHADWICK AND J. W. KYNASTON. *Process for the purification of alumina, bauxite, etc.*

The iron in aluminous materials, such as bauxite or clay, is converted into a soluble oxalate by treating with a solution of oxalic acid, and the oxalate is then removed by filtration and decantation.

269,957—*January 2, 1883.* C. V. PETRAEUS. *Manufacture of porus zinciferous alum.*

Porus zinciferous alum is produced by adding carbonate of zinc to molten sulphate of alumina.

282,878—*August 7, 1883.* F. GARDAIR AND T. GLADYSZ. *Manufacture of anhydrous alumina.*

Crystals of chlorhydrate of aluminum are prepared by the reaction of chlorhydric acid upon a solution of aluminum sulphate, and then decomposed by heat.

301,174—*July 1, 1884.* A. E. SPENCER. *Desiccating alum.*

It is melted and dried in a revolving cylinder by heat externally applied, the alum flowing evenly over the interior surface of the cylinder.

312,894—*February 24, 1885.* C. V. PETRAEUS. *Manufacture of alumina by paper-mill sludge.*

A product free from iron is produced from ferruginous aluminous material by mixing same with the spent soda-liquor from wood-pulp manufacture, evaporating down, and burning.

GROUP V.—COAL-TAR PRODUCTS. See Group XVIII.

GROUP VI.—CYANOGEN COMPOUNDS.

CYANIDES.

269,309—*December 19, 1882.* L. MOND. *Manufacture of cyanogen compounds and ammonia.*

In the manufacture of barium cyanide and ammonia, briquettes are formed of an intimate mixture of carbon, carbonate or oxide of barium, and a refractory basic absorbent—such as magnesia—and heated in a reducing flame before exposure to nitrogen, or the mixture is heated in mass, cooled, and broken up. The nitrogenous gases are passed through the hot barium salts, thereby cooling them, and then through fresh layers of barium salts and carbon at the temperature required to form cyanogen compounds.

277,851—*May 15, 1883.* A. T. SCHUESSLER. *Process of treating spent lime from gas works for cyanides.*

The soluble substances are extracted by leaching; the liquor treated with carbonic-acid gas and the hydrogen sulphide utilized; while the residuum of the first process is decomposed by the addition of commercial salt of sulphate of potash, the precipitate removed, and the liquor evaporated to form salt for the manufacture of ferrocyanides.

484,579—*October 18, 1892.* G. T. BEILBY. *Process of making cyanides.*

Ammonia is passed through a liquid-fused mixture of anhydrous alkali, cyanide, and carbon. The gases may be led through secondary retorts containing alkalized charcoal at a suitable temperature for the formation of cyanide.

507,753—*October 31, 1893.* D. J. PLAYFAIR. *Process of making cyanides.*

A sulphocyanate (sulphocyanide or thiocyanate) is heated to from 800° to 1,000° F. with a metal fusible at the said temperature, of the class comprising lead and zinc, producing a sulphide insoluble in the cyanide. The cyanide is separated by settling or lixiviation.

509,957—*December 5, 1893.* W. SIEPERMANN. *Process of and apparatus for making cyanides.*

Ammonia is passed into a mixture of alkaline carbonates and powdered charcoal, heated to a dark-red heat, and the heat is subsequently raised to a bright red. Cyanide of potassium is separated from its aqueous solution by gradually increasing the percentage of carbonate of potash or caustic potash.

526,592—*September 25, 1894.* C. T. J. VAUTIN. *Process of making cyanides of alkaline metals.*

In the manufacture of cyanides of the alkaline metals from ferrocyanides by the substitution of an alkaline metal for the iron, instead of potassium or sodium an alloy of the alkaline metal with lead is used, and the resulting fused cyanide is separated from the residue of iron and lead.

539,279—*May 14, 1895.* W. McD. MACKEY. *Process of making potassium cyanide.*

A carbonaceous and potassium mixture is treated in a vertical furnace having two sets of tuyères at different levels and an intermediate outlet for the cyanide vapors.

541,066—*June 18, 1895.* H. Y. CASTNER. *Process of making cyanides.*

Previously or separately made alkaline metal is treated with nascent nitrogen and carbon.

543,643—*July 30, 1895.* H. Y. CASTNER. *Process of and apparatus for making alkali cyanides.*

A molten alkali metal, as sodium, at a temperature of 300° to 400° C., is introduced into an atmosphere of anhydrous ammonia in the proportions of 23 pounds of alkali metal for each 17 pounds of ammonia gas. The amid produced is withdrawn and passed through carbon heated to redness.

546,328—*September 17, 1895.* C. HOEPFNER. *Anode for electrolytic apparatus.*

See Group X, Electro-chemistry.

548,058—*October 15, 1895.* B. HUNT. *Process of recovering cyanides.*

A solution of zinc sulphate containing some free sulphuric acid is added to spent cyanide liquor, the supernatant liquor is drawn off, more than sufficient sulphuric acid is added to the precipitate to decompose the zinc cyanide, the mixture is distilled, and the distillate washed and passed through two caustic alkali solutions, the first containing sufficient alkali to combine with a part only of the hydrocyanic acid, and the other an excess of alkali for absorbing the remainder.

567,551—*September 8, 1896.* J. RASCHEN. *Process of making cyanides.*

A sulphocyanide, as of sodium or calcium, mixed with water, is heated in the presence of an oxidizing agent, as nitric acid, and the evolved gases passed through a solution of caustic alkali or alkaline earth, whereby the hydrocyanic acid is absorbed. The unabsorbed nitric-oxide gas is reconverted into nitric acid with air and steam.

567,552—*September 8, 1896.* J. RASCHEN. *Process of making cyanides.*

Referring to No. 567,551, the evolved oxidized gases are passed through a heated-water scrubber, where the nitrous fumes are retained, then into cold water or a water tower, by which the hydrocyanic acid is absorbed for subsequent obtainment of cyanide, then through or in contact with lime water to obtain cyanide, the escaping nitric oxide being reconverted into nitric acid.

569,104—*October 6, 1896.* J. A. KENDALL. *Process of and apparatus for making cyanides.*

The heating vessel, which may be made of nickel or sheet cobalt, with a platinum discharge flue, is inclosed in an outer vessel with hydrogen gas circulating through the intervening space.

569,325—*October 13, 1896.* P. DANCKWARDT. *Process of and apparatus for producing cyanides.*

See Group X, Electro-chemistry.

576,264—*February 2, 1897.* J. D. GILMOUR. *Process of making cyanides.*

A mixture of carbonaceous material and an alkali at a high temperature is treated with atmospheric nitrogen, forming a cyanide, which is lixiviated, and carbon dioxide and nitrogen, obtained from combustion of carbon in atmospheric air, is passed through the solution while at a high temperature, forming hydrocyanic acid and a carbonate of the base of the cyanide. The said acid and carbonate are separated, and the carbonate dried and mixed with carbonaceous material in a fresh operation, and the nitrogen, freed from the said carbon dioxide, is passed therethrough while maintained at a high temperature.

577,837—*March 2, 1897.* H. Y. CASTNER. *Process of making cyanide.*

Molten alkali metal is percolated through carbon heated to redness in the presence of a current of free nitrogen. The molten alkali metal enters the retort and the cyanide is conducted out through trapped pipes.

579,639—*March 30, 1897.* H. W. CROWTHER, E. C. ROSSITER, G. S. ALBRIGHT, AND J. J. HOOD. *Process of and apparatus for making cyanides.*

In the manufacture of ferrocyanides the iron is cleaned by treating it with an alkaline or alkaline-earth sulphide. It is then mixed with a sulphocyanide and the mixture dried in the presence of an inert gas, as limekiln gases, to prevent oxidation.

579,988—*April 6, 1897.* C. KELLNER. *Process of producing metallic cyanides.*

See Group X, Electro-chemistry.

590,217—*September 21, 1897.* A. FRANK AND N. CARO. *Process of making cyanides.*

Carbides of a suitable metal—as a metal of the alkalis—are heated to a red heat and subjected to the action of nitrogen saturated with steam. A caustic alkali or an alkali carbonate may be mixed with the carbide.

591,575—*October 12, 1897.* J. R. MOÏSE. *Process of making cyanides.*

Boride of nitrogen is produced by calcining a mixture of biborate of sodium 100 pounds, and hydrochoride of ammonium 150 pounds, lixiviating with boiling water acidified with hydrochloric acid, and filtering. A mixture of the boride of nitrogen thus obtained with carbonate of potassium and carbon is heated to a dark red, forming cyanides and borates, which are separated by crystallization. Ferrocyanide is produced direct by adding iron filings to the mixture.

591,730—*October 12, 1897.* W. BAIN. *Process of and apparatus for electrolyzing.*

See Group X, Electro-chemistry.

596,641—*January 4, 1898.* H. R. VIDAL. *Process of making cyanides.*

Cyanogen compounds are produced by heating phospham (PN_2H) with a carbonate, *e. g.*, phospham, 6 parts, potassium carbonate, 19 parts. The addition of coal carbon produces a cyanide instead of a cyanate, and iron a ferrocyanide. Sulphocyanides are obtained in the presence of sulphur, and gaseous cyanogen by heating a mixture of phospham and dry natural potassium oxalate.

605,694—*June 14, 1898.* H. S. BLACKMORE. *Process of making cyanides.*

Metallic sulphides, as potassium sulphide, are converted into cyanides, sulphocyanides and ferrocyanides by introducing a metallic carbide, as granular iron carbide, into the molten sulphide and passing nitrogen gas therethrough.

607,507—*July 19, 1898.* P. DANCKWARDT. *Process of and apparatus for making ferrocyanides.*

A mixture of an alkali sulphocyanide, as that of sodium, with lime, charcoal, and a carbide or carbides, preferably calcium carbide and iron carbide, is heated, leached with water, and the ferrocyanide separated.

607,881—*July 26, 1898.* H. REICHARDT AND J. BUEB. *Process of making cyanides from molasses lyes.*

Cyanide of ammonium is produced direct from molasses or molasses lyes by distilling with exclusion of air and maintaining the gases at about 1,100° C. until cyanide of ammonium is formed, by passing them through highly heated fire-brick flues. The cyanogen is separated as ferrocyanide by leading the gases through an iron-salt solution.

623,709—*April 25, 1899.* A. FRANK AND N. CARO. *Process of making cyanides.*

A carbide, as an alkaline metal carbide, is mixed with an oxide of a metal only, and heated in the presence of nitrogen, free or bound. It is heated to a temperature below the melting point of the cyanide until absorption of nitrogen ceases, and then the temperature is raised to the melting point.

625,964—*May 30, 1899.* J. BUEB. *Process of extracting cyanogen from coal gas.*

The gas, before going to the ammonia scrubbers, is passed through a concentrated solution of a metallic salt—as chloride or sulphate of iron—thereby precipitating all of the cyanogen and part of the ammonia, and leaving the greater part of the ammonia with the gas.

641,571—*January 16, 1900.* W. WITTER. *Process of producing solution of cyanogen halide.*

A solution of cyanogen halide—such as chloride or bromide—is produced by electrolyzing, without a diaphragm and with inert electrodes, a solution containing an alkali cyanide, an alkali halide, such as chloride or bromide, and the salt of a metal—as magnesium—which forms an insoluble hydroxide.

642,782—*February 6, 1900.* J. BUEB. *Process of making hydrocyanic acid.*

Gases resulting from the destructive distillation of organic matters, cooled and freed of ammonia, are subjected to contact with alcohol, as in an alcohol tower, and the alcoholic solution of hydrocyanic acid is subjected to fractional distillation. The hydrocyanic-acid gas is separated from the alcohol by reaction with alcoholic caustic alkali.

651,346—June 12, 1900. A. DZIUK. *Process of making cyanides.*

Cyanides and ferrocyanides of the alkaline earth metals, including magnesium, are produced by subjecting carbides of the said metals in the nascent state to the action of a superheated current of pure nitrogen, as by passing heated nitrogen over the carbide while in a fluid state in an electric furnace.

FERROCYANIDES.

441—October 28, 1837. H. STEPHENS. (*Reissue: 3—April 21, 1838.*) *Improved manufacture of coloring matter.*

Prussiate of potash or soda is produced by passing the gases evolved from the distillation of animal matters, or other matters that yield nitrogen and hydrocarbons, direct into a mass of alkali in a state of fusion, and then into a solution of alkali contained in separate vessels. Prussian blue of commerce is digested in strong acid to render it more soluble in oxalic acid, and then dissolved in oxalic acid as a final process.

5,419—January 25, 1848. M. KALBFLEISCH. *Improved mode of treating animal matters previous to calcination for the manufacture of prussiates of potash or soda.*

Animal matter of any kind is dissolved in caustic potash or soda and dried before calcining.

222,547—December 9, 1879. J. TCHERNIAC AND U. GUNZBURG. *Improvement in processes of and apparatus for making ferrocyanides.*

Carbon disulphide and an ammoniacal solution are mixed under heat, and the resultant sulphocyanide of ammonium is mixed with lime under heat; a soluble carbonate or sulphate, as of potassium, is added to the solution; and finally the resultant sulphocyanide is mixed with lime, carbon, and iron, and heated to a red heat.

245,661—August 16, 1881. T. RICHTERS. *Manufacture of potassium ferrocyanide.*

Nitrogenous material is moistened with a solution of carbonate of potassium, dried without combustion while in contact with carbonic acid, then heated in a retort to drive off the volatile ingredients, and the residuum lixiviated with iron; the prussiate of potash being then separated from the liquor, which can be used for moistening fresh material.

259,802—June 20, 1882. H. BOWER AND W. L. ROWLAND. *Process of obtaining ferrocyanides from gas liquor.*

The ammoniacal liquor is treated with iron or a ferric salt, and then with lime (and the ammonia distilled off), and the ferrocyanides are extracted from the sediment by the addition of an alkaline salt, such as potassium or sodium carbonate.

259,908—June 20, 1882. C. C. PARSONS AND E. F. CRUSE. *Process of obtaining cyanides.*

Iron in the form of a salt or in the insoluble form of hydrate, carbonate, oxide, or sulphide, or of metallic iron, is added to ammoniacal gas liquor in the absence of acid and without neutralizing the ammonia; and before the ammonia is removed, to convert the cyanides of ammonium into ferrocyanides of ammonia. Lime is then added, the ammonia distilled off, and the ferrocyanides of calcium converted into prussian blue by the addition of acid and a salt of iron.

291,163—January 1, 1884. C. DE VIGNE. *Manufacture of ferrocyanides.*

Coal gas containing cyanogen or hydrocyanic acid is cooled and deprived of tarry products and then passed through a mixture of iron and an alkaline salt, as iron filings and crystallized carbonate of soda, the mixture being subsequently washed and the solution evaporated to obtain the ferrocyanide.

303,437—August 12, 1884. H. KUNHEIM AND H. ZIMMERMANN. *Process of making ferrocyanides.*

Ferrocyanide of calcium potassium is produced by precipitating ferrocyanide of calcium from its solution by means of chloride of potassium. Spent materials used in gas purification may be used.

312,248—February 17, 1885. H. BOWER. *Manufacture of ferrocyanide of potassium.*

A mixture of nitrogenous animal matters, potassium carbonate, and iron is heated and the resultant cake or melt treated with water and carbon dioxide.

362,236—May 3, 1887. J. VAN RUYMBEKE. *Obtaining cyanide and ferrocyanide from tank water.*

A solution of alkali, as soda or potash, holding finely divided baryta in suspension, is added to tank water which has been prepared from animal substances by the action of steam at a high heat and under pressure, and the resulting solution evaporated to about 20 per cent of the moisture, when the residue is subjected to destructive distillation at red heat and the ammonia generated is forced to pass downward through the porous mixture of red-hot alkali, carbon, and cyanides already formed.

465,600—December 22, 1891. W. L. ROWLAND. *Process of recovering cyanides from coal gas.*

A soluble salt of iron is added to the water used for extracting the ammonia from the gas passing through the scrubbers, in proportion to remove cyanides, but insufficient to remove sulphides, thus forming soluble ferrocyanide of ammonia along with the ammonia compounds. The ammonia is boiled off and the residue treated with lime to give ferrocyanide of calcium, which is treated with an alkaline chloride or sulphate, and the resulting double salt decomposed with an alkaline carbonate to form an alkaline ferrocyanide.

556,130—March 10, 1896. H. BOWER. *Process of making prussiates.*

Prussiate of potash or soda is produced from sulphocyanide of iron by forming cyanide of potassium, adding to this the sulphocyanide during fusion, and then cooling, lixiviating, and crystallizing.

560,965—May 26, 1896. H. BOWER. *Process of recovering cyanogen compounds from gas liquors.*

An acidified solution of a copper salt is added to gas liquor containing soluble ferrocyanide and sulphocyanide and freed of ammonia, to form insoluble ferrocyanide and sulphocyanide of copper, and metallic iron is then added to decompose the precipitate and form a solution of sulphocyanide of iron. If the last step is conducted with heat and pressure, there is produced sulphide of copper and ferrocyanide of iron.

624,383—May 2, 1899. W. SCHRÖDER. *Process of making yellow prussiate of potash.*

The gaseous products of the destructive distillation of coal are passed through an aqueous solution of protochloride of iron, and the solution is then distilled with milk of lime to precipitate calcium ferrocyanide. The excess of lime in the residual solution is first precipitated; then ferric chloride is added to precipitate the remaining calcium ferrocyanide, and the entire precipitate is treated with a solution of potassium carbonate to precipitate calcium carbonate and ferric hydrate, when the solution is concentrated to crystallize out the yellow prussiate of potash.

OTHER CYANIDES.

570,480—November 3, 1896. J. J. HOOD AND A. C. SALAMON. *Manufacture of cyanogen compounds.*

Carbon bisulphide, ammonia, and a fixed base or bases, as peroxide of manganese and lime, are heated together in such proportions that the products of the reactions of the carbon bisulphide and ammonia combine with the fixed base or bases, forming sulphocyanide and sulphide of the base or bases, the whole of the ammonia being utilized in the production of sulphocyanic acid.

578,908—March 16, 1897. G. J. ATKINS. *Chlorocyanid salts and process of making same.*

A new series of compounds, chlorocyanide salts, efficient agents for leaching ores, consist of an alkali and a compound of cyanogen fused together, at as low a temperature as possible, with one or more bases; as, for example, potassium ferrocyanide 1 part and sodium chloride 2 parts.

GROUP VII.—WOOD DISTILLATION.

38,071—March 31, 1863. M. A. LE BRUN-VIRLOY. *Improvement in drying and carbonizing wood, peat, and other fuel.*

First, the material is introduced at one side or end of a furnace and withdrawn from the other side or end in a state suitable for use as fuel; second, the doors or openings are hermetically closed; third, regulated taps, valves, and registers control the admission and exit of air, gas, and other volatile products; fourth, a portion of the volatile products is collected and removed after the whole or part of its caloric has been utilized; fifth, the material and débris of little value and the combustible gases are utilized; and, sixth, the material to be treated is subjected first to a low temperature and then to a gradually increasing temperature.

49,247—August 8, 1865. A. H. EMERY. *Improvement in the manufacture of pyroligneous acid.*

In the distillation of wood in the manufacture of pyroligneous acid, steam is admitted in large quantities, while the heat is not raised sufficiently to char the wood until the wood is thoroughly dried and a large portion of the spirits of turpentine and resin taken out, when the heat is raised to commence rapid charring, the steam being nearly or quite shut off.

62,097—February 12, 1867. P. H. VANDER WEYDE. *Improvement in the manufacture of white lead.*

For use in the manufacture of white lead, acetic acid is produced from the distillation of wood, and at the end of the operation the remaining charcoal is transformed into carbonic acid by blowing air into the bottom of the still. The precipitate is treated with a hot alkaline solution of quicklime, or its equivalent, and the filters washed out with lime water.

93,817—August 17, 1869. L. D. GALE AND I. M. CATTMAN. *Improvement in the manufacture of sugar of lead and acetic acid.*

See Group I, Acetic Acid.

118,787—September 12, 1871. C. J. T. BURCEY. *Improvement in the manufacture of acetate of lime.*

Superheated vapors of pyroligneous acid and dry slaked lime are agitated together. The empyreumatic vapors are condensed, the gaseous products of condensation being utilized for combustion in the furnace.

131,312—September 10, 1872. J. D. STANLEY. *Improvement in processes and apparatus for producing oils, etc.*

Vapor from the distillation of pine wood is passed into condensing water, the uncondensed vapor passes off as an inflammable gas, the floating oil is separated, and the condensing water and acids flow off as waste.

184,898—November 28, 1876. H. M. PIERCE. *Apparatus and process for treating wood for charcoal and other purposes.*

To make concentrated pyroligneous acid the hot volatile products are exhausted from a charcoal kiln and compressed until the acid vapors are liquefied, the temperature being maintained at such height that the diluting water will be separated and permitted to escape in a vaporized condition.

185,141—December 5, 1876. E. R. SQUIBB. *Manufacture of acetic acid.*

Wood in a retort is subjected to the action of heat in an oven, whereby, the temperature being even and controllable, an acid practically free from tar is obtained.

300,384—June 17, 1884. J. A. MATHIEU. *Distillation of wood.*

The vapors resulting from the carbonization of the upper portion of a mass of material in a retort are partially condensed by passing the vapors downward through the uncarbonized portion of the material.

353,998—December 7, 1886. T. W. WHEELER. *Process of and apparatus for distilling wood.*

Wood is first subjected to distillation with steam under low pressure and temperature, thereby softening the wood and driving off the turpentine vapors, which are passed into a bath of limewater, warmed and agitated by a current of steam; when the wood is softened the steam valve and turpentine-vapor valve are closed, the oil valve opened, and the temperature raised to nearly 400° F., thereby quickly running off the creosote oil and pyroligneous acid, which are separated until they run off of the same gravity, when the tar valve is opened and the temperature gradually lowered until the tar and gas are run off.

385,777—July 10, 1888. G. RUMPF. *Manufacture of acetone.*

See Group XVIII, Ketones.

388,529—August 28, 1888. F. S. CLARK. *Process of obtaining creosote, etc.*

The process consists in mingling a caustic-soda solution containing creosote or analogous phenoloid bodies with pyroligneous acid, thereby occasioning a reaction between the mingled bodies, and depositing creosote, and forming acetate of soda by the union of the soda solution and the acetic acid of the pyroligneous-acid solution.

393,079—November 20, 1888. G. RUMPF. *Manufacture of acetone.*

See Group XVIII, Ketones.

407,442—July 23, 1889. E. MEYER. *Process of obtaining methyl alcohol from woodpulp lyes.*

See Group XVIII, Alcohols.

490,497—January 24, 1893. F. H. & R. H. PICKLES. *Process of purifying pyrolignites.*

Pyrolignites in a liquid state are purified of tarry matters by treatment with the carbonaceous residue obtained in the manufacture of prussiate of potash, or alkaline carbonaceous matter prepared by carbonizing animal matter with carbonates or hydrates of the alkalis.

504,264—August 29, 1893. F. J. BERGMANN. *Method of distilling wood waste.*

The method of manufacturing wood vinegar from wood waste, such as sawdust or chips, consists in converting the same into blocks by pressure up to about three hundred atmospheres, expressing water contained in the wood, then carbonizing the blocks in retorts, and precipitating the gases generated.

535,652—March 12, 1895. O. PORSCH. *Process of making acetone.*

See Group XVIII, Ketones.

577,302—February 16, 1897. A. HESSE. *Terpene alcohol.*

See Group XVIII, Alcohols.

622,194—March 28, 1899. F. W. J. F. SCHMIDT. *Method of preparing wood for dry distillation.*

The wood is cut crosswise of the grain into thin laminæ, and then distilled.

648,389—May 1, 1900. H. O. CHUTE. *Process of making acetone.*

See Group XVIII, Ketones.

RESINS AND TURPENTINE.

4,412—March 14, 1846. N. U. CHAFEE. *Improvement in the manufacture of rosin and spirits of turpentine.*

In the manufacture of white resin and white spirits of turpentine from the gum of pines, steam is conducted in and mixed with the gum in a still and then passed through a metal heater.

5,004—March 13, 1847. N. L. MARTIN. *Improvement in refining turpentine.*

Spirits of turpentine are refined by the use of alkali and water, using a strong solution of potashes and water, not less than 12 pounds to the gallon, and 1 gill of alkali to a gallon of spirits of turpentine.

7,528—July 30, 1850. C. J. MEINICKE. *Improvement in distilling spirits of turpentine.*

Crude turpentine is mixed with grease and soda solution and heated, forming a soap, a solution of common salt is added and the spirits of turpentine distilled, leaving the resin saponified ready for soap making.

8,488—November 4, 1851. L. S. ROBBINS. *Improvement in tanners' oil from rosin.*

The product obtained by distilling a mixture of oil, which has been distilled from resin at about 600° F., and slacked lime, say about 5 per cent, with the addition of steam, followed by a second distillation with caustic lime, and further treatment of the product with steam.

8,489—November 4, 1851. L. S. ROBBINS. *Improvement in lubricating oil from rosin.*

The product obtained by distilling a mixture of oil, which has been distilled from resin at about 550° F., and slacked lime, say about 5 per cent, with the addition of steam, followed by a second distillation with caustic lime, and further treatment of the product with steam.

8,490—November 4, 1851. L. S. ROBBINS. *Improvement in distilling acid and naphtha from rosin.*

Resin is melted and heated up to 325° F., or thereabouts, and maintained between 300° F. and 325° F. until the acid and water are driven off, when steam is injected and the temperature maintained at 325° F. to throw off the naphtha.

8,491—November 4, 1851. L. S. ROBBINS. *Improvement in paint oil from rosin.*

The product obtained by the double redistillation with steam of oil which has been distilled from resin at about 650° F. and further treatment of the product with steam.

9,680—April 19, 1853. S. L. DANA. *Improvement in purifying rosin oil.*

Resin oil is deodorized by combining the fluid formed by the first distillation of resin or resin oil with slacked lime or other alkaline, earthy or equivalent metallic base, and distilling the compound.

9,752—May 24, 1853. M. PAGE. *Improvement in processes of distilling rosin oil.*

Steam is introduced into the head of the goose-neck so that the vaporized oils will pass through and be commingled therewith.

10,849—May 2, 1854. H. HALVORSON. *Improvement in processes for distilling rosin oil.*

Clay is mixed with resin—5 parts of clay to 1 part of rosin—and the mixture distilled; no pitch residuum being left in the retort.

27,624—March 27, 1860. D. FEHRMAN. *Improvement in the manufacture of resin.*

Resin is purified by treatment and distillation in a vacuum pan with a small quantity of water and steam at low temperature, rising from 150° F. to 180° F.

27,646—March 27, 1860. H. NAPIER. *Improvement in the manufacture of resin.*

The crude turpentine is heated in a still until it attains a temperature rather exceeding that of steam at a pressure of 10 pounds, then steam at said pressure is caused to permeate and pass through the mass without condensation, until all the oil of turpentine has passed over, when the heat is raised to 550° to 600° F. with the continued blowing of steam through the mass at the same pressure.

28,663—June 12, 1860. S. FRAZER. *Improvement in distillation of oils from resin.*

Crude resin is distilled and certain specified quantities of product are successively drawn off from the receiver of the condenser, the temperature of the product being successively raised from 74° F. for the first drawing to 132° F. for the fourth drawing, and then lowered to 106° F. for the fifth drawing.

44,314—September 20, 1864. D. HULL. *Improvement in extracting rosin and other substances from pine wood.*

Resin is produced direct from pine wood by heating same with heated air or superheated steam, the outgoing blast being conveyed to a condenser, where the spirits of turpentine is collected.

44,435—September 27, 1864. G. R. H. LEFFLER. *Improvement in distilling turpentine from wood.*

Turpentine is distilled direct from wood saturated or thoroughly moistened with steam or water.

46,092—January 31, 1865. A. H. EMERY. *Improvement in obtaining spirits of turpentine, oil, resin, and other products from pine wood.*

A current of ordinary steam is passed over and through the wood into a condenser, the retort being externally heated enough to prevent condensation of steam, the pressure in the boiler being sufficient to give the requisite heat. When the spirits of turpentine have passed over, the temperature is increased for the remaining products.

48,406—June 27, 1865. D. HULL. *Improvement in extracting turpentine and other products from resinous woods.*

Pine or other resinous wood is distilled under less than atmospheric pressure.

49,248—August 8, 1865. A. H. EMERY. *Improvement in the manufacture of pitch.*

Pitch is made from pine wood by one distillation, by heating the bottom of the retort to the requisite degree.

49,249—August 8, 1865. A. H. EMERY. *Improvement in the manufacture of turpentine, etc.*

Wood is distilled under more than atmospheric pressure, say, up to 2 or 3 atmospheres, without the application of steam or superheated steam, to secure an increased production of oil of turpentine and resin before destructive distillation begins.

50,132—September 26, 1865. J. JOHNSON. *Improvement in the manufacture of spirits of turpentine.*

Water, steam, air or gases, and solvents are caused to circulate among the wood in suitable receptacles at a temperature sufficiently low to secure the extractive terebinthinates and resins free from empyreumatic odors. The wood is placed over a stratum of water which condenses the volatile products of the wood and fixes the resin. Two boilers are successively used to economize the heat and save waste of terebinthine products. Suitable soluble salts are added to raise the boiling point and increase the temperature for extraction. Wood is compressed after steaming to eliminate oleo-resins.

54,081—April 17, 1866. J. A. PASTORELLI. *Improved method of extracting turpentine from wood.*

In the distillation of resinous woods for the extraction of essence of turpentine, etc., the wood is placed in a boiler over a fire together with water to form steam to prevent the burning of turpentine formed.

89,493—April 27, 1869. J. MERRILL. *Improvement in the manufacture of rosin oil.*

Resin oil is deodorized by gradually raising the temperature and distilling off the odorous naphthaly oil until the oil coming over reaches from 18° to 14° Baumé's hydrometer, when the distillation is stopped, the remaining oil being virtually free from odor.

100,953—March 15, 1870. J. TREAT. *Improvement in the manufacture of rosin oil.*

Resin oil is refined and bleached by adding from 2 to 4 ounces of caustic soda per gallon of oil and a small quantity of gum benzoin, and distilling. Steam is introduced into the worm to commingle with the vapor before condensation.

130,598—August 20, 1872. J. D. STANLEY. *Improvement in distilling and purifying turpentine from wood.*

The vapor from the distillation of pine wood is introduced into a receiver containing the vapor generated from water or other liquid impregnated or saturated with lime, which vapors combine and condense.

139,402—May 27, 1873. A. K. LEE. *Improvement in bleaching resins.*

Resin is reduced to a powder or small lumps and bleached by the direct action of steam and heat while the mass is under agitation.

145,151—December 2, 1873. S. L. COLE. *Improvement in the production of turpentine from sawdust.*

Spirits of turpentine is produced from sawdust by destructive distillation by the application of fire direct to a retort containing the same.

179,960—July 18, 1876. A. ROCK. *Improvement in production and treatment of resin.*

In the distillation of scrap turpentine and the production of resin therefrom the condensable vapors are eliminated while under treatment in a retort during distinct and separate meltings, or exposures to a melting heat, followed in each instance by an exposure to a cooler temperature, and the vapors are condensed, whereby colopholic acid is prevented from being unduly developed in the resin; the vapors are eliminated by means of currents of air sweeping over the turpentine or resin while successively melted and cooled.

180,467—August 1, 1876. L. J. DUROUX. *Improvement in purifying spirits of turpentine.*

Powdered alum, or alum water, is mixed with spirits of turpentine—2 to 3 per cent of powdered alum or a solution of 5 to 10 per cent of alum in water equal to the turpentine—and agitated, and the mixture allowed to settle, when the purified spirit is drawn off.

194,701—August 28, 1877. A. MARTIN. *Improvement in the manufacture of brewer's pitch.*

Brewer's pitch is made direct from crude turpentine, using oil of resin instead of tallow or other oils, by first melting the turpentine and drawing off a portion, reducing the remainder by extracting spirits and acids before adding the oil of resin and ocher, and, when drawing off the mass through a strainer, adding thereto a portion of turpentine first drawn off.

200,168—February 12, 1878. D. M. BUIE. (*Reissue: 10,338—June 5, 1883.*) *Process of manufacturing oils from organic substances.*

See Group XVI, Essential Oils.

242,015—May 24, 1881. J. A. MCCREARY. *Process of and apparatus for distilling turpentine.*

The crude material is diluted with a suitable menstrum, as spirits of turpentine; an alkali added, the excess of the latter precipitated, filtered, and then distilled; and pending the process of distillation the uncondensed products are conducted from the worm to the still and forced through the liquid contents of the latter.

276,981—May 1, 1883. L. PRADON. *Method of and apparatus for the manufacture of oil from resinous wood.*

Pine oil, a mobile transparent liquid, $C_{20}H_{16}$, produced by distilling resinous wood at a temperature of about 400° C. It is mixed with petroleum or coal oil to form an illuminating oil.

277,505—May 15, 1883. H. M. PIERCE. *Process of and apparatus for the recovery of turpentine and other wood products, and for the manufacture of charcoal.*

The vapors from wood distillation are subjected to the action of a spray of water, whereby the oils and resinous matters are separated, and the supernatant oily matter is then drawn off.

277,506—May 15, 1883. H. M. PIERCE. *Process of and apparatus for the manufacture of turpentine.*

Wood is subjected in a closed chamber to the action of heated gases and steam, and the gases and vapors withdrawn and condensed.

284,367—September 4, 1883. L. BELLINGRATH. *Process of manufacturing rosin and spirits of turpentine.*

Crude turpentine is melted and heated by steam heat to a temperature sufficient to volatilize the spirit which is driven off and condensed, the resin being passed through sieves and retained heated and in a liquid state by steam heat until all the water and vaporizable impurities are dispelled.

324,878—August 25, 1885. D. J. OGILVY. *Rosin oil.*

As a new article of manufacture, resin oil of commerce treated with and containing an alkaline salt of sodium or potassium sufficient to wholly or partially neutralize the resinous acids, say from $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent of commercial caustic soda.

386,138—July 17, 1888. E. KOCH. *Process of distilling pine wood for the production of crude dry turpentine and pine tar.*

The pine oil is extracted by dry distillation; the distillate treated with milk of lime and agitation; the mixture settled; the oil and lye or other impurities combined therewith separated; the oil agitated with dilute sulphuric acid to remove the last traces of alkali; and the oil finally distilled.

390,451—October 2, 1888. F. S. CLARK. *Pine-oil product.*

An oily body, light in color, sp. gr. heavier than water, not distilling over below 500° F., not volatile at ordinary temperatures, not flashing when heated under 350° F., and becoming solid between zero and 32° F., is produced by the fractional distillation and treatment of pine oil. (Process No. 390,454.)

390,452—October 2, 1888. F. S. CLARK. *Pine-oil product.*

An oily body, sp. gr. at 68° F. of 0.856, completely volatilizing if soaked in paper, boiling at 326° F., produced from the distillation and treatment of pine oil. (Process No. 390,454.)

390,454—October 2, 1888. F. S. CLARK. *Process of refining pine oil.*

The process consists in fractionally distilling pine oil and separating the fractions at or about 540° F., and in separately treating said fractions by two or more fractional distillations and treatments with caustic soda and one or more treatments with sulphuric acid. (Products Nos. 390,451 and 390,452.)

393,942—December 4, 1888. J. B. UNDERWOOD. *Process of distilling turpentine.*

A refined petroleum is mixed with crude turpentine and the mixture distilled, thereby obtaining an increased yield of spirit, and toughening the resin left as a residuum.

395,731—January 8, 1889. E. A. BEHRENS. *Bleaching and refining resins and other substances.*

Resins are first dissolved in a volatile substance, having a low boiling point, such as naphtha, the solution mixed with an alkali to separate the impurities, the alkali and impurities removed, the solution mixed with a suitable bleaching agent and the latter removed, and finally the resin separated by evaporation of the solvent and the latter recovered. The movements of the solutions are controlled by the compression and exhaustion of the air.

495,543—April 18, 1893. G. COL. *Process of treating crude resins and their residues.*

The heated crude products are stirred, then run into settling tanks and settled, and the upper liquid portion decanted and distilled until the volatile matters have passed into a condenser.

508,608—November 14, 1893. R. L. ETHERIDGE. *Manufacture of rosin.*

Bluing (indigo) is mixed with turpentine and distilled to produce a high-grade resin, and eradicate the coloring matter imparted by mixing the "virgin" and the "yearling" dips.

568,258—September 22, 1896. V. J. KUESS. *Process of and apparatus for distilling fatty substances,*

See Group X, Electro-chemistry.

631,749—August 22, 1899. A. MULLER-JACOBS. *Manufacture of substances from rosin oils.*

The invention consists in the products resulting from and in the process of producing from resin oil an oil useful as a lubricant and gums or resinous substances useful as substitutes for shellac, by treating the resin oil with sulphuric acid, converting the resulting sulpho-acids into water-soluble alkali salts, removing the oil, and treating the remaining liquid with acid or with soluble salt or salts of an alkaline earth or metal forming corresponding precipitates, and washing and drying the matter precipitated.

656,252—August 21, 1900. F. G. KLEINSTEUBER. *Compound for dissolving resins.*

See Group XV, Other Plastics.

GROUP VIII.—FERTILIZERS.

PRODUCTS.

6,234—March 27, 1849. P. S. AND W. H. CHAPPELL. *Improvement in artificial manures.*

The residuum from the manufacture of alum and the residuum from the manufacture of epsom salts are mixed with sulphate of lime, the residuum from the manufacture of prussiate of potash, bisulphate of soda, common salt, and a composition resulting from the treatment of bones with gas liquor and sulphuric acid.

7,053—January 29, 1850. R. HARE. *Preparation of animal and other manure.*

Animal material or nitrogenous vegetable matter is treated with mineral acids to produce a concentrated manure; wood tar, coal tar, or their equivalents are also added.

17,392—May 26, 1857. L. S. ROBBINS. *Improvement in fertilizing compounds.*

Green sand, containing little or no carbonate of lime, is mixed with superphosphate of lime in the proportion of 2 parts of the former to 1 of the latter, and ground.

22,544—January 11, 1859. D. BRUCE. *Improvement in artificial manure.*

Animal matter, decomposed to a pulpy mass by standing in closed vessels at a temperature of 32° to 50° C., is disinfected by mixing therewith charred bituminous shale or a roasted mixture of carbonaceous matter and clay, and then dried.

24,988—August 9, 1859. E. BLANCHARD. *Improvement in composts.*

A mixture of lime, sodium chloride, wood ashes, charcoal, wheat bran, chimney soot, and gypsum.

26,184—November 22, 1859. L. HARPER. *Improvement in fertilizers.*

Peat, muck, or lignite are mixed with sulphate of lime, soda, potash, and magnesia, and, if desired, with green-sand marl, as a base for fertilizer compositions; phosphate and biphosphate of lime is added to the base, and the mixture impregnated with ammonia, as by admixture of pulpy nitrogenous matter.

26,196—November 22, 1859. J. J. MAPES. *Improvement in fertilizers.*

One hundred parts by weight of apatite or calcined bones or phosphate of lime is saturated with sulphuric acid, and after the superphosphate of lime is formed there is then added 36 parts of Peruvian guano and 20 parts of sulphate of ammonia.

26,507—December 20, 1859. J. J. MAPES. *Improvement in fertilizers.*

The fertilizer product of No. 26,196 is mixed and ground with equal quantities by weight of dried blood.

26,985—January 31, 1860. L. HARPER. *Improvement in fertilizers.*

Green-sand marl, after atmospheric disintegration, is spread in a layer, covered with a layer of fish or offal, and the latter covered with marl impregnated with sulphate or nitrate of soda or potash. After decomposition is advanced, marl mixed with bone dust dissolved in an excess of sulphuric acid is added, and sulphate of lime is sprinkled from time to time until decomposition is completed and no more ammonia is evolved; the mass being repeatedly turned toward the end, and finally dried.

27,072—February 7, 1860. A. ROLLAND. *Improvement in fertilizers.*

A mixture of alum, 7 parts; sulphate of iron, 29 parts; sulphate of soda, 36 parts; sulphate of lime, 25 parts; sulphuric acid, 3 parts; all by weight, to be used direct as a fertilizer, or a solution of the same is sprinkled on manure.

28,516—May 29, 1860. L. STEPHENS. *Improvement in fertilizers.*

A mixture of decomposed animal matter, 1,200 pounds; animal charcoal, 150 to 200 pounds; sombrero guano, 200 pounds; Peruvian guano, 175 pounds; ammonium sulphate, 25 pounds; common salt, 100 pounds; and solution of bone in muriatic acid, 50 gallons.

33,706—November 12, 1861. J. B. HYDE. *Improvement in manufacture of manure from fish.*

Dried peat, marl, clay, or plaster is mixed with fish pulp or pumice and the mixture ground, whereby effectual pulverizing is secured.

34,039—December 24, 1861. ST. J. O'DORIS. *Improvement in fertilizers.*

A mixture of coal ashes, 75 parts; animal manure, 15 parts; animal matter, 5 parts; and vegetable matter, 5 parts—all in bulk.

34,825—April 1, 1862. J. M. GALLACHER. *Improved fertilizing composition.*

A mixture of liquid animal matter, obtained by condensing the gases and vapors from the charring or burning of bones, with animal charcoal and sulphuric acid.

39,519—August 11, 1863. G. F. WILSON. *Improved fertilizer or manure.*

Bone sulphate of lime, the residue from the treatment of bone coal with sulphuric acid for the production of phosphate of lime, is mixed with the ammoniacal and other bodies condensed in the distillation of the bones.

41,331—January 19, 1864. E. VON NORDHAUSEN. *Improved artificial manure.*

The residuum of petroleum, known as "still bottoms," is crushed and mixed with slacked lime and a sulphate of lime produced, to which is added urine, producing a sulphate or ammonia, and the mass dried.

43,639—July 26, 1864. W. H. H. GLOVER. *Improved fertilizer.*

Muck is dried and mixed with the refuse water, gurry, etc., from the manufacture of fish oil.

46,847—March 14, 1865. W. D. HALL. *Improved manure.*

Lobster refuse is desiccated and pulverized.

46,957—March 21, 1865. J. B. TRIBBLE. *Improved composition for preventing disease in vegetables.*

A mixture of wood ashes, 3 pecks; slacked lime, 2 pecks; sulphur, 1 peck; and sodium chloride, 1 peck (per acre of land; a preventive of potato rot).

49,943—September 12, 1865. J. D. WHELPLEY. *Improved fertilizer.*

A mixture of finely pulverized feldspar, feldspathic granite, and other potash-bearing rock, with gypsum and bone or phosphate of lime.

50,940—November 14, 1865. O. LUGO. *Improved fertilizer.*

Leather treated with sulphuric or other acids, boiled, ground, and afterwards treated with urate of ammonia.

52,844—February 27, 1866. J. GOULD. *Improved fertilizer.*

Mixtures of gas lime, lime, salt, and animal and vegetable or vegeto-animal matter are fermented, whereby the carbolic acid and carbo-hydrogens of the gas lime are intimately combined with the lime.

55,871—June 26, 1866. J. AND A. HURSH. *Improved fertilizer.*

Ocher, either in a raw or burnt state, is used as a fertilizer.

61,870—February 5, 1867. F. C. RENNER. *Improved fertilizer.*

A mixture of rich earth, 1,600 pounds; saltpeter, 100 pounds; sulphate of ammonia, 200 pounds; and flour of raw bone, 100 pounds; the mixture being allowed to "sweat" in a heap.

64,602—May 7, 1867. W. VERMILYA. *Improved composition for invigorating fruit and forest trees.*

A mixture of sulphate of copper, 3 pounds; sulphur, 1 pound; saltpeter, 1 ounce; and iron filings, half a pound. A hole is bored near the root of the tree, and after inserting some of the mixture the hole is plugged.

66,357—July 2, 1867. P. G. KENNY. *Improved manure.*

Sulphate of iron is mixed with manure, and dissolved by urine passed through the mass. Aluminous earth may be spread on the pile above a sprinkling of iron sulphate.

66,650—July 9, 1867. J. A. THOMPSON. *Improved composition of matter for disinfecting and preparing fertilizers.*

Charcoal charged with sulphurous acid or other disinfecting or other gas is mixed with ground gypsum, as a disinfectant and deodorizer. It is mixed with animal and vegetable substances to form a fertilizer with or without the addition of common salt, wood ashes, bone dust, or other material.

67,335—July 30, 1867. J. K. MOORE. *Improved fertilizer.*

Powdered clam or oyster shells (not burnt) treated with acid.

67,450—August 6, 1867. H. E. POND. *Improved artificial fertilizer.*

Meadow muck is partially dried, then treated with sulphuric acid; lime is then added and mixed therewith, then a solution of potash, salt, and nitrate of soda, and finally superphosphate of lime, and the mass dried.

70,608—November 5, 1867. H. E. POND. *Improved fertilizer.*

Meadow muck is partially dried, then treated with sulphuric acid; sulphate of lime or gypsum is then mixed therewith, then a solution of nitrate of potash, salt, and nitrate of soda, and finally superphosphate or biphosphate of lime.

71,724—December 3, 1867. L. S. FALES. *Improved fertilizing compound.*

A mixture of sea sand, sulphate of ammonia, charcoal, bones, and dried blood.

71,725—December 3, 1867. L. S. FALES. *Improved fertilizer.*

A mixture of night soil treated with waste acid from petroleum refineries, charcoal—preferably that made from peat—sulphate of ammonia, pulverized bones, dried blood, and saltpeter.

72,026—December 10, 1867. W. C. GRIMES. *Improved fertilizer.*

Eight bushels of ground bone and 80 pounds of sulphate of ammonia are dissolved in 180 pounds of oil of vitriol, and 40 gallons of urine and 10 bushels of rich earth added, and the mixture dried.

74,799—February 25, 1868. J. COMMINS. *Improved mode of treating mineral phosphates for the manufacture of fertilizers.*

Phosphatic minerals or earths are heated to a red or white heat and saturated with a solution of sodium chloride while hot, to convert the insoluble phosphates into soluble mineral.

76,991—April 21, 1868. W. G. BUSEY. *Improved fertilizer.*

Six hundred pounds of Peruvian guano and 100 pounds of sodium chloride are mixed together and then mixed with 1,300 pounds of soluble superphosphate of lime, formed by treating carbonized bone with sulphuric acid.

77,667—May 5, 1868. A. SMITH. *Improvement in fertilizers.*

Cracklings reduced to powder are combined with phosphates.

77,840—May 12, 1868. J. S. RAMSBURG. *Improved fertilizer.*

One hundred pounds of calcined bone is mixed with 25 pounds of sulphate of ammonia and 3 gallons of hot water or barnyard liquor, and 25 pounds of sulphuric acid added to form au ammoniated superphosphate of lime, which while hot is mixed with 60 pounds of sulphate of soda, 125 pounds of sulphate of lime, and 150 pounds of slacked ashes or muck.

77,860—May 12, 1868. J. ALTHOUSE. *Improved fertilizer.*

Seven hundred pounds of air-slacked lime is mixed with 180 pounds of ground bone and 100 pounds of wood ashes, covered with a layer of ground plaster and wet with 320 pounds of urine, and allowed to stand for eight to twelve weeks, when it is mixed with 400 pounds of wheat bran and 300 pounds of hen dung.

79,160—June 23, 1868. D. A. TER HOEVEN. (*Reissue: 4052 and 4053—June 28, 1870.*) *Improvement in fertilizers.*

A fertilizer composed of horns, hoofs, or like animal matter; produced by steaming, drying, and crushing or grinding.

86,574—February 2, 1869. O. A. MOSES. *Improved prepared phosphate.*

South Carolina phosphates and marls are ground under water and separated according to their specific gravity and dried, thereby producing, as the finer material, nearly pure fertilizing phosphates.

88,443—March 30, 1869. S. A. BURKHOLDER and G. W. WILSON. *Improvement in fertilizers.*

A mixture of bone dust, 600 pounds; oil of vitriol, 200 pounds; sulphate, 100 pounds; sodium nitrate, 10 pounds; sodium chloride, 50 pounds; ground plaster or sulphate of lime, 300 pounds; wood ashes, 80 pounds; and 7 bushels of earth or sand.

88,466—March 30, 1869. L. S. FALES. *Improved fertilizer.*

A mixture of bones, leather scrap, and blood in sulphuric acid and water is subjected to the steam and ammoniacal vapors from a mixture of sulphate of ammonia, gas liquor, and slacked lime, the solid portion of the product drained and mixed with dry peat.

90,057—May 11, 1869. D. STEWART. *Improved phosphate fertilizing compound.*

Manures are produced from soluble silicates and phosphates by composting them with caustic alkalis, as by forming alternate layers of insoluble phosphates previously moistened with a saturated solution of crude potash and quicklime, and allowing the successive layers to slack as strata after strata is added. After cutting down and mixing, a handful of ground gypsum is added to each shovel of the compost.

91,667—June 22, 1869. F. C. RENNER. *Improved fertilizer.*

One thousand and fifty pounds of rich earth is mixed with 100 pounds of sulphate of ammonia and 50 pounds of saltpeter, and then incorporated with 300 pounds of bone dust, 100 pounds of salt cake, 200 pounds of Peruvian guano, and 200 pounds of plaster.

92,077—June 29, 1869. E. N. McKIMM AND H. W. BENDER. *Improved fertilizing compound.*

A mixture of earth, 1,000 pounds; sulphate of ammonia, 100 pounds; sodium chloride, 100 pounds; pearlash and sulphate of soda, each 25 pounds; together with ground bone, 400 pounds; Peruvian guano, 150 pounds; and ground plaster, 150 pounds.

92,810—July 20, 1869. R. FISH. *Improved fertilizer.*

A mixture of night soil, marl, peatashes, charcoal, copperas, salt, tobacco, gypsum, tincture of almonds, tincture of coffee, and coffee grounds.

97,169—November 23, 1869. B. R. CROASDALE. *Improved bags for guano, phosphates, and other fertilizers.*

They are coated inside with tar, pitch, or gum, and then inside and outside with a thin coat of crude petroleum or other oil.

97,939—December 14, 1869. O. LUGO. (*Reissue: 3,840—February 15, 1870.*) *Improved fertilizer or guano.*

An antiseptic fertilizer from fish or other animal matter, prepared by passing hot air downward through the material until about 90 per cent of the water is extracted, and then introducing, by means of a current of air, hydrocarbon and phenol (carbonic acid) vapors, followed by a blast of hot air to expel the remaining portion of water and hydrocarbon. The oils and fatty matters in solution with the hydrocarbon and surplus phenol are condensed.

99,255—January 25, 1870. I. W. SPEYER. *Improvement in fertilizers.*

The minerals obtained from the mines of Stassfurt, Prussia, chiefly sulphates and muriates of potash and magnesia, are pulverized, dissolved in boiling water, and crystallized out by cooling, for use as a manuring compound.

99,294—February 1, 1870. J. COMMINS. *Improvement in fertilizers.*

A mixture of 1 part, by measure, of gas-liquor and 3 parts of blood, is coagulated with one five-hundredth part of sulphuric acid, dried, and reduced to a powder.

99,452—February 1, 1870. O. LUGO. *Improvement in fertilizers or fish-guano.*

Fish are dried (without scorching or roasting) before decomposition sets in, so as to secure a highly nitrogenized product, pulverized and mixed with phosphates, etc.

99,978—February 15, 1870. A. VAN HAAGEN AND W. ADAMSON. *Improved fertilizer from glue residuum.*

Glue residuum is boiled in an alkaline solution, common salt added, the soap product removed, and charcoal or plaster of paris or other fertilizing absorbent mixed with the mass.

100,168—February 22, 1870. O. LUGO. *Improvement in the manufacture of fertilizers from animal substances.*

An antiseptic fertilizer, prepared from animal matter by treating it with carbolic acid or phenol, in solution with suitable hydrocarbons or preferably in a state of vapors, with or without a current of hot air or gases.

100,629—March 8, 1870. H. A. HOGEL. *Improvement in treating blood for the preparation of fertilizers, and for other purposes.*

Coagulated blood, prepared by the action of steam, drained and pressed.

100,729—March 15, 1870. J. COMMINS. *Improvement in fertilizers.*

A fertilizer formed of gas-liquor, blood, and sulphuric acid, with dry ground phosphate of lime, mixed and evaporated to dryness.

101,131—March 22, 1870. H. A. HOGEL. *Improvement in fertilizers.*

The fat of dead animals is extracted with steam, and the flesh is subjected to heavy pressure, dried, and pulverized.

102,438—April 26, 1870. W. I. SAPP. *Improvement in the manufacture of fertilizers.*

A fertilizer made from silicated phosphates, produced by treating phosphatic guano or like material with soluble silicic acid or water glass, to render the phosphates soluble.

102,648—May 3, 1870. E. P. BAUGH. *Improvement in drying guano.*

Rock phosphate, or other material, is banked over grated flues for hot gases, so that they can penetrate the mass.

106,313—August 16, 1870. G. BOURGADE. *Improvement in compound for fertilizer.*

A mixture of blood and lime, formed by mixing slacked lime with the blood, adding water and heating at a low heat and subjecting the coagulated mass to pressure to expel the albumen.

106,626—August 23, 1870. T. SIM. *Improvement in the manufacture of fertilizers.*

Cottonseed residuum, or other matter, divested of oil by chemical means (as by bisulphide of carbon), is mixed with phosphate of lime.

107,878—October 4, 1870. J. COMMINS. *Improvement in the manufacture of fertilizers.*

Black salt-marsh grass (*Spartina glabia*), is chopped, macerated, and reduced to a pulpy mass, for use with phosphates or animal matter; it contains a large amount of nitrogen, 10 per cent of potash, and 8 per cent of soda.

108,369—October 18, 1870. J. M. LOEWENSTEIN. *Improvement in fertilizing compounds.*

Night soil is mixed with double the quantity of pulverized unslaked lime, subjected to pressure to express superfluous liquid, and is then treated with dilute sulphuric acid.

111,357—January 31, 1871. J. M. LOWENSTEIN. *Improvement in fertilizing compounds.*

A compositiou formed of night soil, sulphuric acid, bones or bone dust, and unslacked lime.

112,653—March 14, 1871. T. TAYLOR. *Improvement in fertilizers.*

A mixture of night soil with peat, clay, soluble silicates, a persalt of iron, and tincture of quassia.

114,133—April 25, 1871. W. B. HAMILTON. *Improvement in fertilizing compounds.*

A mixture of night soil, cotton-seed meal, salt, gypsum, and bone phosphate.

114,798—May 16, 1871. L. C. GIFFORD. *Improvement in compounds for preserving fruit trees.*

A mixture of 2 parts of calomel and 1 part of carbonate of soda, by weight, mixed dry.

118,987—September 12, 1871. U. S. TREAT. *Improvement in fertilizers from seaweed.*

Seaweed is reduced to a pulp by the action of steam under pressure and mixed in a mill with finely powdered quicklime.

119,994—October 17, 1871. D. W. PRESCOTT. *Improvement in the manufacture of soluble phosphates for fertilizers.*

A mixture of 1,600 pounds of bone dust and 300 pounds of soda ash is moistened thoroughly with water and allowed to remain in a heap for two weeks and then dried.

124,254—March 5, 1872. B. R. CROASDALE. *Improvement in bags for phosphates, etc.*

It is made of a textile fabric, as burlap, coated with roofing paper, which may be saturated with an acid-proof or waterproof substance.

124,413—March 5, 1872. J. R. WESTOVER. *Improvement in compounds for fruit trees, etc.*

A mixture of kerosene oil, 1 quart; fish oil, 1 pint; flour of sulphur, one-half pound; pulverized saltpeter, one-fourth pound, and 1 pint of water, as an insect destroyer and fertilizing compound.

125,927—April 23, 1872. J. R. BLACK. *Improvement in fertilizers.*

A mixture of stable manure and muck in equal parts is formed; and also a mixture of saltpeter 50 pounds, common salt 3 barrels, lime 3 barrels, and ashes 5 barrels: and a compost formed of alternate layers of the two mixtures, the latter mixture being one-fourth of the former.

125,939—April 23, 1872. J. M. DEERING. *Improvement in fertilizing compounds.*

Fish or lobster chum is mixed with material charged with carbolic acid, as tar water, ammoniacal water, or spent lime, spread and covered with dry earth, peat, or brick dust, then with air-slacked lime, then wet seaweed, then ground gypsum, and then dry earth or peat. The layers may be repeated, and the pile is allowed to slowly decompose.

126,418—May 7, 1872. T. SEWELL. *Improvement in compositions for deodorizing and preparing fertilizers.*

Ground peat charcoal is saturated with equal parts of carbolic acid and perchloride of manganese, and used in combination with clay, earth, or soil.

128,578—July 2, 1872. W. S. AMIES. *Improvement in artificial manures.*

Carbon and sulphate of iron are mixed in the proportions of from 1 to 5 parts of carbon to 1 part of sulphate of iron.

132,543—October 29, 1872. C. F. SMITH. *Improvement in compositions for renovating and invigorating apple trees.*

A mixture of pulverized blue vitriol, 4 parts; white chalk, 1 part, and iron scales, 1 part, all in bulk; applied by boring a hole to the center of the tree near the roots and filling it with the mixture.

138,458—April 29, 1873. J. WHITEHILL. *Improvement in fertilizers.*

For agricultural purposes caustic lime is ground to the state of sand.

143,213—September 23, 1873. J. B. WILSON. *Improvement in fertilizing soils.*

Pulverized anthracite coal, either with or without manure ingredients, is used as a fertilizer; it maintaining the soil in a moist condition.

143,310—September 30, 1873. J. J. STORER. *Improvement in fertilizers from offal.*

A fertilizer consisting of offal, tank-stuff, blood, etc., treated with burning gases directly in contact so as to impregnate the mass with soot and free carbon, and give a dark brown or almost black color to the product.

147,035—February 3, 1874. R. BIRDSALL. *Improvement in fertilizing compounds to be used to protect trees, etc.*

A mixture of 8 bushels of topsoil, 1 bushel of gas lime, 4 quarts of common salt, 2 quarts spirits of turpentine, 2 pounds of saltpeter, and 2 quarts of crude coal oil, with sufficient water to work into a homogeneous mass; afterwards dried.

149,243—March 31, 1874. C. PERRY. *Improvement in fertilizers.*

Malt, or grain, with the germinating principle destroyed, is used as a fertilizer or as an ingredient for a fertilizer and plant food.

149,244—March 31, 1874. G. J. POPPLEIN. (*Reissue: 7,296—September 5, 1876.*) *Improvement in fertilizers.*

A fertilizer containing tripoli, or consisting of tripoli and phosphate of lime, pulverized and intimately mixed.

149,472—April 7, 1874. J. H. GREEN. *Improvement in waterproofing compounds for guano bags, bales, etc.*

A composition for waterproofing bagging consists of rubber cement, linseed oil, benzine, zinc or white lead, magnesia, umber, flour bran or sawdust, litharge, and sulphur.

152,725—July 7, 1874. R. A. CHESEBROUGH. *Improvement in antiseptic fertilizers.*

A mixture of boneblack and hydrocarbon oil, say in the proportions of 70 per cent and 30 per cent. It should be mixed with an equal amount of earth.

152,921—July 14, 1874. S. D. SHEPARD. *Improvement in fertilizing compounds.*

A composition of peat, 120 pounds; fish oil, 15 gallons; and fish liver, from which the oil has been removed, 30 gallons.

153,477—July 28, 1874. B. R. CROASDALE. *Improvement in bags for phosphates, guano, etc.*

Bags of a textile fabric are saturated with hydrate of lime, dried, and then immersed in oil or oil and paraffine.

154,017—August 11, 1874. B. G. CARTER. *Improvement in fertilizing compounds.*

A mixture of Peruvian guano, 500 pounds; archilla guano, 300 pounds; dissolved bone, 200 pounds; wood ashes, 300 pounds; soda, 50 pounds; and ground plaster, 650 pounds.

155,341—September 22, 1874. G. E. E. SPARHAWK AND M. A. BALLARD. *Improvement in fertilizers.*

A mixture of 2½ bushels each of air-slacked lime, wood ashes, hen guano, and soil; 1 bushel of salt, 200 pounds of gypsum, and 10 pounds of bone dust.

160,191—February 23, 1875. C. H. HOFFMANN. *Improvement in fertilizing compounds.*

A fertilizing liquid for germinating seeds, etc., produced by boiling a mixture of 3 gallons of liquid manure, 3 ounces of salt, and 2 ounces of saltpeter; dissolving therein three-quarters of a pound of unslacked lime; straining, and then adding one-half ounce each of crude petroleum and sulphur balsam.

171,857—January 4, 1876. ST. J. RAVENEL. *Improvement in fertilizers.*

Pulverized iron pyrites is mixed with ground phosphatic material.

173,621—February 15, 1876. A. G. GRIFFITH. *Improvement in fertilizers.*

One hundred pounds of horse manure is mixed with 80 to 100 pounds of sulphuric acid, and then 100 pounds each of bone dust and of archilla, curacoa or Mexican guano are mixed therewith.

174,568—March 7, 1876. G. J. POPPLEIN. (*Reissue: 8,187—April 16, 1878.*) *Improvement in fertilizers.*

An intimate mixture of tripoli or infusorial earth and potash or soda.

175,846—April 11, 1876. J. B. WILSON. *Improvement in composts.*

A pile is formed of layers of mud, muck or marl, manure or guano, and salt, with a dilute solution of sulphuric acid poured thereover, then a layer of lime, and a covering of sand or earth; the mass standing for thirty days or so, when it is thoroughly decomposed.

178,194—May 30, 1876. A. W. ROWLAND. *Improvement in fertilizers.*

A compound of wood ashes, cottonseed, earth, manure, sulphates of magnesia of soda, and of ammonia, sodium chloride, sodium nitrate, dissolved bone, and ground plaster.

191,476—May 29, 1877. H. SELIGMAN. *Improvement in deodorizing, disinfecting, and fertilizing compounds.*

A compound of mineral potash salt, as carnaillit, 70 parts; gypsum or other calcareous substance, 25 parts; and sulphuric acid, 5 parts.

193,890—August 7, 1877. C. F. PANKNIN. *Improvement in fertilizers.*

A fertilizing compound consisting of a comminuted mixture of 95 parts of phosphate of lime and 5 parts of sulphur.

203,674—May 14, 1878. B. J. TIMBY. *Improvement in compositions for protecting trees.*

A compound of 20 pounds of sulphur, 2 pounds of soot, and 900 balm-of-Gilead buds.

206,077—July 16, 1878. T. J. BOYKIN AND J. W. CARMER. *Improvement in fertilizers.*

A compound consisting of a mixture of dissolved bone, 3 bushels; ground plaster, 3 bushels; sodium nitrate and sodium sulphate, each 40 pounds; and ammonium sulphate, 33 pounds; to be incorporated with a suitable base, as dry peat or muck.

208,224—September 24, 1878. A. F. CROWELL. *Improvement in fertilizers.*

A fertilizer consisting of the waste nitrogenous and gelatinous fluid obtained in the process of extracting oil from fish, combined with the soluble portions of a superphosphate, the solution being concentrated or evaporated to dryness.

208,540—October 1, 1878. C. RICHARDSON. *Improvement in fertilizers.*

A fertilizer composed of hair or bristles in the form of fine powder, produced by treating them with live steam at, say, 90 pounds pressure, drying, and grinding.

209,980—November 19, 1878. A. PIRZ. *Improvement in fertilizers.*

A fertilizer composed of bone and artificial sulphate of lime (a waste product from the manufacture of acetic acid) in equal parts. The constituents are mixed with water and allowed to lie until the mass has become solid.

211,238—January 7, 1879. J. INGMANSON. *Improvement in fertilizers.*

A fertilizer composed of ground bone. 90 pounds; caustic lime, 10 pounds; mixed together with 5 pounds of oil of vitriol diluted with 5 gallons of water.

216,290—June 10, 1879. E. OSGOOD. *Improvement in compounds for preventing the destruction or rotting of bags, etc.*

A compound of beeswax and tallow, to which tar may be added, is applied to fertilizer bags.

232,756—September 28, 1880. H. M. POLLARD. *Fertilizer.*

A mixture of night soil and calcined plaster, in equal quantities, with umber in the proportion of 1 in 200 by weight, and sulphuric acid 1 in 25.

233,875—November 2, 1880. J. C. PERKINS. *Mixed phosphatic manure.*

A mixture of sulphuric acid, water, animal charcoal, bones, marl, coprolite, sugar scum, night soil, fish or fish refuse, hard-wood charcoal, castor pomace, hydrochloric acid, sulphate of lime, ashes from calcined leather, tobacco ashes, sodium nitrate, and ammonium sulphate.

234,782—November 23, 1880. B. JOHNSON AND W. P. GIDDINGS. *Fertilizer.*

A mixture of ground and unburned oyster shells, 100 pounds; common potash, 2 pounds; and carbonate of soda, 1 pound.

240,025—April 12, 1881. W. H. HUBBELL. *Fertilizer.*

A mixture of guano, 200 pounds; bone dust, 400 pounds; plaster, 800 pounds; and German potash, 200 pounds.

242,193—May 31, 1881. W. FIELDS. *Fertilizer.*

A composition of limestone, 500 pounds; feldspar, 1,000 pounds; oyster shells, 300 pounds, all unburned and ground fine; cast-iron scrapings and moldings from foundry, 200 pounds; water, 9 gallons; sulphuric acid, 2 gallons; and nitric acid, 1 pint.

246,121—August 23, 1881. L. GRAF. *Artificial manure.*

Produced by mixing an alkaline solution of leather scrap with lime or lime salts—such as sulphate or carbonate of lime—and with phosphate of lime, and then treating the mixture with sulphuric acid.

246,242—August 23, 1881. B. TERNE. *Treatment of tank waters of slaughterhouses, etc.*

Concentrated tank water is combined with sulphuric acid and used as a solvent for phosphatic substances in the manufacture of manures.

250,706—December 13, 1881. H. S. BRADLEY. *Compost.*

A mixture of 1,000 pounds each of stable manure and of swamp muck, 1 bushel of slacked lime, 8 pounds each of sulphate of ammonia and of sulphuric acid, and 1 pound of alum.

251,364—December 27, 1881. E. J. HOUSER. *Fertilizing compound.*

A mixture of cottonseed meal, 4 parts; dissolved bone, 3 parts; and German potash salts, 3 parts; by weight.

251,628—December 27, 1881. G. B. OAKES. *Manufacture of fish guano.*

A pulverized fertilizer composed of boiled fish refuse with 5 per cent of sulphuric acid, pulverized charcoal, finely ground gypsum or mineral phosphates, and salt to prevent fermentation.

253,971—February 21, 1882. I. BROWN. *Fertilizer.*

As a manure or an ingredient therefor, a solid mixture of sulphuric acid and gypsum, or peat or equivalent medium, denominated a "supersulphate."

253,991—February 21, 1882. I. ELSASSER. *Fertilizer.*

A mixture of bat guano, cottonseed meal, bone dust, and the shell known as *Gnathadon cuneata*, pulverized.

258,524—May 23, 1882. R. R. ZELL. *Fertilizer bag.*

A bag made acid proof by treatment with an aqueous solution formed of rosin soap, 100 parts by weight; alum, 5 parts; asbestos, 4 parts; and gelatine, 1 part.

263,907—September 5, 1882. W. H. HORNER AND F. HYDE. *Bag for holding phosphates, etc.*

Fertilizer bags are made acid proof by treatment with a composition of rosin, paraffine, or mineral oil, and soap or saponified grease.

268,314—November 28, 1882. W. D. STYRON. *Fertilizer compound.*

A compound known as the "Norfolk Fertilizer and Insecticide" is a mixture of sulphur, 25 pounds; saltpeter, 40 pounds; salt, 200 pounds; kainit, 200 pounds; bone phosphate, 40 pounds; and lime, 1,495 pounds.

269,704—December 26, 1882. D. E. PAYNTER. *Fertilizing compound.*

A compound of calcined gypsum, water, and mineral coal dust is burned, the ashes mixed with acidulated urine, and dried.

277,023—May 8, 1883. J. GOULD. *Fertilizer.*

A mixture of salicylic acid, gas lime from gas works using oyster-shell lime, animal matter (night soil or blood), vegetable matter (sumac, seaweed, or leaves), with salt, alum, and carbolic acid.

278,383—May 29, 1883. J. R. YOUNG, JR. *Fertilizer.*

A mixture of night soil, bone phosphate of lime, and sulphuric acid is evaporated to dryness after the resulting chemical action is complete.

278,384—May 29, 1883. J. R. YOUNG, JR. *Fertilizer.*

A mixture of night soil, 1,000 pounds; dry fish scrap, 400 pounds; and sulphuric acid, 175 pounds; dried.

278,480—May 29, 1883. J. R. YOUNG, JR. *Fertilizer.*

A mixture of night soil, 100 gallons; phosphatic guano, 400 pounds; and sulphuric acid, 75 pounds; evaporated to dryness after chemical action is complete.

281,840—July 24, 1883. W. J. COURTS. *Fertilizer.*

A mixture of dissolved raw bone, sulphates of aluminum, of ammonium, of iron, of magnesium, and of potash, sodium nitrate, kainit, and humus or rich dirt, in certain specified proportions.

283,308—August 14, 1883. T. WELLS. *Fertilizer.*

A mixture of carbonate of ammonia, 8 pounds; carbonate of soda, 12 pounds; salt, 50 pounds; wood ashes, 3 bushels; and stable manure, 20 bushels.

285,555—September 25, 1883. J. B. BECK. *Fertilizer.*

A mixture of bitter salt, limestone, plaster, sodium sulphate, ammonium sulphate, and potash.

290,633—December 18, 1883. A. EDWARDS. *Fertilizer for tobacco crops.*

A comminuted mixture of fresh horse manure, 1 ton, blood, 100 pounds or more; and potash, 100 pounds.

290,829—December 25, 1883. W. R. WILKINSON. *Fertilizer.*

A mixture of bone ash, 50 per cent; gypsum, 10 per cent; sulphate of iron, 5 per cent; sulphate of potash, 22½ per cent; and dried blood, 12½ per cent.

292,470—January 29, 1884. D. R. CASTLEMAN. *Fertilizer.*

A mixture of pulverized tobacco stems and prepared phosphate, in equal proportions.

298,939—May 20, 1884. B. C. BRIGGS. *Fertilizer.*

A mixture of 1 barrel each of bone meal and plaster; 2 barrels each of ashes, hen manure or guano, muck, and urine, and 1 bushel of salt.

307,718—November 4, 1884. L. HAAS. *Fertilizer.*

A mixture of furnace slag end sulphate of ammonia composed of liquid ammonia and sulphuric acid, to which is added limestone or oyster shells and ground bone, sodium nitrate, sodium chloride, sodium sulphate, and potash, with plaster.

308,397—November 25, 1884. J. R. YOUNG, Jr. *Fertilizer.*

A mixture of night soil, phosphate of lime, sulphuric acid, nitrogen compound (as ammonia), and potash.

317,010—May 5, 1885. W. S. PIERCE. *Phosphate fertilizer.*

A fertilizer is made from the insoluble phosphates of alumina, iron, lime, and other bases, by drying and pulverizing the raw material, mixing with it a certain quantity of sulphate of ammonia—sufficient to prevent the fertilizer from absorbing moisture—treating the mixture with strong sulphuric acid, and drying.

318,371—May 19, 1885. L. HAAS. *Fertilizer.*

A compound of furnace slag, oyster shells, charcoal, tan-bark waste, tobacco stems, broom-corn seed meal; sodium nitrate, sulphate, and chloride; diluted sulphuric acid or ammonia, plaster, ashes, phosphatic iron ores, phosphatic rock, ground slag, and kainit.

327,256—September 29, 1885. L. HAAS. *Fertilizer.*

A fertilizer and insect preventive, consisting of furnace slag, 70 per cent; salt, 10 per cent; ashes, 10 per cent; charcoal, 10 per cent; and water, with 5 per cent of acid.

330,075—November 10, 1885. A. E. WEMPLE. *Fertilizer.*

A mixture of bone flour, 50 per cent; sulphate of ammonia, 15 per cent; sodium nitrate, 15 per cent; potassium chloride, 5 per cent; magnesium sulphate, 5 per cent; and nitrogenous matter, as dried blood, 10 per cent.

341,968—May 18, 1886. J. VAN RUYMBEKE. *Fertilizer.*

A nonviscid and nondeliquescent fertilizer, consisting of concentrated and partially decomposed tank wastes, containing carbolic acid and other phenols without the addition or artificial mixture of said phenols; the product of No. 342,238.

345,507—July 13, 1886. W. W. HICKS. *Treatment of humus and muck.*

A mixture of calcined humus and muck, which has been changed and sweetened by the heat and gases of the said calcining.

346,024—July 20, 1886. H. H. COLQUITT. *Fertilizer.*

A mixture of the raw kernels of cottonseed with phosphoric rock or phosphate of lime.

349,289—September 14, 1886. P. VINSON. *Combined fertilizer and insecticide.*

A mixture of cattle dung, horse dung, sheep dung, fowl dung, blue vitriol, saltpeter, slacked lime, leached ashes, cayenne pepper, black pepper, ginger, mustard seed, and garlic.

353,210—November 23, 1886. D. W. DUDLEY. *Fertilizer.*

Equal quantities of bone meal and wood ashes are mixed and saturated with water and allowed to stand for about three weeks, then lime is slacked in brine and added to the mixture, and gypsum and salt in equal quantities are added to the mass.

367,732—August 2, 1887. J. VAN RUYMBEKE. *Fertilizer.*

Nitrogenous fertilizing material, consisting of the undecomposed coagulated albuminoids of concentrated tank waters freed from undue deliquescence and viscidity produced by rendering the gelatinous substances insoluble, as by the addition of sulphate of iron.

371,630—October 18, 1887. P. B. ROSE. *Tank-waste fertilizer.*

A fertilizer in a dry form consisting of tank waste incorporated with cellulose or lignine vegetable material, or paunch material taken from slaughtered animals.

372,087—October 25, 1887. J. REESE. *Phosphatic fertilizer.*

A fertilizer composed essentially of pulverized calcareous phosphatic basic slag; pulverized to an impalpable powder.

377,084—January 31, 1888. G. H. MURRAY. *Fertilizing composition.*

A compound of one-half pulverized tan bark, one-quarter distillery slop or animal excrement, and one-quarter common salt, slacked lime, and potash.

378,688—February 28, 1888. P. C. JENSEN. *Fertilizer.*

Tankage or tank-water residue is dried at a low temperature, broken up and mixed with unslacked lime, and the mixture thoroughly pulverized.

382,604—May 8, 1888. S. L. GOODALE. *Fertilizer.*

Crude mineral containing hydrated aluminic and ferric phosphates is pulverized and mixed with carbonaceous matter wet with sulphuric acid, and the mixture heated to a degree sufficient to expel the constituent water contained in the hydrated phosphate.

396,274—January 15, 1889. H. ENDEMANN. *Fertilizer.*

A fertilizer produced from tobacco, and having certain specified characteristics; product of process No. 404,348.

397,056—January 29, 1889. P. HOGAN. *Fertilizer.*

Composed of dissolved lignine from vegetable substances, and alkaline salts from the digesters in the manufacture of chemical fiber or similar works, in combination with peat, clay, lime, earth, or other absorbent matter.

407,240—July 16, 1889. N. B. POWTER. *Phosphatic fertilizer.*

A dry granular compound composed of phosphatic rock or earth containing over 10 per cent of alumina or iron, 1,000 pounds; sulphuric acid (60°), 500 pounds; and tank water containing about 20 per cent of animal matter, 750 pounds.

407,241—July 16, 1889. N. B. POWTER. *Phosphatic fertilizer.*

A dry fertilizing composition composed of Cayman Islands phosphatic rock, 800 pounds; 600 pounds of animal matter combined with not more than the same amount of water; 550 pounds of sulphuric acid (60°), and 50 pounds of carbonate of lime.

408,491—August 6, 1889. J. A. LIGHTHALL. *Fertilizer.*

Tobacco stems reduced to dry, granular charcoal.

415,246—November 19, 1889. J. J. HANSELMAN. *Liquid manure.*

It consists of water, sulphurous acid, soap, salt, lime, isinglass, spirits of ammonia, and the soluble parts of cow dung and guano.

432,091—July 15, 1890. J. D. SIMMONS. *Phosphatic fertilizer.*

A mixture of wood ashes, 6 parts; phosphate of lime, 9 parts; muriate of potash, 2 parts; pulverized sulphur, 2 parts; and sodium nitrate, 1 part; all by weight.

434,243—August 12, 1890. L. J. CARLILE AND G. B. RUMPH. *Combined fertilizer and insecticide.*

A composition of refuse tobacco, bran, cottonseed meal, paris green, powdered hellebore, arsenious oxide, and India berries (cocculus indicus).

438,859—October 21, 1890. J. PATTERSON. *Fertilizer.*

A mixture of caustic lime—unslacked when introduced—gypsum, rotten rock, common bog, sulphate of iron, salt, and water.

446,088—February 10, 1891. J. VAN RUYMBEKE. *Nitrogenous fertilizer.*

A fertilizing material consisting of "stick" and a soluble salt of iron or alumina made basic by the addition of lime thereto.

448,387—March 17, 1891. J. VAN RUYMBEKE. *Nitrogenous fertilizer.*

A dry pulverulent and practically nondeliquescent material consisting of a mixture of liquid stick, 1 ton, and ground, dried animal matter, 600 to 800 pounds, subjected to a heat not exceeding 380° F.

450,253—April 14, 1891. J. REESE. *Ammoniated phosphate.*

A fertilizer composed essentially of pulverized, calcareous, phosphatic, basic slag and salts of ammonia, such as sulphate of ammonia.

450,254—April 14, 1891. J. REESE. *Phosphatic fertilizer.*

A fertilizer composed essentially of pulverized, calcareous, phosphatic, basic slag and potassic material such as kainit, sulphate of potash, or muriate of potash.

450,255—April 14, 1891. J. REESE. *Phosphatic fertilizer.*

A mixture of pulverized, calcareous, phosphatic, basic slag, potash, and ammonia (such as the sulphate).

450,531—April 14, 1891. J. REESE. *Phosphatic fertilizer.*

A mixture of muriate of potash and pulverized, calcareous, phosphatic, basic slag.

453,749—June 9, 1891. J. VAN RUYMBEKE. *Phosphatic fertilizer.*

A fertilizer consisting of a metaphosphate prepared by submitting acidified rock to the action of a high degree of heat (No. 446,087), and stick loaded with about 15 per cent of carbonate of lime, mixed and allowed to stand until granulated.

453,750—June 9, 1891. J. VAN RUYMBEKE. *Phosphatic fertilizer.*

A mixture of iron or alumina acid phosphates and stick, subjected to the action of heat at or above 212° F. until it assumes a black color, when it will granulate.

462,476—November 3, 1891. C. W. DOUGHTY. *Fertilizer.*

A compound of ground and unburnt but dried carbonate of lime and human feces in equal proportions, and dried but unburnt gypsum in the proportion of 10 per cent of the carbonate of lime.

484,631—October 18, 1892. J. J. DUNNE. *Nitrogenous fertilizer and process of making the same.*

A fertilizing material, consisting of a bulky, flocculent, pulverulent, impalpable precipitate composed of coagulated nitrogenous albuminoids of tank waters combined with phosphatic material insoluble in water, but soluble in citrate of ammonia; produced by heating tank waters with phosphates and an acid, then treating with a neutralizing agent, separating the precipitated matter, and drying.

484,679—October 18, 1892. J. D. SIMMONS. *Fertilizing composition.*

A mixture of sulphuret of iron, 2 parts; sulphate of potash, 2 parts; wood ashes, 6 parts; and phosphate of lime, 10 parts, all by weight.

508,220—November 7, 1893. C. J. GREENSTREET. *Nitrogenous fertilizer and process of making same.*

A soluble salt of manganese—as black oxide of manganese—with or without the addition of basic ferric sulphate, is mixed with "stick" and evaporated to dryness.

517,486—April 3, 1894. S. B. SCHENCK. *Fertilizer.*

A fertilizer produced by boiling skins or their products or other like nitrogenous materials in sulphuric acid, to produce a jelly-like mass, and adding night soil, boneblack, and ground tobacco.

517,661—April 3, 1894. N. B. POWTER. *Phosphatic fertilizer.*

A dry, odorless fertilizing compound, consisting of substantially pure phosphate of alumina containing insoluble phosphoric acid mixed with slaughter-house or other refuse, without the addition of acid; the product of No. 517,662.

522,561—July 3, 1894. E. GULICK. *Mineral fertilizer.*

A mixture of aluminous shale, 80 per cent, and wood charcoal, 20 per cent.

525,242—August 28, 1894. J. VAN RUYMBEKE. *Coagulant.*

A coagulant, formed by adding a boiling solution of an alkaline bichromate to a mixture of copperas and sulphuric acid.

536,283—March 26, 1895. J. W. HICKMAN. *Fertilizer.*

Composed of muriate of potash, black hellebore, sodium nitrate, paris green, superphosphate of lime, hydrocyanic acid, and ground bone.

537,822—April 23, 1895. C. J. GREENSTREET. *Fertilizer and process of making same.*

A nitrogenous fertilizer composed of solids of tank water combined with a soluble silicate, produced by adding an agent capable of neutralizing the silicate and retaining free ammonia (such as sulphuric acid), then adding a soluble silicate of an alkali and expelling the surplus water, and drying.

539,747—May 21, 1895. J. M. McCANDLESS AND J. F. ALLISON. *Fertilizer compound.*

A mixture of an acid phosphate, 1,200 pounds; dried blood, 100 pounds; cottonseed meal, 250 pounds; muriate of potash, 50 pounds; and ground graphitic schist, 400 pounds.

550,545—November 26, 1895. C. H. THOMPSON. *Fertilizing material and process of making same.*

Peat moss, or like fibrous or spongy material, is boiled in a weak solution of phosphoric acid together with a fertilizing composition—as soot, bone meal, and gypsum—and then strained and partially fermented.

576,848—February 9, 1897. P. HUFF. *Fertilizer.*

A composition, for protecting and fertilizing corn, of coal tar, brimstone, soft soap, saltpeter, lime, and plaster.

589,197—August 31, 1897. J. E. STEAD. *Phosphate and method of making same.*

A silico-phosphate, readily soluble in solvents existing in the soil, of the formula: $(CaO)_4 P_2 O_5 + CaO. SiO_2 = Ca_5 P_2 SiO_{12}$; capable of isolation in characteristic crystals in the form of a double salt; produced by melting normally insoluble phosphates with silicious and calcareous matter in proportion to yield compounds containing the ratio of 310 of tribasic phosphate of lime to between 58 and 116 of monosilicate of lime.

599,056—February 15, 1898. V. DOANE. *Insecticide.*

A composition of kainite, potassium nitrate, and white arsenic, the kainite being in excess; for destroying cranberry insects.

601,089—March 22, 1898. J. G. WIBORGH. *Phosphate and method of making same.*

A tetra-calcium-sodium (or potassium) phosphate, readily soluble in citrate of ammonia; produced by heating apatite to a red or yellow heat with matter containing sodium (or potassium) in proportion to yield a compound containing the ratio of about 426 of phosphoric acid to 560 of oxide of calcium, and from about 124 to 188 of oxide of sodium (or potassium).

619,633—February 14, 1899. C. H. THOMPSON. *Fertilizer and method of making same.*

A fermented fertilized material (which will serve as a substitute for earth), produced by dissolving phosphoric acid, potassium carbonate, and sodium nitrate in water; adding thereto a mixture of soot, gypsum, and bone meal with water; boiling therein a spongy or fibrous material as peat moss; straining; adding yeast and sugar or saccharine matter, and fermenting the product.

635,622—October 24, 1899. W. WARING AND J. E. BRECKENRIDGE. *Acid-proof bag for fertilizers.*

The bags are treated with an acetate, preferably acetate of lime.

639,805—December 26, 1899. J. H. BREWER. *Fertilizing compound.*

A solution of water, saltpeter, sal soda, bluestone, nitrate of ammonia, and potash, is sprinkled on stable manure, and then wood ashes, salt, lime, phosphate, cottonseed meats, and kainit is mixed therewith.

649,941—May 22, 1900. H. MEHNER. *Artificial fertilizer.*

A fertilizer containing as an essential ingredient silicon nitrides, which form ammonia with the acid reagents in the soil.

PROCESSES.

3,139—June 24, 1843. C. BAER AND J. GOULIART. *Improvement in making manure.*

Vegetable matter is formed into heaps, without previous immersion in lye (as according to the Jauffret method), and subsequently the lye is poured onto it.

12,480—March 6, 1855. R. C. DEMOLON AND G. A. C. THURNEYSSEN. *Improvement in treating fish for manure and oil.*

It is reduced to a dry powder, by steaming, expressing the oil, grating, desiccating, and pulverizing.

16,111—November 25, 1856. C. BICKELL. *Process of treating feldspar for a manure.*

Feldspar, either potash or soda feldspar, is decomposed by heating it with lime and phosphate of lime, to obtain potash or soda, either in the caustic or carbonated state, or for the purpose of obtaining a fertilizer.

16,882—March 24, 1857. L. REID. *Improvement in processes for preparing fertilizers.*

The liquid matter obtained from the treatment of animal matter with high pressure steam, after separation of the fat and pulpy matter, is treated with sulphuric acid, and neutralized with bone dust; then the solid matter properly ground is mixed therewith together with pulverized bones and dried clay, and the mass dried and ground.

17,237—May 5, 1857. C. STEARNS. *Improved process of preparing green-sand marl as a fertilizer of lands.*

The sand is washed with agitation to separate useless earthy matters, then disintegrated, with or without the admixture of animal matter, and then ammonia is added, in the form of ammonia sulphate or otherwise.

25,772—October 11, 1859. D. STEWART. *Improved method of preparing bones for fertilizing purposes.*

Bones are stratified in a heap along with animal, vegetable, and mineral matter, to effect decomposition, the order of stratification being old plaster; stable manure, etc.; bones, blood, etc.; stable manure, etc.; old plaster.

26,548—December 20, 1859. W. D. HALL. *Improvement in fertilizers.*

Fish is boiled in fresh water, drained, sprinkled with from 1 to 3 per cent of sulphuric acid, mixed, and dried.

35,417—May 27, 1862. L. HARPER. *Improvement in fertilizers.*

Phosphatic guano, which is deficient in soluble matter, is spread in moistened layers together with layers of nitrogenous matter and layers of sulphate of lime, sprinkled with sulphuric acid, and exposed to the sun, with turnings of the material.

38,040—March 31, 1863. L. D. GALE. *Improvement in treating phosphatic guanos.*

Animal matter is treated with acid, or its equivalent, to separate the nitrogenous matter from the oil; and a concentrated manure is formed by mixing animal matter so treated with pulverized gypsum and then with guano.

41,428—February 2, 1864. L. HARPER. *Improvement in restoring phosphatic guano.*

A portion of the phosphatic guano is nitrogenized by saturating it with animal broth or juice or urine, and dried; another portion is treated with sulphuric acid; and nitrogenous animal matter is treated with alkaline salts, sulphate of iron, and magnesium chloride; the three masses are then mixed in a heap and subjected to fermenting and heating for a month.

41,663—February 16, 1864. A. A. HAYES. *Improvement in restoring deammoniated guano.*

Common salt is mixed with the phosphate or guano and oil of vitriol diluted with water, animal secretion, or ammonia water. After the moist mixture begins to stiffen it is placed in a heap and mixed with animal matter sufficient to supply the required amount of ammonia and allowed to ferment until putrefaction ceases.

42,006—March 22, 1864. G. A. LIEBIG. *Improvement in treating and preparing Navassa guano.*

The larger particles, available for fertilizers, are separated out, and the finer material containing peroxide of iron, organic and indefined material, is used for paint and other uses.

43,466—July 12, 1864. W. ADAMSON. *Improved process of treating hair.*

Hair of hogs and other animals is dried and deodorized by subjecting it to the direct action of the products of combustion of coal or other fuel.

45,961—January 17, 1865. G. A. LIEBIG AND E. K. COOPER. *Improved process for manufacturing fertilizing phosphates.*

Navassa guano or other substances containing phosphate of iron or of alumina are made available for agricultural purposes by, first, treating with caustic lime or carbonate or sulphate of lime, giving a phosphate of lime convertible into superphosphate with sulphuric acid; second, treating with caustic or carbonate or sulphate of soda or potash; third, treating with silicic acid.

46,318—February 14, 1865. W. ADAMSON. (*Reissues; 2,114—November 28, 1865; Div. A 8,741 (process); Div. B 8,742 (product), June 10, 1879.*) *Improved method of treating offal.*

Animal offal is drained and dried by subjecting it to the direct action of the products of combustion, in a chamber, at one operation.

46,700—March 7, 1865. R. B. POTTS. *Improved process for treating Navassa guano.*

Superphosphate of lime is made from Navassa guano or all guano containing more than 6 per cent of iron and alumina, by sprinkling it with the requisite quantity of sulphuric acid while the mass is continually agitated.

47,610—May 9, 1865. E. P. BAUGH. *Improved mode of manufacturing superphosphate of lime.*

Bones and other offal or guano are fed into a closed or nearly closed tank, along with a stream of sulphuric acid, and therein thoroughly mixed; the product being continuously discharged from the bottom.

47,611—May 9, 1865. E. P. BAUGH. *Improved method of treating manure.*

Sewage, guano, etc., is dried by passing the products of combustion from a furnace through the material; the same being fed by traveling aprons across the current of hot gases.

47,941—May 30, 1865. R. B. FITTS. *Improved process for treating and compounding marl.*

Marl is treated with night soil in combination with sulphuric acid, and to the product there is added salt cake, gas lime, and animal charcoal.

49,831—September 5, 1865. G. A. LIEBIG. *Improvement in the manufacture of superphosphates.*

Sulphurous acid, or muriatic acid, or sodium chloride is used as a substitute for sulphuric acid in the production of a superphosphate from Navassa guano or other phosphatic compound.

49,891—September 12, 1865. F. KLETT. *Improvement in the manufacture of fertilizers.*

A mixture of feldspar, carbonate or hydrate of lime, fluoride of calcium, and phosphate of lime or iron is calcined at a red heat for about five hours, using 2 parts of the carbonate or hydrate of lime and 1 part of the phosphate of lime or iron for every 1 part of the feldspar and 2 parts of fluoride of calcium for every 1 part of alkali contained in the mineral.

52,863—February 27, 1866. A. AND E. LISTER. *Improvement in deodorizing offal.*

Hot air and gases are forced into closed offal-drying chambers, and at the same time the gases, vapors, and exhalations are withdrawn therefrom and passed into the furnace.

54,635—May 8, 1866. J. WISTER. *Improved mode of grinding bones for manure, etc.*

Hard plaster is mixed with bones in grinding to facilitate the process and prevent gumming of the mill.

59,978—November 27, 1866. A. DE FIGANIÈRE. *Improvement in the manufacture of super-phosphates of lime.*

The powdered guano is brought into contact with a surface wet with sulphuric acid, as the surface of a revolving cylinder.

60,948—January 1, 1867. A. SMITH. *Improved fertilizer.*

Boiled animal matter is subjected to pressure, as in a hydraulic press, to preserve the fleshy matter from decomposition.

62,760—March 12, 1867. G. A. LEINAU. *Improvement in preparing fertilizers.*

Sod is banked up with quicklime, and after standing for some time blood, urine, domestic guano, and land plaster are successively applied or spread on the bank, and then spent charcoal is worked into the mass.

70,671—November 5, 1867. W. DE ZENG. *Improvement in the preparation of fertilizers.*

Finely pulverized slags of reducing and smelting furnaces are used in combination with acids and alkalis, as the waste acids of dyeworks, and also with urine, farm-house manure and other ammoniacal compounds.

71,689—December 3, 1867. J. W. BITNER. *Improvement in fertilizers.*

Manure is damp-rotted, then dried and pulverized.

75,325—March 10, 1868. G. F. WILSON. *Improvement in the manufacture of phosphatic fertilizers.*

A mixture of bones, bone ash or bone coal, and hot viscid niter or salt cake is treated in a revolving cylinder with hot water and steam under pressure.

75,326—March 10, 1868. G. F. WILSON. *Improvement in the preparation of bones for the manufacture of phosphoric acid and phosphates.*

To remove the cyanides, sulphides, and other organic compounds from bones which have been distilled according to No. 75,329. The bone-black material is heated in a muffle furnace and the material turned over from time to time until it assumes a uniform gray tint.

75,327—March 10, 1868. G. F. WILSON. *Improvement in the manufacture of phosphates for agricultural purposes.*

Bones are treated with water and oil of vitriol in a vat having a steam heating coil until the whole mass is reduced nearly or quite to dryness.

78,061—May 19, 1868. J. COMMINS. *Improved mode of treating mineral phosphates for the manufacture of fertilizers.*

Mineral or earthy or natural phosphates are heated and plunged into gas liquor, combined with sulphuric acid or other acid or salt. The phosphates may be first treated with a solution of sodium chloride.

78,730—June 9, 1868. L. S. FALES. *Improvement in the manufacture of fertilizers.*

Bones, blood, and highly nitrogenous material are treated with the waste acid from oil refineries and the vapors from waste ammoniacal water of gas works, and the mass reduced to a pasty consistency and cooled to a powder. This is mixed with blood digested with sulphuric acid and peat.

79,160—June 23, 1868. D. A. TER HOEVEN. (*Reissue: 4,052 and 4,053—June 28, 1870*). *Improvement in the manufacture of fertilizers.*

Horns, hoofs, or other animal matter of an equivalent character are steamed, dried, and crushed or ground.

88,223—March 23, 1869. A. SMITH. *Improved fertilizer.*

Refuse leather is steamed at about 75 pounds pressure for four to eight hours, dried and pulverized without the use of chemical agents. It may then be mixed with a phosphate.

90,328—May 18, 1869. G. F. WILSON. *Improved process of treating offal-gelatine and scrap for the manufacture of fertilizers.*

Offal-gelatine and scrap is treated with acid phosphate of lime concentrated and dried, and mixed with bone sulphate of lime, dried peat, gypsum, clay, etc.

90,367—May 25, 1869. W. LALOR. *Improved fertilizer.*

The refuse acid of petroleum-oil refineries is used instead of sulphuric acid in the conversion of bone into superphosphates.

92,744—July 20, 1869. J. G. NICKERSON. *Improved fertilizer from seaweed.*

Seaweed is cut into small pieces, dried, mixed with any of the fertilizing ingredients, and ground.

99,924—February 15, 1870. O. LUGO. *Improvement in the manufacture of fertilizers and in extracting oils and fats.*

Fish, offal, blood, and other animal matter is treated with sulphurous acid or with nitrous fumes and sulphurous acid, separate or in connection with hot air, steam, or gases of combustion.

100,457—March 1, 1870. C. U. SHEPARD, Jr. *Improvement in preparing ammoniated sulphuric acid for the manufacture of fertilizers.*

Phosphatic material is treated with ammoniated sulphuric acid for the production of an ammoniated superphosphate, said acid being produced by treating ammoniacal water with lime or other liberating material, or by the liberation of ammonia from boneblack or other ammoniacal matter, and the absorption of the vapor by sulphuric acid in such proportions as to leave a part of the sulphuric acid uncombined.

102,689—May 3, 1870. O. LUGO. *Improvement in the manufacture of fertilizers and oil from fish.*

Fish is boiled, steamed, or cooked in acid or acid-salt solution to retain and bind the nitrogenous substances.

104,327—June 14, 1870. O. LUGO. *Improvement in manufacture of fertilizers from fish, etc.*

Fish liquor is treated with sulphuric acid, acid sulphates, hydrochloric acid, or pyroligneous acid, and may then be concentrated, either to dryness, forming a highly nitrogenized product, or partially concentrated and mixed with fish scrap or pomace previous to desiccation.

105,283—July 12, 1870. E. WHITLEY. *Improvement in the manufacture of fertilizers.*

Vegetable matter is burned under a covering of earth, so that the latter is impregnated with the gaseous products of combustion, and the earth and ashes are then mixed.

105,319—July 12, 1870. A. DUVALL. *Improvement in treating vitriolized phosphates.*

Pulverized crude phosphate mixed with sulphuric acid, in a semiliquid state, is run into a large bin, the heat generated in the mass keeping it in a state of ebullition and thoroughly mixing it. It also effects the evaporation of the water. The side of the bin is afterwards removed and the mass broken up.

108,909—November 1, 1870. C. P. HOUGHTON. *Improvement in the manufacture of fertilizers.*

Pulverized crude marl is treated with a solution of soda-ash, niter, and salt to correct its caustic qualities, and may be mixed with bones and Peruvian guano.

111,734—February 14, 1871. L. S. FALES. *Improvement in treating blood for the manufacture of fertilizers.*

Blood is treated with lime, soda, or potash, and acids and afterwards subjected to heat and agitation to evaporate its water.

111,851—February 14, 1871. W. B. JOHNS. *Improvement in treating bones, horns, hoofs, etc., for manufacture of fertilizers.*

They are desiccated and rendered friable by treating with steam in contact therewith, at the commencement of the operation, and then subjected to heat evolved from steam not in contact; in one continuous operation and in one vessel or apparatus.

111,910—February 21, 1871. J. J. CRAVEN. *Improvement in treating blood for the manufacture of fertilizers and ammoniacal salts.*

Dried salt cake—either the bisulphate or binitrate of soda—is mixed with blood and submitted to heat sufficient to dissolve the salt.

113,416—April 4, 1871. D. FORBES AND A. P. PRICE. *Improvement in the treatment of sewage and the manufacture of fertilizers.*

Natural phosphates of alumina are treated with the sulphuric acid or hydrochloric acid, or mixtures of the same, either with or without a base such as lime, and sewage is then treated with the product.

114,693—May 9, 1871. G. T. LEWIS. *Improvement in grinding phosphate substances.*

Mineral phosphates are ground with water, instead of grinding dry, to reduce them to extremely fine powder.

119,000—September 19, 1871. W. ADAMSON AND C. F. A. SIMONIN. (*Reissue: Div. A, 5610; Div. B, 5611; Div. C, 5612—October 21, 1873.*) *Improvement in treating offal, flesh, entrails, etc., for preservation of manure, etc.*

Animal oils and fats are extracted by means of hydrocarbon vapors in a closed vessel; the residue, deprived of its fatty constituents and retaining the ammonia, constitutes a fertilizer.

122,273—December 26, 1871. W. H. McNEILL. *Improvement in deodorizing the gases from lard boiling, etc.*

The vapors are subjected to the action of a disinfectant previous to passing to the condenser.

122,773—January 16, 1872. J. A. MANNING. *Improvement in processes for manufacturing fertilizers.*

The contents of vaults and cess pits is treated with 5 per cent of sulphuric acid, and then evaporated in tanks. Products of combustion passing over or in contact with the material are then forced, with the vapors, into a condenser; the carbureted hydrogen passing to a purifier and thence to a gas holder; the weak solution of ammonia treated for the manufacture of sulphate of ammonia; and the dry product for a fertilizer.

123,744—February 13, 1872. B. TANNER. *Improvement in the manufacture of superphosphates of lime.*

Slowly soluble superphosphate of lime; produced by heating a mixture of sulphate of lime and phosphate of soda or of potash, with or without water; or by treating lime or sulphate of lime with any of the forms of phosphate of soda or of potash; or with phosphoric acid and sodium or potassium chloride, or equivalent agents. Soda or potash in a caustic condition, or in combination with an acid, are produced as by-products.

124,041—February 27, 1872. J. E. DOTCH. *Improvement in deodorizing and fertilizing materials.*

Pulverized clay, argillaceous earth, and clay marl is treated with sulphomuriatic acid and then mixed with night soil, etc. Clay thus treated may be mixed with coal ashes, coke, or gas-house silt, as a disinfecting substitute for dry earth.

124,901—March 26, 1872. J. M. LOEWENSTEIN. *Improvement in deodorizing and fertilizing compounds.*

Dilute sulphuric acid is neutralized with caustic or carbonate of lime, and then equal quantities of peat, charcoal, sand, carbolic acid, clay, common salt, and river sediment are added; the composition to be used in a dry state to deodorize night soil.

124,964—March 26, 1872. M. B. MANWARING AND R. DE WITT BIRCH. *Improvement in the manufacture of potash and phosphate of lime.*

See Group III, Potash.

125,017—March 26, 1872. S. BROWN. *Improvement in preparing fertilizing materials from earth, etc.*

A fertilizer composed of burnt earth and wood ashes, prepared by charging and burning a kiln with alternate layers of wood and earth.

125,074—March 26, 1872. H. H. PARISH. *Improvement in treating sewage for fertilizers, etc.*

A mixture of retorted charcoal (the product of pyroligneous-acid works), 1 part, and slacked lime, 2 parts, is mixed with sewage to deodorize and convert into manure.

125,112—March 26, 1872. M. J. STEIN. *Improvement in rendering animal matters and drying and pulverizing the same.*

A fertilizer derived from the treatment of animal matters in a confined condition, the material not coming in contact with the air at any stage of the process.

125,343—April 2, 1872. A. SMITH. *Improvement in apparatus for pulverizing animal matters for fertilizers.*

Animal matter is desiccated and pulverized by triturating the same in a hot chamber in a revolving cylinder, mixed with hard substances, as pieces of iron or stones.

125,613—April 9, 1872. N. A. PRATT. *Improvement in treating phosphates of lime for the manufacture of fertilizers.*

Crude phosphates treated with sulphuric acid are at once subjected to hydraulic or other pressure to extract the soluble phosphates. The liquor, and a thin smooth paste of lime, are heated to about 180° F. and one poured into the other in such proportions as to neutralize, and boiled and stirred until the phosphate of lime is precipitated, when it is compressed into cakes.

126,904—May 21, 1872. N. A. PRATT AND G. T. LEWIS. *Improvement in the treatment of phosphates for the manufacture of fertilizers, etc.*

Crude phosphate is ground with acid and water, and the product pressed in bags, to obtain the phosphoric extract, which extract is then ground with lime, magnesia, or other base, or their salts to produce an artificial phosphate.

127,670—June 4, 1872. M. J. STEIN. *Improvment in drying and deodorizing animal matters, oils, etc.*

The vapors and gases are exhausted from the heating chamber or vessel as fast as generated.

128,454—July 2, 1872. H. C. BABCOCK. *Improvement in baling manures.*

It is formed and pressed into bales, either with or without embedded handles.

129,517—July 16, 1872. E. P. AND D. BAUGH. *Improvement in the treatment of horns, hoofs, and other organic matter.*

Exhaust steam is passed through a mass of horns, hoofs, bones, or other organic offal preparatory to grinding (steam, under pressure, having a tendency to force in the glutinous constituents and obstruct the trituration).

128,752—July 9, 1872. N. A. PRATT AND G. T. LEWIS. *Improvement in treating phosphatic rock, etc.*

The phosphatic extract of No. 126,904 is evaporated to dryness, alone or mixed with salts of soda, potash, magnesia, or ammonia; or such mixtures are calcined to produce compound phosphates of lime and of the alkalis. It may be mixed with other fertilizing components.

130,616—August 20, 1872. H. C. BABCOCK. *Improvement in preparing manure for transportation, storage, or market.*

The straw is eliminated and the residuum is compressed into a bale, and may be covered with a coating of clay, cement, or the like.

131,131—September 3, 1872. J. J. STORER. (*Reissue: 5,703—December 23, 1873.*) *Improvement in processes and apparatus for deodorizing and destroying the gases from offal-treating establishments.*

The gases are deodorized by passing them through an independently heated furnace, flue, or other heat-radiating chamber; also by contact with burning coke, charcoal, or coal, or a blast of fine pulverized fuel.

132,498—October 22, 1872. J. J. STORER. *Improvement in treating offal so as to produce fertilizers and destroy offensive gases and vapors.*

Animal refuse is treated in a reverberatory furnace, the steam being drawn off through hot-wall flues and passed through burning fuel, or into the fire-place or stack.

133,404—November 26, 1872. L. W. BOYNTON. *Improvement in preparing manures for transportation.*

Peat is mixed with manure and compressed to concentrate and exclude the atmosphere, and may then receive a waterproofing coat of soft clay.

135,383—January 28, 1873. J. J. STORER. *Improvement in treating offal and manufacturing fertilizers.*

Offal and blood are dried in a cylinder by passing the flame of pulverized fuel and other products of combustion through the cylinder directly over or in contact with the material.

135,995—February 18, 1873. J. McDOUGALL. *Improvement in fertilizers.*

Ammonia gases or vapors arising from the destructive distillation of carbonaceous or ammoniacal substances or from gas liquor are caused to be absorbed by an acid phosphate of lime, the latter being made porous, if need be, by an admixture of sawdust or porous material. Sulphuric acid may be added to the product to render the phosphate again soluble.

136,036—February 18, 1873. W. D. CRAVEN. *Improvement in preparing blood for fertilizers.*

Blood is injected or introduced directly upon the heated walls of a vessel or chamber, whereby immediate dehydration is produced.

137,969—April 15, 1873. E. C. C. STANFORD. *Improvement in deodorizing animal matters for fertilizers, etc.*

Solid or liquid matter, as excreta, is deodorized by subjecting the same to the action of granulated charcoal (preferably seaweed charcoal), alone or mixed with earthy matter; the charcoal being recovered and revivified.

138,250—April 29, 1873. F. HILLÉ. *Improvement in the treatment of sewage.*

Sewage is treated with lime, chloride of zinc, and the chloride of magnesium, and the solid and liquid constituents separated by deposition and filtration. The precipitate is mixed with the spent filtering materials (charcoal) and dried for fertilizer.

140,391—July 1, 1873. J. TURNER. (*Reissue: 5845—April 21, 1874.*) *Improvement in treating offal and manufacturing gas.*

The gases are separated from the moisture and carbureted.

140,559—July 1, 1873. B. TANNER. *Improvement in the manufacture of superphosphate of lime.*

A chemical examination is made of a calcic phosphate solution, and if the phosphoric acid and lime or calcium are present in the proportion of 71 parts of phosphoric acid for 28 parts of lime or 20 parts of calcium, it is evaporated to dryness and the heat maintained until the final decomposition is complete. If the lime or calcium is in excess the solution is treated with sulphuric or oxalic acid in a specified manner, or phosphoric acid is added to balance the lime; if phosphoric acid is in excess, lime in proper proportion is added.

141,848—August 19, 1873. A. F. ANDREWS. *Improvement in fertilizers.*

Tank stuff or animal matter is mixed with about one-third the quantity of unslacked lime, either with or without the addition of sodium chloride or calcium chloride, and subjected to agitation in a mixer, which is externally heated, and reduced to a dry condition.

141,853—August 19, 1873. C. C. COLE. *Improvement in drying and disintegrating animal matters.*

Blood and animal matter is mixed with from 5 to 10 per cent of dry quicklime and partially dried, and then from 2 to 5 per cent of sulphuric acid is added and the drying finished.

144,877—November 25, 1873. H. STEVENS. *Improvement in the manufacture of fertilizers.*

After the rendition of fatty matter from animal matter, the remaining liquor is evaporated to a sirup, and then mixed with the solid animal matter and plaster of paris, forming a friable mass.

146,285—January 6, 1874. B. F. SHAW. *Improvement in treating waste liquors of slaughterhouses to produce fertilizers.*

The washings, scrubbings, and waste liquors are defecated by cooling to a point at which blood will not coagulate, adding a quantity of blood and thoroughly mixing and boiling for a few minutes, with or without the prior addition of charcoal or the addition of chemical reagents.

149,038—March 31, 1874. A. HERBERT. *Improvement in methods of analyzing soils.*

Ten experimental plats of homogeneous land are planted in like manner, using a fertilizer formed from nine ingredients of plant food, one plat with the complete manure, and each of the others with the complete manure less one of the ingredients, whereby the fertilizer required in that soil for perfect plant growth is ascertained.

151,905—June 9, 1864. G. E. NOYES. *Improvement in the manufacture of fertilizers from night soil.*

Night soil is mixed with hydraulic cement or calcined plaster, and sprinkled with sulphuric acid, to form solid bricks or lumps.

152,389—June 23, 1874. H. A. P. LISSAGARAY. *Improvement in fertilizers.*

Blood is converted into an imputrescible fertilizer by treatment with an alkaline sulphite or its equivalent, and then adding sulphuric acid in constant and regulated quantities. The apparatus is also claimed.

154,092—August 11, 1874. H. Y. D. SCOTT. *Improvement in the manufacture of fertilizers from sewage.*

Process of deodorizing excreta and urinous liquors by separating the solids from the liquids by the use of charcoal, dried earth, sawdust, or like material, and then extracting the phosphoric acid and nitrogen from the liquids by lime or hydrated phosphate of magnesia.

154,093—August 11, 1874. H. Y. D. SCOTT. *Improvement in treating sewage.*

Quicklime is added to sewage water, in any of the modes usually practiced, and the precipitate calcined to obtain useful and marketable products.

155,517—September 29, 1874. E. H. HUCH. *Improvement in treating blood.*

Blood is treated with pulverized unslacked lime, and the gelatinous mass dried. It may be mixed with boneblack and used as a manure, or with flour or other farinaceous substance as an article of food.

158,772—January 19, 1875. B. ACKERMAN. *Improvement in the preparation of fertilizers.*

Excrementary matter and straw or litter is baled in rectangular form, the lines of band compression, when the bales are corded up, forming ventilating grooves.

161,827—April 6, 1875. S. SEITZ. *Improvement in fertilizers.*

Oyster shells, as a base fertilizer, are scorched and dried, so as to render them friable, without decomposing the nitrogenous matter connected with them, and then ground.

163,099—May 11, 1875. T. MYERSON. *Improvement in processes of treating blood for the manufacture of manures.*

Blood is treated with a salt of alumina—as the sulphate or double sulphate of alumina and ammonia—to retain the ammonia.

165,172—July 6, 1875. C. H. NORTH. *Improvement in fertilizers.*

The soup obtained from rendering offal, after the water is nearly all evaporated, is treated to a heat of about 300° F. for about four hours, forming a brittle and soluble fertilizer product without deliquescence.

165,345—July 6, 1875. O. LUGO. *Improvement in fertilizers.*

Coagulated, granular, pulverulent blood combined with antiseptics, is prepared by breaking it up with agitation, coagulating with heat, and removing the free water by centrifugal action. The antiseptic is preferably added after the disintegration of the clots (though it may be incorporated before) or to the finished product.

172,590—January 25, 1876. L. STOCKBRIDGE. *Improvement in processes of manufacturing fertilizers.*

Salts containing nitrogen, potash, and phosphoric acid are compounded—and these elements with lime and magnesia for cotton and tobacco—in the proportions in which they are taken up by the crop, as shown by an analysis of the plants, and in amounts requisite to produce any desired amount of crop within certain limits.

183,242—October 10, 1876. R. R. ZELL. *Improvement in processes and apparatus for manufacturing fertilizers from night soil.*

The night soil is separated into watery and semifluid bodies, and the ammonia vapor distilled from the watery constituent and incorporated with the semifluid mass or base of the fertilizing compound after the treatment of the latter with sulphuric acid, for the purpose of fixing the ammonia.

186,204—January 16, 1877. S. L. GOODALE. *Improvement in processes of treating fish scrap.*

Fish or fish scrap is washed subsequent to its being cooked (preferably after cooking, draining, and once pressing), and before it is finally pressed; whereby gelatine is removed, the yield of oil increased, and the subsequent drying of the scrap facilitated.

196,831—November 6, 1877. P. G. L. G. DESIGNOLLE. *Improvement in treatment of mineral phosphates.*

Poor mineral phosphates are enriched, carbonate of lime eliminated, and also tribasic phosphate of lime transformed into monobasic phosphate in solution by the use of sulphurous acid, either in closed or open vessels. The monobasic phosphate of lime so obtained is concentrated to 45° to 50° Baumé and mixed with sufficient plaster of paris to absorb excess of water and solidify the mass.

206,158—July 16, 1878. H. WIESINGER AND L. RISSMÜLLER. *Improvement in treating rags for obtaining paper stock and fertilizers.*

Woolen and half-woolen rags, hair, etc., are subjected to the action of hot lime-water to disintegrate the animal fiber, and then dried. The nitrogenous powder is then separated from the unchanged cellulose, for use in the manufacture of fertilizers.

209,445—October 29, 1878. E. P. BAUGH. *Improvement in the treatment of offal for fertilizers.*

The residuum of fat-rendering tanks is agitated and exposed to heat during agitation, after leaving the main rendering tank and before it is subjected to pressure.

216,816—June 24, 1879. W. ADAMSON. *Improvement in methods of treating bones for glue stock.*

Bones are first subjected to the action of hydrocarbons, liquid or vapor, to extract fat and oily matter, and then to the usual acid treatment.

221,232—November 4, 1879. J. M. HIRSH. *Improvement in processes and apparatus for deodorizing and disinfecting.*

The noxious gases are converted into salts by contact with a liquid composed of metallic salts in solution mixed with a solution of organic salts—as the nitrates of iron and the salts of the phenyl, xylol, cresyl, etc., series. The apparatus is claimed.

228,387—June 1, 1880. W. PLUMER. *Process and apparatus for the manufacture of fertilizers.*

Night soil is heated to desiccate it and expel its noxious vapors; antiseptic vapor, as carbolic acid, is mingled with the desiccated material, and the free ammonia is fixed as crude sulphate of ammonia and mixed with the disinfected desiccated material to complete the fertilizer.

228,955—June 15, 1880. B. TERNE. *Treatment of sewerage.*

A solution for disinfecting and precipitating tank and sewage waters, consisting of water containing superphosphate of lime and tannic or gallic acid.

229,955—July 13, 1880. J. H. CHAMBERS. *Manufacture of an improved fertilizer from stable manure.*

Stable manure is rotted by subjecting it to a moderate heat in a closed chamber with moistening at intervals. The chamber is provided with a steam coil and a steam inlet pipe.

236,763—January 18, 1881. F. J. BOLTON AND J. A. WANKLYN. *Process of manufacturing artificial manures.*

Urine is evaporated at about 212° F., with a small proportion of charcoal, soot, burned bones, or other charred absorbent material, and the solid constituents obtained in a condition suitable for manure.

238,133—February 22, 1881. G. T. LEWIS. *Manufacture of fertilizers.*

Pulverized bone phosphate or other insoluble phosphates are mixed with coarsely powdered pyrites, and exposed to the action of atmospheric oxygen and moisture for several months.

238,240—March 1, 1881. J. M. & J. LIPPINCOTT. *Fertilizer.*

Slag or scoria from blast furnaces for the manufacture of pig iron from iron ores—preferably the nonvitreous or gray slag—is pulverized and used as a base in the manufacture of fertilizers.

241,463—May 10, 1881. R. WERDERMANN. *Manufacture of fertilizers from blood.*

A rich nitrogenous product is produced by adding lime to fresh blood, agitating the mixture, precipitating the lime by settling, and finally drying the coagulated blood.

241,868—May 24, 1881. G. A. LIEBIG. *Treating phosphates for fertilizers.*

A calcined mineral phosphate, produced by mixing phosphates or phosphorites with coal or charcoal and subjecting it to a great heat, the phosphoric acid formed, though insoluble in water, being available for plant food.

242,777—June 14, 1881. A. J. HUET. *Treatment of animal and vegetable substances for the manufacture of fertilizers, etc.*

A solution of magma of lava resulting from treating lava with acid, alunite calcined with chloride of potassium, and lime mixed with oxidized oil of tar, to preserve and disinfect and destroy germs.

247,579—September 27, 1881. W. PLUMER. *Process of and apparatus for manufacturing and desiccating animal and vegetable substances.*

The material is subdivided and passed through heated retorts into receptacles, the gases and vapors generated being carried off by a blast of air through a pipe connected with the retorts, but without actual contact with the material treated, the material being cooled and aerated by another blast of air after leaving the retorts.

252,029—January 10, 1882. J. F. GIBBONS AND G. A. LIEBIG. *Treating phosphates for fertilizers.*

A phosphatic fertilizing compound consisting of superphosphates combined with acid salts of alkalis and lime; produced by mixing crude ferruginous or aluminous phosphates with salts of soda, potash, or magnesia, and carbonaceous matter, burning or calcining, and then mixing the product with an acid.

258,737—May 30, 1882. C. L. FLEISCHMANN. *Treatment of prairie soil to obtain useful products therefrom.*

Rich prairie soils are exposed to the heat of combustion and sublimation, and the products treated by purification and lixiviation to extract the alkaline, carbonaceous, and nitrogenous matter.

259,140—June 6, 1882. F. L. HARRIS. *Manufacture of fertilizing material.*

Two or more charges of bone, horns, or hoofs are successively boiled in the same water in a closed vessel under pressure, removed and dried, then a suitable quantity of the material thus treated is soaked in the liquor to absorb the gelatine contained therein, and it is finally dried and pulverized.

259,202—June 6, 1882. F. PETRI. *Method of and means for treating sewage.*

The solid substances are eliminated; the liquid passed through an absorbent filtering and antiseptic material, then again filtered, then acidulated or a chloride is mixed therewith; the acid or chloride is then eliminated or neutralized, and finally the neutralizing agent is eliminated by filtration.

260,165—June 27, 1882. H. COLLET. *Treatment of excreta for the production of fertilizing substances.*

Solid and liquid constituents of excreta are separated and the solid ingredients collected as a scum by the application of "nitriolic powder;" the latter formed by treating sulphate of iron with nitric acid and sulphuric acid, and the sulphate of sesquioxide of iron thus formed is mixed with clay or argillaceous earth.

261,038—July 11, 1882. A. F. POULLAIN-DUMESNIL. *Special fertilizer for plants.*

A fibrous absorbent material, such as moss, is wetted with an adhesive fluid (as milk) impregnated with a fertilizing substance in the state of an impalpable powder (as the phosphates and nitrogenous substances), and then dried.

263,322—August 29, 1882. A. F. CROWELL. *Manufacture of fertilizers.*

Fish and superphosphate—say in the proportion of 6 of the former to 1 of the latter by weight—are cooked together, and then subjected to pressure; the oil being separated and the gelatinous, nitrogenous, and phosphatic liquid used as a fertilizing material.

269,487—December 19, 1882. B. TERNE. *Utilizing tank waters of slaughterhouses.*

Tank waters are concentrated, mixed with animal charcoal, and dried.

276,143—April 17, 1883. J. J. KNIGHT. *Preparation and production of mineral phosphates.*

Mineral phosphates containing alumina and oxides of iron are subjected to the action of strong sulphuric acid of 1.70 specific gravity, equal to 140° Twaddle, or upward, in excess; by means of which the sulphates of alumina and iron produced are rendered insoluble, while the phosphoric acid is rendered soluble, and can be separated out.

279,445—June 12, 1883. C. SCHEIBLER. *Obtaining phosphatic fertilizers from basic iron slag.*

Slags obtained in the dephosphorization of iron are powdered, roasted by an oxidizing flame, treated with muriatic acid, the quantity being sufficient only for dissolving caustic lime and magnesia, together with the silicates and the phosphates thereof, while its dilution is such as is attained by adding at least 9 parts of water to 1 part of the acid of commerce of 21° Baumé, and the phosphate of lime or magnesia finally precipitated by adding to the liquor, separated from the residue, caustic lime or magnesia (or the carbonates may be used).

280,320—June 26, 1883. C. J. F. R. DE JANNEL MENARD AND H. J. E. HENNEBUTTE. *Manufacture of fertilizers.*

Sewage is agitated or mixed with chloride or sulphate of zinc and subsequently with a salt of alumina (preferably impure sulphate), filtered, and the residue dried.

281,635—July 17, 1883. A. H. KOEFOED AND T. B. STILLMAN. *Method of treating phosphates of iron and alumina.*

Insoluble phosphates are powdered and mixed with powdered dolomite or limestone, the mixture calcined, then pulverized and treated with a mineral acid.

283,426—August 21, 1883. E. A. SCRIBNER. *Process of manufacturing artificial fertilizers.*

A small percentage of sulphur is mixed with phosphates of iron and alumina and the mixture roasted.

283,427—August 21, 1883. E. A. SCRIBNER. *Process of manufacturing artificial fertilizers.*

Mineral phosphates are ground and roasted, and the vapor of sulphur r sulphurous anhydride is forced through the mineral while roasting.

284,674—September 11, 1883. G. ROCOUR. *Process of treating phosphatic slags for manure, etc.*

The phosphate of iron in phosphatic slag is reduced by roasting into a phosphide, and the latter is then converted into a soluble alkaline phosphate by oxidation with a sulphate of sodium or potassium, carbon, and sulphur or iron pyrites.

285,187—September 18, 1883. T. G. WALKER. *Offal drier.*

The offal is forced by a current of steam, and in the presence of a current of air, through a heated coil; the process being continuous.

301,248—July 1, 1884. G. A. LIEBIG AND J. F. GIBBONS. *Treating phosphates of alumina and iron.*

Mineral phosphates containing iron or alumina are treated with dilute acid of a strength between 32° and 47°, according to the amount of water contained in the phosphorite.

301,406—July 1, 1884. S. G. THOMAS. *Manufacture of alkaline phosphates.*

Phosphate of soda or potash is obtained by treating their chlorides in a basic Siemens furnace or Bessemer converter in the presence of oxygen and superheated steam, or other hydrogen-supplying substance, with molten phosphoric iron and atmospheric oxygen or oxide of iron.

301,407—July 1, 1884. S. G. THOMAS. *Manufacture of alkaline phosphates.*

Soluble alkaline phosphates are manufactured from phosphoric nonsilicious molten pig iron in a basic-lined Siemens furnace or Bessemer converter, by pouring the molten metal upon alkaline carbonate (covered with an iron casing or plate, or with limestone or oxide of iron to prevent too rapid volatilization of the carbonate before the acid has decomposed it), turning on the blast, and with the blast introducing a further quantity of the carbonate, the alkali rising through the bath, and combining with the nascent phosphoric and silicic acids and forming a slag of phosphate and silicate of soda and potash; running off the slag; lixiviating it; and evaporating or precipitating with milk of lime.

302,266—July 22, 1884. G. A. LIEBIG AND J. F. GIBBONS. *Treating phosphates for fertilizers.*

Mineral phosphates containing iron or alumina are treated with dilute acid of 32° to 47°, and then salts of ammonia or potash. Preferably the sulphates are added, producing a fertilizer consisting of soluble and available phosphate of iron, soluble and available phosphate of alumina, and alum.

303,371—August 12, 1884. F. L. HARRIS. *Manufacture of fertilizing materials.*

Phosphates, mineral and phosphatic guanos, marine and oyster shells, limebearing and other substances are placed in a closed vessel with enriched liquor from animal substances, and heated to 250° to 320° F., or higher, after which the material is dried and broken up.

305,249—September 16, 1884. T. B. STILLMAN AND A. H. KOEFOED. *Method of treating phosphates for fertilizers.*

Insoluble phosphates are broken into pieces (not powdered as in No. 281,635), and mixed with dolomite or limestone, also broken into pieces, roasted, pulverized, and treated with a mineral acid.

318,826—May 26, 1885. W. G. STRYPE. *Process of preparing dried blood.*

A solution of sulphate of alumina or alum is added to blood—say 1 part in 50—and the blood finally dried.

324,103—August 11, 1885. C. GIBSON. *Process of making a fertilizer from tank waters.*

Acid sulphate of an alkali, aluminous cake, or sulphate of alumina is added to the tank waters (say in quantity equal to one-fourth of the contained solids), the excess of water evaporated, and a carbonate, oxide, or hydrate of an alkali or alkaline earth added to the residue (say 10 per cent of the original contained solids), and the mass cooled and ground.

342,238—May 18, 1886. J. VAN RUYMBEKE. *Process of making a fertilizer from tank wastes.*

The wastes are evaporated to about 20 per cent of moisture and then distilled at about 460° F., producing a nonviscid and nondeliquescent product. (No. 341,963.)

342,417—May 25, 1886. E. A. BECKER. *Process of making a fertilizer from tank waste.*

Wet or pressed tankage is mixed with sulphuric acid in quantities proportioned to the contained phosphates; then tank water or tank liquor is added, and the mixture dried.

345,625—July 13, 1886. J. J. DUNNE. *Process of making phosphates.*

Fertilizers are made from phosphates, natural or manufactured, containing insoluble phosphate by mixing therewith alkalis or alkaline salts, sulphate of soda, and sulphate of potash, in the proportion of from about one-half to an equal part of alkaline salt to the quantity of phosphate, and furnacing the mixture at a high temperature in conjunction with carbon.

353,825—December 7, 1886. C. SCHEIBLER. *Manufacture of phosphates from slags.*

Process No. 279,445 is modified by using acids which are less diluted than with 9 parts of water to 1 of acid, the slag being first roasted in an oxidizing flame and pulverized, thereby dissolving the main portion of the silica and alkaline-earth phosphates and a part of the oxides of iron and manganese, and then fractionally precipitating the elements of the solution with successive quantities of milk of lime or magnesia, whereby there are separately obtained the phosphates of iron and manganese, and then the alkaline-earth phosphates, with or without the silica; the phosphorus is separated from the iron and manganese by oxidation, dissolved and precipitated, whereby there is obtained an additional amount of alkaline-earth phosphates and an amount of metallic oxides.

354,983—December 28, 1886. J. T. JULLIEN. *Manufacture of fertilizers.*

A combined fertilizer and antiphylloxeric formed by dissolving sulphur in liquid sewage and adding sulphide of carbon.

361,656—April 19, 1887. T. TWYNAM. *Process of producing soluble alkaline phosphates.*

The fused alkaline slag produced in a basic furnace or converter receives such additional quantity of an alkaline salt, as carbonate of soda, as will form, with the alkali already present, at least three equivalents of base for each equivalent of phosphoric acid, or trisodic or tripotassic phosphate. Soluble alkaline phosphates are produced by adding to phosphoric pig iron (during its conversion into iron or steel in a basic or neutral lined converter or furnace) trisodic or tripotassic phosphate.

387,104—July 31, 1888. D. E. PAYNTER. *Process of drying offal and garbage.*

The mass is subjected to the action of heated air and the vapors passed through sulphate of lime before escaping, forming carbonate of lime and sulphate of ammonia, and destroying offensive odors.

395,532—January 1, 1889. W. J. WILLIAMS. *Phosphatic fertilizer.*

Nitrogenous matter, as wool waste, hair, blood, tankage, etc., is treated with sulphuric acid, and at the same time calcined phosphate of alumina or iron, or a mixture of the two, is mixed with water, and the two mixtures are then thoroughly incorporated, and the mass dried at a heat not exceeding 180° F.

404,348—May 28, 1889. H. ENDEMANN. *Process of making fertilizers.*

Tobacco is moistened, crushed, subjected to the action of mineral acid, washed with water, and the extract added to basic material, such as ground bones. (Product No. 396,274.)

409,230—August 20, 1889. C. C. PECK. *Process of making fertilizers.*

Tank water is evaporated to a semiliquid condition, mixed with infusorial earth, and dried.

413,232—October 22, 1889. T. R. HOUSEMAN AND C. B. M. SPROWLES. *Process of desiccation.*

Garbage, brewer's grain, etc., is desiccated by subjecting to pressure and at the same time heating it by a dry heat throughout its mass.

423,320—March 11, 1890. E. R. HODGKINS. *Process of making phosphatic fertilizers.*

Finely pulverized phosphatic material and calcic oxide are combined, as by spreading them in alternate layers, the calcic oxide slacked by the addition of water, and the ingredients mixed.

434,977—August 26, 1890. C. CLIFFORD. *Process of preparing fertilizers.*

Refuse leather is dampened and placed in a heap to undergo a natural sweating; when the sweating subsides the heap is opened and turned over to expose to the air, again closed up and again sweated, the operation being repeated as long as fermentation lasts; the resulting product is then ground.

438,646—October 21, 1890. P. B. ROSE. *Manufacture of fertilizers.*

An insoluble compound of iron, as ferrous or ferric oxide, is added to "stick" or other albuminoid, either with or without an alkaline earth or its salt, or an alkali or a salt of the same, and the mass evaporated to dryness. A soluble iron salt may be added, and then precipitated by an alkaline earth or an alkali, or their salts.

439,880—November 4, 1890. J. A. LIGHTHALL. *Process of making bags acid-proof.*

Sufficient dry pulverulent acid-proof material is introduced into fertilizer bags to cover the interior surface, and they are then passed between rollers.

442,490—December 9, 1890. C. G. MOOR. *Process of making fertilizer from sewage sludge.*

Sewage sludge, obtained by the use of sulphate of magnesia as a precipitant, is compressed; fed in successive charges to a furnace having a forced draft; a part of the sludge removed from time to time when carbonized (for use with precipitating agent and filter bed); the remainder calcined; the ash removed from time to time; and finally mixed with sulphate of ammonia to form a manure.

443,559—December 30, 1890. H. T. YARYAN. *Process of making fertilizer from tank water.*

Tank water is evaporated to about 25° Baumé and then passed through a dialyser, by which such salts as produce deliquescence (the potash and other alkaline salts) are removed, and the material is then evaporated to a dry product.

445,055—January 20, 1891. R. GIEBERMANN. *Process of separating gluten from slaughterhouse washings.*

The temperature of the washings is gradually raised to about 200° F.; an alumina compound is then introduced to precipitate the gluten, and the washings are passed through a filter.

445,255—January 27, 1891. W. B. SEAL. *Process of making fertilizers.*

Raw phosphatic material is subjected to the action of sulphuric acid, and then powdered coal is added while the chemical changes are taking place, with or without the subsequent addition of nitrogenous material.

446,087—February 10, 1891. J. VAN RUYMBEKE. *Phosphate and process of making the same.*

An iron and alumina metaphosphate mixed with an iron and alumina sulphate; produced by treating an iron and alumina acid phosphate with sulphuric acid and then heating it at a temperature of from 400° to 800° F., until the acid phophate contained therein is converted into metaphosphate, usually indicated by the product assuming a gray color.

446,998—February 24, 1891. J. VAN RUYMBEKE. *Making phosphatic fertilizers.*

Iron and alumina phosphate is pulverized, mixed with muriate of potash or preferably low-grade sulphate of potash, treated with sulphuric acid, and then subjected to heat until the contained acid phosphate is converted into metaphosphate.

453,300—June 2, 1891. C. GLASER. *Process of separating alumina from phosphates.*

Phosphate of alumina is dissolved out of phosphatic material by a hot solution of a carbonate of an alkali, as sodium carbonate; the phosphate of alumina separated as a precipitate from the solution on cooling; and the solution again used as a solvent for repeating the operation.

458,744—September 1, 1891. E. WATSON. *Manufacture of fertilizers.*

Tank water, or stick, is converted into a practically dry nondeliquescent fertilizer by adding thereto a portion of other animal matter practically nondeliquescent, and an alkali, and drying the product.

461,164—October 13, 1891. J. VAN RUYMBEKE. *Process of making fertilizer from stick.*

"Stick," a substance produced by concentrating tank water, is first treated with sulphates in any usual way, as with basic persulphate of iron, to cure the vicidity and deliquescence of the substance, then dissolved in sulphuric acid, and then there is mixed therewith tribasic phosphate of lime and the mass allowed to lie until apparently dry.

471,306—March 22, 1892. J. VAN RUYMBEKE. *Process of making nitrogenous fertilizers.*

A solution of soluble salt of iron or alumina is formed with slacked lime added in about the proportions of 10 per cent, in weight, of dry slacked lime, and boiled, and the solution is then mixed with stick, preferably hot (in proportions determined by the condition of the stick) and the product dried.

474,419—May 10, 1892. T. M. SMITH. *Process of making fertilizers.*

Animal substances are placed within a suitable vessel with a definite amount of water (sufficient only to reduce the material to a soft and pasty mass while hot), the vessel closed and subjected to heat until the texture of the material has been destroyed; though soft while hot it becomes brittle and pulverable when cold without further desiccation.

489,010—January 3, 1893. O. T. JOSLIN. *Process of making fertilizer from tank water.*

The water is evaporated to a sirupy condition, heated to 140° to 200° F., when a small percentage of sulphuric acid is added, and then from 5 to 20 per cent of sulphate of magnesium may be added and an absorbent of the supernatant liquid, and the product dried by subjecting it to a temperature of 300° to 400° F. while in motion, for fifteen minutes to an hour.

494,939—April 4, 1893. L. RISSMÜLLER AND H. VOLLBRECHT. *Manufacture of superphosphates from kettle residue.*

The kettle residue of glue factories is mixed with warm sulphuric acid of 50° Baumé, heated at about 200° F., and allowed to stand until the nitrogenous substances have entered into solution with the acid, the gypsum has been precipitated, and the fat risen to the surface, when the solution is separated and powdered phosphate is added thereto in sufficient quantity to take up all the sulphuric acid present, thus rendering soluble the phosphoric acid of the added phosphate and yielding a comparatively dry fertilizer product.

494,940—April 4, 1893. L. RISSMÜLLER AND H. VOLLBRECHT. *Manufacture of superphosphates.*

The process of No. 494,939 is applied to offal, bones, and other animal matter, the fat and fat acids being skimmed off and separately collected as fast as they rise to the surface.

495,042—April 11, 1893. O. T. JOSLIN. *Process of making fertilizer from tank water.*

Tank water is first decomposed by the addition of sulphuric acid, then 5 to 13 per cent of a concentrated solution formed by dissolving waste fuller's earth in sulphuric acid is added, and the product is then dried at a temperature of from 300° to 350° F.

495,043—April 11, 1893. O. T. JOSLIN. *Process of making fertilizer from tank water.*

From 5 to 10 per cent of an acid phosphate of calcium is added to tank waters; then from 5 to 13 per cent of a concentrated solution formed by dissolving waste fuller's earth in sulphuric acid; then an absorbent, as pressed, cooked blood, may be added, and the product dried.

496,687—May 2, 1893. P. C. HOFFMANN. *Process of treating phosphates.*

Florida inland phosphates are pulverized, mixed with a theoretical amount of sulphuric acid, and heat is supplied to the ingredients, independent of the heat of chemical reaction, sufficient to retain the mass (until the free phosphoric acid has had its effect upon the insoluble phosphoric acid) at a temperature above the normal temperature occasioned by the chemical reaction of the mixture, which is ordinarily about 50° C., and yet not exceeding the temperature at which pyro-phosphates are formed, or about 200° C.

500,100—June 20, 1893. M. A. GOLOSEIEFF. *Fertilizer.*

The gelatine refuse from tallow manufactories is evaporated to the consistency of 27° to 28° Baumé; unslacked lime is then combined therewith in the proportion of 500 pounds of lime to 1,000 pounds of the partially evaporated broth; the mass is then allowed to expand and dry, and is reduced to a powdered state.

501,037—July 4, 1893. H. B. ARNOLD. *Process of disposing of city garbage.*

The material is cooked in a closed vessel from 4 to 8 hours, with condensation of the vapors that pass off; the solid matter or tankage is separated from the water or grease; and the tankage pressed and dried in a closed drier with condensation of the vapors.

506,363—October 10, 1893. N. DOWLING. *Process of and apparatus for treating garbage.*

The solid and liquid matter is disinfected in transit; the solid separated from the liquid, squeezed, pulped; compressed, and dried; conveyed to a furnace and incinerated; the separated liquid matter being continuously agitated and disinfected. The apparatus is claimed.

514,042—February 6, 1894. J. J. SELDNER. *Process of converting hair into fertilizers.*

Hair or other substance is heated with a weak solution of mineral acid in a closed vessel to a temperature that will produce a pressure and disintegrate the hair; sufficient pulverized alkaline matter is then added to neutralize the free acid; and the mass is dried.

514,043—February 6, 1894. J. J. SELDNER. *Process of making fertilizers.*

A mixture of hair or like material and an acid phosphate is subjected to heat in a closed vessel until the material becomes disintegrated and dissolved.

515,708—February 27, 1894. J. GREGORY. *Process of making phosphatic fertilizers.*

Boneblack, which has been previously used as a filtering material for oil, either by itself or mixed with bones or offal, is mixed with sulphuric acid, and the mixture boiled to cause the greasy substance to rise and filter through the boneblack, the residue being separated from the greasy material for fertilizer.

517,662—April 3, 1894. N. B. POWTER. *Process of making fertilizers.*

From 5 to 50 per cent of substantially pure phosphate of alumina containing insoluble phosphoric acid is mixed with slaughterhouse refuse and similar waste, in quantity sufficient to take up all soluble and volatile ingredients.

524,813—August 21, 1894. C. WEIGELT. *Process of making fertilizers.*

Fish and meat refuse is comminuted and mixed with potassium salts (as potassium chloride or potassium sulphate) and allowed to stand, say from three to five days, until a lye is formed, which is then drawn off; the fatty matter contained in the remaining mass is extracted; and the material dried and ground.

527,810—October 23, 1894. E. RECORDS. *Process of making fertilizers.*

The solid parts of tankage are disintegrated, without pulverizing, by the admixture of powdered marl. A mixture of pulverized calcareous marl and blood, tankage, or offal is dried, and then more blood, tankage, or offal is added to the mixture and again dried. The ultimate addition of sulphuric acid converts the ammonia into a stable compound.

530,126—December 4, 1894. N. B. POWTER. *Process of utilizing garbage and similar waste products.*

Garbage is reduced to a condition of sludge by steaming or boiling in the presence of sulphuric acid; the grease is removed, a proper amount of insoluble alumina phosphate is added; and the mass subjected to simultaneous stirring and evaporation in vacuum until it is converted into a dry, granular mass.

535,076—March 5, 1895. A. R. C. PIEPER. *Process of making citrate soluble phosphates.*

Pulverized phosphate of iron or alumina is mixed with a hot pulp, obtained by slacking caustic lime in a soda or potash lye in such proportions that there will be about two equivalents of oxide of lime for each equivalent of phosphoric acid in the compound. The burnt lime is slacked in from 5 to 10 per cent of an alkali lye. A nitrate, as saltpeter, is preferably added to the final product.

535,204—March 5, 1895. H. M. HOWE AND J. E. STEAD. *Process of making tetrabasic phosphates.*

In the dephosphorization of iron, phosphoric acid is rendered soluble by adding phosphates to the slag thereby produced, with or without the addition of a base, such as an alkaline earth, oxide of iron, oxide of manganese, or alumina, or their equivalent. The product, when finely ground, may be utilized direct as a fertilizer.

542,080—July 2, 1895. D. T. DAY. *Process of making phosphates soluble in dilute citric acid.*

A mixture of phosphate rock containing a suitable percentage of silica, or added silica, and a calcareous base is heated to a temperature at which carbonate of lime gives up its carbonic acid, and the temperature maintained well below partial fusion to secure a maximum of citric-acid-soluble phosphate. A potassium salt, such as sulphate or muriate, may be added, whereby the temperature can be reduced to between 535° and 650° C.

546,716—September 24, 1895. W. A. SHEPARD. *Method of and apparatus for preparing fertilizers.*

Superheated steam is passed through excrement in an air-tight chamber; the ammoniacal and other gases condensed in water; and the dehydrated and cooked solid matter mixed with lime.

548,342—October 22, 1895. J. WODISKA. *Process of treating garbage.*

The liquid is expressed, the garbage heated to further expel moisture, and it is then subjected to destructive distillation in a retort.

550,024—November 19, 1895. E. MEYER. *Process of disintegrating Thomas slag.*

The disintegration of Thomas slag is facilitated by introducing, while in a fluid state, a small quantity of an alkaline disintegrating agent, such as alkaline carbonate, or alkaline silicate, either with or without a reducing powder, such as coke powder or a metallic sulphide.

578,512—March 9, 1897. H. A. HOGEL. *Process of and apparatus for making fertilizers.*

Garbage is digested with hot water and steam under pressure and reduced to a sludge; filtered by forced filtration while well heated; hot water is forced through the mass; the grease is separated from the rest of the filtered liquids; and the solid matter dried, mixed with phosphatic fertilizing ingredients and converted into a finely powdered condition.

580,224—April 6, 1897. W. S. RICHARDSON. *Method of making fertilizers.*

Hair, fleshings, or similar refuse of skin dressers is converted into a fertilizing component by dry distillation, by subjection to a dry heat in a closed oven at a temperature to make available the nitrogenous matter thereof and the fixing of the same, as ammoniates, in the resulting product, say from 150° to 160° C.; the by-products being driven off and condensed, and the residual product reduced to a comminuted state.

588,266—August 17, 1897. G. DE CHALMOT. *Treatment of phosphates.*

See Group X, Electro-chemistry.

596,008—December 21, 1897. L. RISSMÜLLER. *Process of treating garbage.*

Garbage is boiled with acid in a digester and reduced to a sludge; the evolved gases are led to a furnace, heated and mixed with producer gas by passing therethrough and utilized as fuel; the digested waste is subjected to centrifugal action to remove the grease; and the residue is dried.

602,363—April 12, 1898. W. E. ROWLANDS. *Process of making fertilizers.*

Waste leather is fermented, mixed with crude phosphate, and the mass agitated with the addition of sufficient sulphuric acid to decompose the phosphate.

603,668—May 10, 1898. J. B. TAYLOR AND H. V. WALKER. *Process of and apparatus for recovering ammonia and waste products from garbage.*

The garbage is divided into sections for successive treatment; one section dried and burned in a thick layer, the products led off, the ammonia separated from the combustible gases, and the latter burned in the presence of the next successive section, for drying the same; the cycle being repeated with further sections successively.

609,797—August 30, 1898. H. DUDEN. *Process of making fertilizers.*

Concentrated tank water is mixed with albuminous substance, as concentrated blood serum and the like, and the mixture (acidified if necessary) simultaneously subjected to the action of steam and electricity—say a current of 75 to 120 volts—whereby it is vigorously oxidized. It is finally dried and ground.

611,580—September 27, 1898. L. RISSMÜLLER. *Process of treating garbage and fertilizers obtained therefrom.*

A grease-freed fertilizer, having available ammonia, is produced by boiling garbage and converting it into a uniform fluid mass and then separating the ingredients by centrifugal action, according to their respective specific gravities.

619,056—February 7, 1899. B. TERNE. *Process of making fertilizers from garbage.*

The pressed and dried solid matter obtained from garbage is subjected to destructive distillation, and the phosphated charcoal obtained is mixed with concentrated tank liquors, expressed from the garbage, and the mixture dried.

620,443—February 28, 1899. W. L. GOLDSMITH. *Process of making fertilizers.*

Phosphate rock and lignite or bituminous coal are crushed and pulverized together, whereby they are intimately mixed, and the powder is then treated with sulphuric acid.

622,401—April 4, 1899. F. M. SPENCE. *Process of treating sewage for obtaining fertilizers.*

A mixture of aluminic sulphate and ferric sulphate is added to sewage and sufficient sulphuric acid to complete the neutralization of the alkalinity of the sewage; the precipitated putrescible and fatty matters are separated from the liquid, pressed, dried, and treated with a solvent to dissolve out the fat or fatty acid; the solid fertilizing portion separated; and the fat or fatty acid separated from the solvent.

631,181—August 15, 1899. G. SCHÜLER. *Process of making superphosphates.*

To produce a double superphosphate, a lye of mineral superphosphate of a specific gravity of at least 1.21 is formed, thereby precipitating gypsum, the precipitate separated from the remaining product, which is a mixture of monocalcium phosphate and phosphoric acid, comminuted phosphate added to the said product, and the mixture heated to about 110° C.

634,423—October 3, 1899. D. CAMERON, F. J. COMMIN, AND A. J. MARTIN. *Process of and apparatus for treating sewage.*

Sewage is subjected under exclusion of air, of light, and of agitation to the action of anaerobic bacteria until the whole mass of solid contained organic matter becomes liquefied, and the liquid effluent is then subjected to air and light.

646,559—April 3, 1900. L. RISSMULLER. *Process of making fertilizers from refuse liquids.*

Nitrogenous substances are extracted from nitrogenous refuse liquids (in a heated condition) by adding sulphite residue of the cellulose industry—the water from the sulphite liquor may be more or less evaporated—then filtering and drying the resulting product.

646,716—April 3, 1900. B. TERNE. *Process of making fertilizers.*

In the manufacture of fertilizers from animal excreta, the urine is collected, the liquid is separated from the solid excrements by pressure, mixed with the collected urine, and allowed to putrefy, when it is distilled to obtain the contained ammonia in the form of its salts, which are then mixed with the solid matter.

GROUP IX.—BLEACHING MATERIALS.

CHLORINE.

49,597—August 22, 1865. T. MACFARLANE. *Process of preparing chlorine, bleaching powder, carbonate of soda, and other products.*

See Group II, Carbonate of Soda.

85,370—December 29, 1868. H. DEACON. *Improvement in the manufacture of chlorine.*

For the continuous production of chlorine a current of hydrochloric-acid gas and atmospheric air, heated preferably from 200° to 450° C., is passed over heated material impregnated or mixed with oxides of copper and manganese, or the like.

118,211—August 22, 1871. H. DEACON. *Improvement in apparatus for producing chlorine.*

It is cleansed of dust or deposit of foreign matter by means of powerful blasts of air, reversible at pleasure.

134,190—December 24, 1872. L. E. AUBERTIN. *Improvement in producing chlorine.*

A mixture of air and gaseous or liquid hydrochloric acid is passed over sesquioxide of chrome, heated by preference to about 315° C.

141,333—July 29, 1873. H. DEACON. *Improvement in the manufacture of chlorine.*

In Deacon's process for the manufacture of chlorine, there is employed a mixture of an inactive but accelerating substance such as sulphate of soda, with an active substance such as sulphate of copper.

165,801—July 20, 1875. H. DEACON. *Improvement in the manufacture of chlorine.*

In the manufacture of chlorine by the Deacon process, the impure hydrochloric-acid gas is submitted to the action of aqueous hydrochloric acid, or of chlorides such as sodium chloride, at an elevated temperature, to absorb the sulphuric acid contained in the gas.

165,802—July 20, 1875. H. DEACON. *Improvement in the manufacture of chlorine.*

In the manufacture of chlorine, substances consisting mainly or essentially of sesquioxide of iron are employed as the porous material. Salts or compounds of magnesia are used in conjunction with salts or compounds of copper or other active chemical agents, and the same may be natural magnesian minerals or products impregnated with salts of copper, etc.

316,195—April 21, 1885. E. SOLVAY. *Manufacture of chlorine.*

In the manufacture of chlorine, a composition is used consisting of calcium chloride, silica, alumina, and the residuum remaining after treatment of the composition in a previous operation, the latter being infusible at the temperatures required to produce reaction.

348,348—August 31, 1886. G. RUMPF. *Process of producing chlorine.*

Sal-ammoniac vapors are passed over an oxide of manganese at a temperature below the red-hot state. Atmospheric air is then passed over the resulting chloride of manganese producing free chlorine and regenerating the manganese oxide.

357,659—February 15, 1887. D. G. FITZ-GERALD. *Obtaining chlorine by electrolysis.*

See Group X, Electro-chemistry.

389,781—September 18, 1888. W. WEBSTER, JR. *Process of electrolyzing sewage and sea water.*

See Group X, Electro-chemistry.

390,895—October 9, 1888. A. R. PECHINEY. *Manufacture of chlorine.*

In the manufacture of chlorine and hydrochloric acid by heating magnesium or manganese chlorides in the presence of oxygen or steam with exclusion of products of combustion, the chlorine-yielding material is charged into chambers which have been previously internally heated by hot gases, a series of regenerators being used.

391,159—October 16, 1888. J. A. JUST. *Process of making chlorine.*

Nitric acid, hydrochloric acid, and manganese dioxide are heated in a generator—the nitric acid and manganese dioxide being in equivalent excess of the hydrochloric acid—until all of the chlorine gas is evolved. The residual manganous nitrate liquor is then decomposed by heat, forming manganous dioxide and nitrous vapors, which latter are recovered as nitric acid.

416,038—November 26, 1889. L. MOND AND G. ESCHELLMANN. *Process of obtaining chlorine.*

An intimate mixture of magnesia and a chloride of a fixed alkali is briquetted and treated at from 400° to 600° C. with the vapor of hydrochloric acid or of chloride of ammonium, and then with hot dry air or oxygen.

420,837—February 4, 1890. E. SOLVAY. *Process of making chlorine.*

Chlorides are decomposed in the dry state by charging a mixture of a chloride and calcined silicious clay into the shaft of a decomposing apparatus, introducing gas or combustible dust midway of the shaft and producing combustion therein, and then introducing an air current into the bottom of the shaft.

423,868—March 18, 1890. C. HORNBOSTEL. *Production of chlorine gas.*

A continuous current of air is forced into and through the chlorine-generating materials in the generating vessel, and conducted, charged with the gas, to the point of application.

427,467—May 6, 1890. R. DORMER. *Obtaining chlorine.*

An aqueous mixture of sulphuric acid, hydrochloric acid, and manganese dioxide is formed and the chlorine evolved is collected. The aqueous residue is neutralized, and calcium chloride added in excess, thereby throwing down calcium sulphate, which is separated, and the remaining solution of manganese chloride and calcium chloride treated with lime to form manganese dioxide.

462,567—November 3, 1891. F. M. LYTE. *Process of making alkaline carbonate and chlorine.*

See Group X, Electro-chemistry.

463,767—November 24, 1891. P. DE WILDE AND A. REYCHLER. *Process of making chlorine.*

In the manufacture of chlorine by the alternate passage of hydrochloric-acid gas and heated air through a body of material which disengages chlorine at a red heat, a mixture of sulphate of magnesium and manganite of magnesia is used, formed by calcining equivalent quantities of sulphate of magnesium, chloride of magnesium, and chloride of manganese, all three being hydrated.

495,462—April 11, 1893. J. A. JUST. *Process of making chlorine.*

Hydrochloric acid with a slight excess of double the equivalent of manganese dioxide is decomposed by heat and nitric acid added to decompose the resulting manganous chloride and the residual manganese dioxide. The residual manganous nitrate liquor is then neutralized with manganese protoxide, hydroxide or carbonate, settled, evaporated, calcined, and the gases condensed.

503,429—August 15, 1893. F. M. & C. H. M. LYTE. *Process of producing chlorine and purifying lead.*

See Group X, Electro-chemistry.

510,276—December 5, 1893. F. M. LYTE. *Process of electrilytically decomposing fused metallic chlorides.*

See Group X, Electro-chemistry.

518,445—April 17, 1894. W. DONALD. *Process of making chlorin.*

Dry and cool hydrochloric acid gas is subjected to a mixture of strong nitric and sulphuric acids at a low temperature—about 0° C.—and the resulting chlorine and nitrogen-oxide gases are subjected to dilute nitric acid, and finally to strong sulphuric acid.

518,446—April 17, 1894. W. DONALD. *Process of making chlorin.*

As a modification of the process of No. 518,445, additional hydrochloric-acid gas or hydrochloric-acid gas and air is introduced into the body of resulting chlorine and nitrogen-oxide gases prior to subjecting them to the action of dilute nitric acid.

521,629—June 19, 1894. P. J. WORSLEY, W. WINDUS, AND B. BRACEY. *Process of and apparatus for absorbing chlorin gas.*

Chlorine gas is dehydrated, whereby it can be handled by pumps and pipes, and then the dry product is pumped into vessels containing the absorbing liquid.

529,130—November 13, 1894. L. MOND. *Process of obtaining chlorin.*

Ammonium chloride is vaporized in a retort lined with antimony and containing fused chloride of zinc—preferably by introducing it in small quantities and dropping it into the molten zinc chloride—and the vapors passed through a mass of balls or fragments formed of magnesia, clay, lime, and potassium chloride heated to 350° C. by the prior passage of hot inert gases therethrough, until the balls have absorbed their charge of chlorine, the ammonia given off being collected. A current of inert gas of 500° to 550° C. is then passed through the balls and the ammonia and afterwards the hydrochloric acid given off are collected. Hot dry air of 800° to 1,000° C. is then passed through, liberating the chlorine previously absorbed. The temperature of the balls is then lowered with a current of cold air or inert gas to 350° C. and the cycle is recommenced. Air which is only weakly charged with chlorine, near the end of the process, is passed through another body of chloridized salts to save the diluted chlorine and enrich a subsequent operation.

537,508—April 16, 1895. H. W. WALLIS. *Process of making chlorin.*

Chlorine is manufactured from aqueous acids by decomposing aqua regia in the presence of sulphuric acid and passing the gaseous products through sulphuric acid.

570,624—November 3, 1896. W. DONALD. *Process of making chlorin.*

A mixture of an alkaline chloride and manganic oxide—as the peroxide—with nitric acid and water is heated to produce chlorine, and the residual product evaporated and roasted; the evolved oxides of nitrogen being oxidized and converted into nitric acid, while the residue is dissolved in water, the manganese peroxidized by the blowing in of air, and the caustic alkali separated.

618,575—January 31, 1899. F. M. LYTE. *Method of and apparatus for producing chlorin, zinc, or other metals from mixed ores.*

See Group X, Electro-chemistry.

623,447—April 18, 1899. A. VOGT AND A. R. SCOTT. *Process of obtaining chlorin.*

To produce chlorine, hydrochloric acid, sulphuric acid and nitric acid flow in substantially horizontal and continuous streams in the same direction, in contact with each other, subject to suitable heat.

HYPOCHLORITES, MATERIALS.

147,476—February 17, 1874. M. L. BUSH. *Improvement in putting up chloride of lime.*

Chloride of lime is packed in a wrapper of impervious noncorrosive fabric, as paper saturated with an oleaginous or resinous solution.

210,273—November 26, 1878. T. SIMON, COMTE DE DIENHEIM-BROCHOCKI. *Improvement in the manufacture of bleaching liquids.*

Chlorozone, an oxygenated and chlorous decolorizing agent, having for a base a soluble alkali or alkaline earth, is formed by saturating an alkaline solution by a current of hypochlorous-acid gas, produced by the decomposition in the cold of hypochlorites or of chlorates by an acid and a current of air.

212,890—March 4, 1879. T. DE DIENHEIM-BROCHOCKI. *Improvement in bleaching compounds.*

A solid bleaching compound produced by saturating a solution of sodium protoxide with chlorine gas, and adding to the hypochlorite thus produced 20 to 40 per cent of desiccated carbonate of soda.

271,906—February 6, 1883. A. L. NOLF. *Process of and apparatus for obtaining chlorine and sodium.*

See Group X, Electro-chemistry.

309,970—December 30, 1884. A. McKAY. *Bleaching solution.*

It consists of a solution of chloride of lime to which has been added a mixture of fuller's earth and decoction of Iceland or Irish moss.

325,684—September 8, 1885. G. LUNGE. *Application of chloride of lime to bleaching purposes.*

The action of chloride of lime is increased and hastened by the use of acetic or formic acid added to or used in conjunction with the chloride of lime.

415,644—November 19, 1889. G. KERNER AND J. MARX. *Process of electrolyzing salts of the alkalies.*

See Group X, Electro-chemistry.

417,287—December 17, 1889. E. SOLVAY. *Process of making bleaching powder.*

A mixture of chlorine and carbon dioxide is passed through a dilute solution of chloride of lime with the separation of the carbonic acid; then the liquid chloride of lime is decomposed by the chlorhydric acid produced, and finally solid chloride is formed by means of the rich chlorine gas obtained.

442,334; 442,396; 442,594—December 9, 1890. I. L. ROBERTS. *Electrolytic apparatus.*

See Group X, Electro-chemistry.

450,103—April 7, 1891. E. A. LE SUEUR. *Electrolytic apparatus.*

See Group X, Electro-chemistry.

480,554—August 9, 1892. W. B. BRITTINGHAM. *Bleaching compound.*

A bleaching compound consisting of the tungstate of an alkali, as tungstate of soda, combined with a hypochlorite.

481,407—August 23, 1892. F. M. LYTE. *Production of caustic alkalies and chlorine.*

See Group X, Electro-chemistry.

484,990—October 25, 1892. H. BLACKMAN. *Electrolytic process and apparatus.*

See Group X, Electro-chemistry.

491,700—February 14, 1893. E. B. CUTTEN. *Method of electrolytically producing soda and chlorine.*

See Group X, Electro-chemistry.

501,121—July 11, 1893. C. N. WAITE. *Art of manufacturing chlorine or caustic alkali by electrolysis.*

See Group X, Electro-chemistry.

523,263—July 17, 1894. G. A. CANNOT. *Process of manufacturing hypochlorous acid.*

See Group X, Electro-chemistry.

541,146—June 18, 1895. H. BLACKMAN. *Electrolytic process and apparatus.*

See Group X, Electro-chemistry.

541,598—June 25, 1895. J. D. DARLING. *Process of utilizing niter-cake or other acid sulfates.*

See Group X, Electro-chemistry.

546,328—September 17, 1895. C. HOEPFNER. *Anode for electrolytic apparatus.*

See Group X, Electro-chemistry.

556,038—March 10, 1896. M. H. WILSON. *Electrolytic apparatus.*

See Group X, Electro-chemistry.

558,240—April 14, 1896. C. N. WAITE. *Method of utilizing saline solutions.*

See Group X, Electro-chemistry.

558,241—April 14, 1896. C. N. WAITE. *Method of utilizing saline solutions.*

See Group X, Electro-chemistry.

559,454—May 5, 1896. C. KELLNER. *Process of and means for producing bleaching agents.*

See Group X, Electro-chemistry.

560,518—May 19, 1896. J. MEYRUEIS. *Treatment of sodium chlorid.*

See Group X, Electro-chemistry.

565,953—August 18, 1896. E. ANDREOLI. *Apparatus for indirect electrolysis.*

See Group X, Electro-chemistry.

568,229—September 22, 1896. H. BLACKMAN. *Electrode.*

See Group X, Electro-chemistry.

568,230—September 22, 1896. H. BLACKMAN. *Electrode for electrolytic decomposition.*

See Group X, Electro-chemistry.

568,231—September 22, 1896. H. BLACKMAN. *Electrolytic anode and apparatus.*

See Group X, Electro-chemistry.

572,472—December 1, 1896. H. Y. CASTNER. *Anode for electrolytic processes.*

See Group X, Electro-chemistry.

578,457—March 9, 1897. C. KELLNER. *Process of and apparatus for simultaneously producing ammonia, sodium hydroxid, and chlorine.*

See Group X, Electro-chemistry.

583,330—May 25, 1897. E. A. LE SUEUR. *Process of electrolysis.*

See Group X, Electro-chemistry.

583,513—June 1, 1897. W. SPILKER. *Electrolysis of watery salt solutions.*

See Group X, Electro-chemistry.

586,236—July 13, 1897. L. P. HULIN. *Process of electrolytic decomposition of solutions.*

See Group X, Electro-chemistry.

591,730—October 12, 1897. W. BEIN. *Process of and apparatus for electrolyzing.*
See Group X, Electro-chemistry.

606,981—July 5, 1898. W. S. ROMME. *Process of and apparatus for decomposing solid substances.*
See Group X, Electro-chemistry.

609,745—August 23, 1898. W. G. LUXTON. *Diaphragm for electrolytic purposes.*
See Group X, Electro-chemistry.

621,908—March 28, 1899. H. H. DOW. *Porous diaphragm for electrolytic cells and method of producing same.*
See Group X, Electro-chemistry.

637,410—November 21, 1899. G. H. POND. *Process of and apparatus for dissociating substances by electrolysis.*
See Group X, Electro-chemistry.

652,611—June 26, 1900. J. HARGREAVES. *Combined diaphragm and electrode.*
See Group X, Electro-chemistry.

HYPOCHLORITES, PROCESSES.

63,036—March 19, 1867. T. GRAY. *Improvement in the manufacture of bleaching powder.*
In the manufacture of bleaching powder, free acid is neutralized or eliminated by passing the chlorine gas through a solution of caustic soda or by mixing the alkali with the lime.

81,709—September 1, 1868. A. P. VIOL AND C. P. DUFLO. *Improvement in bleaching and dyeing feathers.*
Black, gray, brown, or otherwise tawny-colored feathers are first bleached (either by the action of chlorine in the gaseous form or in solution, or by means of chlorine salts, or by the action of sulphurous acid in a gaseous form or in solution, or by sulphites, or by chromates, bichromates, or oxygen salts and acids, or, in some cases by alkalis, separately, or in succession or even simultaneously) and then dyed.

100,071—February 22, 1870. E. T. RICE. *Improved process of bleaching and cleaning vegetable fibers.*
The fibers or fabric are first steeped in a weak acid solution, and then steeped, washed, or scrubbed in a weak alkaline solution or ordinary soapsuds at above 100° and below 212° F. It is then treated with chlorine or other bleaching agent, followed by an acid solution, and washing in a weak alkaline solution.

118,210—August 22, 1871. H. DEACON. *Improvement in the manufacture of bleaching powders.*
The sections of the apparatus or shelves are arranged in series, each becoming the first of the series in rotation, the freshly filled lime section being always at the gas exit end of the series, so that the strongest chlorine gas acts first on lime that has absorbed the most chlorine, and the most diluted chlorine passes over the freshest lime.

121,595—December 5, 1871. H. DEACON. *Improvement in the manufacture of bleaching powders, sulphates, etc.*
The apparatus has a series of oppositely inclined shelves with narrow interspaces and a controlled discharge at the bottom; the chemical gas passing upward and acting on the solid material during its passage downward, over and along the inclined shelves.

126,550—May 7, 1872. F. M. IRONMONGER. *Improvement in bleaching peanuts.*
They are washed in a weak aqueous solution of sal soda, and then treated with a dilute aqueous solution of chloride of lime and sulphuric acid; then washed and dried.

139,239—May 27, 1873. H. DEACON. *Improvement in the manufacture of bleaching liquors.*
Carbonate of lime—such as lumps of limestone or of chalk, or that obtained by causticizing solutions of the carbonates of soda and of potash by means of lime—is used to replace, wholly or in part, the caustic lime usually employed in the manufacture of bleaching liquors. Carbonates of lime are used to absorb chlorine when the same is mixed with carbonic-acid gas, or is otherwise diluted.

145,816—December 23, 1873. J. B. RICKARDS. *Improvement in bleaching damaged cotton.*
Vegetable fibers are first treated in a bath of permanganate of potassium and chloride of lime, and then in a bath of carbonate of potassium and chloride of lime, with or without the addition of glycerine in either bath.

154,292—August 18, 1874. J. L. SNEED AND J. S. MOUNT. *Improvement in bleaching hemp.*
It is soaked first in hot water and then in a solution of chloride of lime, after which it is dried and hackled.

184,577—November 21, 1876. J. BÉNÉ. (*Reissue: 7,850—August 21, 1877.*) *Improvement in refining and bleaching hair.*
Hair is refined and bleached by treatment in a bath composed of acids and chlorate of potash; the color is then fixed or set by treatment in a bath of warm water, muriate of tin, bisulphite of soda, and muriatic acid; and finally the hair is washed in water and ammonia to cleanse and remove all impurities, producing hair of fine texture from coarse hair.

196,258—October 16, 1877. E. SOLVAY. *Improvement in manufacture of hypochlorites of lime and magnesia from the silicates and aluminates.*
The compound silicate resulting from the manufacture of chlorine or hydrochloric acid is treated with chlorine gas. The hypochlorite formed is separated from the silicate and aluminate by lixiviation.

263,365—August 29, 1882. C. TOPPAN. *Bleaching fabrics.*
Cotton or linen fabrics are boiled in a solution of water and "sinapetroline" No. 2 (patent No. 186,640—January 23, 1877), then treated with a solution of chloride of lime and water, aired, and finally washed in a solution of hot water and "sinapetroline" No. 2.

280,094—June 26, 1883. F. SUTER. *Process of producing open-work fabrics.*
Vegetable fibers are embroidered on a ground of animal fiber, and the latter is then dissolved in a solution of chloride of lime.

280,141—June 26, 1883. L. A. DELABOVE. *Bleaching threads and fabrics.*
Fibers or fabrics of flax or hemp are first treated with a solution of calcium hypochlorite, and afterwards with a solution of aluminum sulphate saturated with aluminum hydrate.

293,376—February 12, 1884. J. B. THOMPSON. *Process of and apparatus for bleaching.*
Vegetable fibers and fabrics are boiled in a solution of cyanide of potassium or sodium, then subjected to alternate baths of a solution of chloride of lime and of carbonic-acid gas in a closed vessel, and lastly passed through a solution of triethylrosaline and oxalic acid, with suitable washings.

294,619—March 4, 1884. E. HERMITE. *Bleaching of paper pulp or other fibrous or textile materials or fabrics.*
See Group X, Electro-chemistry.

297,319—April 22, 1884. J. C. VANLOHE. *Bleaching raw cotton.*
The cotton in a compressed state, as in a bale, is subjected to the action of bleaching liquids, then rinsed, then torn apart or loosened and dried.

303,065—August 5, 1884. J. A. SOUTHMAYD. *Process of bleaching vegetable tissues.*
The material is first treated with permanganate of potash to destroy the coloring matter; then treated with oxalic acid, sulphite of sodium, and chlorine, to neutralize and bleach; and finally washed to remove the chlorine and discharging agents. As a preparatory step the material may be boiled with potash under pressure.

333,875—January 5, 1886. W. MATHER. *Process of bleaching.*
Cotton yarns and fabrics are first treated with a boiling solution of caustic soda, then steamed in a closed vessel with occasional introductions of the soda liquor while subject to the steaming, and then washed—the steps may be repeated—and then subjected to the action of chlorine liquor, washed, and finally scoured.

339,493—April 6, 1886. E. SOLVAY. *Manufacture of bleaching powder.*
The chlorine gas is drawn or forced in a downward direction through the lime and the porous or pulverulent beds.

382,159—May 1, 1888. E. HERMITE. *Process of bleaching.*
See Group X, Electro-chemistry.

389,898—September 25, 1888. R. M. PERRINE. *Process of bleaching wax.*
The combined vapor of bleaching solution of steam and gases, resulting from decomposed chloride of lime, is passed through the melted wax in divided jets, and finally pure steam is passed through the body of wax to cleanse and remove the bleaching solution.

396,551—January 22, 1889. F. E. BROWN. *Process of bleaching cotton.*
Cotton fabric, spread out wide, is passed through a boiling solution of caustic soda, then passed over perforated steam pipes and subjected to the action of steam, cooled by passing into a cold solution of caustic soda, boiled in a solution of soda-ash and washed, subjected to the action of chlorine liquor, steamed, scoured, and finally washed.

415,608—November 19, 1889. I. Q. BRIN. *Process of bleaching.*
The material is treated with a chlorous bleaching solution, and free oxygen is introduced into the mass, during the action, in regulated quantities.

432,401—July 15, 1890. A. & B. GRATZ. (*Reissue: 11,205—December 1, 1891.*) *Process of making jute bagging.*
A solution of sodium chloride is applied to fabric made from jute butts and it is then stored away in mass while damp, to allow the bleaching action to take place.

471,454—March 22, 1892. A. E. WOOLF. (*Reissue: 11,244—June 7, 1892.*) *Process of and apparatus for bleaching by electrolysis.*
See Group X, Electro-chemistry.

481,414—August 23, 1892. J. A. MYRICK. *Process of bleaching.*
Cotton-chain warp or like fiber is subjected to the action of a solution of chloride of lime, then to hot water, then to a solution of sulphurous acid, and finally rinsed.

499,184—June 6, 1893. C. J. DELESCLUSE. *Process of bleaching cotton.*
Cotton is bleached in a bath consisting of a chloride solution to which has been added a viscous acid solution composed, say, of 20 parts of water, by weight, and 1 part of a mixture of grape sugar, 90 per cent, and sulphuric acid, 10 per cent.

541,147—June 18, 1895. H. BLACKMAN. *Process of and apparatus for bleaching.*
See Group X, Electro-chemistry.

560,411—May 19, 1896. C. KELLNER. *Process of and apparatus for bleaching vegetable fibers.*
See Group X, Electro-chemistry.

565,706—August 11, 1896. B. S. SUMMERS AND C. O. BORING. *Electrolytic separation of vegetable fibers.*
See Group X, Electro-chemistry.

569,680—October 20, 1896. B. S. AND L. L. SUMMERS. *Electrolytic process of bleaching and refining.*
See Group X, Electro-chemistry.

588,084—August 10, 1897. G. H. POND. *Process of and apparatus for electro-chemical treatment of straw or other fibrous materials.*
See Group X, Electro-chemistry.

588,085—August 10, 1897. G. H. POND. *Method of and apparatus for electro-chemical treatment of fibrous material.*
See Group X, Electro-chemistry.

610,265—September 6, 1898. V. C. DRIFFIELD, A. CAREY, AND F. W. WRIGHT. *Process of and apparatus for making bleaching powder.*
The gas issuing from one compartment is dried to remove the vapor of water evolved in that or preceding compartments, and also cooled before it enters a succeeding compartment.

616,139—December 20, 1898. G. H. POND. *Method of electrolytically treating straw or other fibrous material.*
See Group X, Electro-chemistry.

616,988—January 3, 1899. B. S. SUMMERS. *Method of refining vegetable fiber.*
See Group X, Electro-chemistry.

655,239—August 7, 1900. T. JESPERSEN. *Process of bleaching by electrolytic chlorin water.*
See Group X, Electro-chemistry.

SULPHUR DIOXIDE.

121,564—December 5, 1871. J. WATTEAU. *Improvement in bleaching wool.*

Wool is bleached by means of a suitable bleaching gas forced through the wool by the atmospheric pressure produced by an exhausting or condensing fan or centrifugal machine.

125,469—April 9, 1872. P. MARCELIN. *Improvement in bleaching and disinfecting*

A sulphurous-acid solution is used as a bleaching and disinfecting agent.

129,819—July 23, 1872. E. C. HASERICK. *Improvement in bleaching wools, yarns, etc.*

Wool and woolen fabrics are bleached by treating in a water bath of a compound of sulphurous acid and an alkali or a sulphite, then rinsing, and then treating in an acid bath to decompose the sulphite and set the sulphurous acid free.

147,887—February 24, 1874. J. B. FRÈZON. *Improvement in treating mixed fabrics previous to dyeing.*

Woolen and silk fabric containing vegetable matter or impurities is exposed to a heated acid bath containing a mordant, to simultaneously destroy the vegetable matter and prepare the fabric for dyeing or bleaching.

187,882—February 27, 1877. W. MAYNARD. *Improvement in processes of softening, decolorizing, and cleansing animal and vegetable fiber.*

The fiber is subjected to the action of hydrated sulphurous acid and a solution of an alkali mixed in neutralizing proportions.

311,595—February 3, 1885. I. S. McDOUGALL. *Production of sulphurous acid.*

Air is forced under pressure into a retort containing ignited sulphur-bearing material and in which a low temperature is maintained by a cooling jacket, the sulphurous gases being conducted off and passed into and below the surface of an absorbing liquid in a vessel or series of vessels before it escapes.

HYDROGEN DIOXIDE AND OZONE.

87,155—February 23, 1869. W. ELMER. *Climozonator.*

An ozonized atmosphere for dwellings is produced by means of a thermo-electric battery operated by the differences in temperature of the warmed and cool air currents.

107,071—September 6, 1870. O. LOEW. *Improvement in process of obtaining ozone or ozonized air.*

Atmospheric air is passed transversely through a flame, preferably that of a Bunsen burner, and the ozone collected.

109,601—November 29, 1870. C. F. DUNDERDALE. *Improvement in apparatus for the manufacture of ozone.*

Atmospheric air or oxygen is passed through finely divided streams or currents of electricity to convert the oxygen into ozone.

118,976—September 12, 1871. P. A. ROYCE. *Improvement in generating ozone.*

It is produced from phosphorous acted on by water and air, under hydraulic and atmospheric pressure.

128,227—June 25, 1872. T. A. HOFFMANN. *Improvement in the generation of ozone, and in treating liquids with the same.*

Atmospheric air is forced into a mixture of potassium permanganate or hypermanganate and sulphuric acid, producing ozone, and then through a washer. It is applied to fermenting and fermented saccharine liquids and the production thereof.

185,040—December 5, 1876. H. MILSOM. (*Reissue: 9,976—December 20, 1881.*) *Ozone machine.*

The process consists in the generation, purification, and emission of ozone by the slow oxidation of phosphorous in a chamber having porous earthenware walls, whereby the separation and retention of the acid fumes and the egress of ozone are effected.

261,270—July 18, 1882. J. STEIN. *Process of bleaching hair.*

Hair is bleached by first saturating it in a mixture of a solution of peroxide of hydrogen and ammonia with a solution of peroxide of hydrogen and cream of tartar, and then passing it through a solution of blue aniline and alcohol. A composition of peroxide of hydrogen and cream of tartar is claimed, the latter substance preserving the softness of the hair and preventing it from becoming stiff and breaking.

273,569—March 6, 1883. C. MARCHAND. *Manufacture of hydrogen peroxide.*

In the manufacture of hydrogen peroxide, the acid solution is given a continuous movement of rotation in vertical as well as in horizontal planes in a cooled vessel, while adding the binoxide.

302,800—July 29, 1884. M. TRAUBE. *Manufacture of hydrogen dioxide.*

Hydrogen dioxide is produced by bringing a flame of carbonic oxide or other gas in contact with water; as, for example, by spraying water through the flame.

361,923—April 26, 1887. A. & L. Q. BRIN. *Ozone apparatus.*

Oxygen or air is passed between layers or masses of granular conducting material connected, respectively, with the poles of an electric generator.

392,742—November 13, 1888. J. E. P. MEYER. *Composition for developing ozonized oxygen.*

A mixture of barium permanganate, 25 parts, with the acid salts of sulphuric acid, as anhydrous sodium bisulphate, 16 parts, in powdered form, generates ozonized oxygen when mixed with water.

420,394—January 28, 1890. C. F. W. STELZER. *Process of making ozone water.*

A small quantity of hydrochloric acid or hydrochloric acid with a chloride is added to ozone water to make it retain all of its properties.

440,792—November 18, 1890. W. ERWIN. *Process of making hydrogen peroxide.*

A powdered metallic oxide (protoxide or peroxide), as of lead, chromium, or manganese, is suspended in water maintained in gentle agitation or circulation, and under generated gas pressure or of air forced in, and decomposed by such an acid, as hydrofluoric acid, as is ordinarily used in making hydrogen peroxide. An intermediate substance, as fluorspar, may be added, which upon treatment by an acid, as sulphuric acid, will liberate the acid required for the decomposition of the oxide.

450,404—April 14, 1891. J. C. DITTRICH. *Preparing ozone water.*

A small quantity of a phosphite or hypophosphite is added to ozone water, before or after charging, to cause it to retain its properties.

509,163—November 21, 1893. N. HELMER. *Process of liberating ozone.*

For the purpose of quickly liberating ozone from peroxide of hydrogen, the latter is added to a solution of an alkali, such as refined carbonate of potash.

511,330—December 26, 1893. E. FAHRIG. *Process of and apparatus for manufacturing ozone gas.*

See Group X, Electro-chemistry.

513,825—January 30, 1894. C. R. POULSEN. *Process of and apparatus for making ozone.*

Ozone is produced by the action of oxygen, or the oxygen of the air, upon phosphorous moistened with a diluted solution of sulphuric acid and permanganate of potash.

527,326—October 9, 1894. J. T. DONOVAN AND H. L. GARDNER. *Process of producing ozone.*

See Group X, Electro-chemistry.

563,288—July 7, 1896. W. LOBACH. *Electrical production of chemical reactions.*

See Group X, Electro-chemistry.

577,523—February 23, 1897. G. J. ANDERSSON AND J. C. DITTRICH. *Process of manufacturing ozone and by-products.*

See Group X, Electro-chemistry.

596,936—January 4, 1898. F. K. IRVING. *Process of producing ozone.*

See Group X, Electro-chemistry.

632,096—August 29, 1899. G. T. BRUCKMANN. *Composition of matter.*

Hydrogen peroxide is charged with carbonic acid to preserve it.

OTHER METALLIC DIOXIDES.

109,025—November 8, 1870. J. LAMBERT, JR. *Improvement in removing dyes made from analine, etc., from portions of fabrics.*

Aniline dyed fabrics are decolorized, according to design, by the application of powdered metals or soluble cyanides.

223,463—January 13, 1880. P. T. AUSTEN. *Method of preparing an aqueous bleaching solution of soda or potassa.*

A bleaching solution of silicate of sodium or potassium, barium peroxide, and the hydrate of sodium, potassium, or ammonium.

231,106—August 10, 1880. C. M. SARTWELL. *Preparing moss for upholstery.*

It is treated with a solution of protoxide of calcium, to remove the bark or exterior coating.

277,054—May 8, 1883. I. OHNSTEIN. *Art of treating jute, butts, and animal hair.*

The jute is torn into fine fibers, then the animal hair is macerated in a solution of lime and washed in boiling water, then the several materials are steeped in a solution of potash and dyestuff, dried, mixed, and moistened with castor oil and alcohol, and batted.

482,477—September 13, 1892. C. J. E. DE HAEN. *Process of bleaching.*

The goods are treated in a bath of peroxide of sodium and magnesium salts, such as magnesium chloride—a salt containing an oxide capable of being precipitated by sodium.

486,188—November 15, 1892. H. Y. CASTNER. *Bleaching compound.*

A bleaching compound composed of sodium peroxide and one or more neutral salts of the alkaline-earth metals.

650,023—May 22, 1900. H. OPPERMANN. *Process of making magnesium superoxid.*

See Group XIX, Oxides.

650,518—May 29, 1900. C. SAVIGNY. *Process of making dioxid of barium.*

See Group XIX, Oxides.

METALLIC PERMANGANATES.

266,660—October 31, 1882. P. THOMAS. *Bleaching fiber.*

The material is first boiled with caustic soda, then treated in a bath of potassium permanganate, and lastly in a solution of borax in hydrated sulphurous acid.

475,551—May 24, 1892. C. GIRARD. *Process of ungumming and decorticating textile material.*

Textile plants are treated with a basic salt of a polyatomic acid, as manganate of potash, to dissolve the gummy substance of the plant; then the fiber is washed; and then passed into a bath of sulphurous acid to remove the gum and oxides, and washed.

534,450—February 19, 1895. J. CLAPHAM, J. PICARD, C. VILLEDIEU, AND W. W. L. LISHMAN. *Process of bleaching.*

Fibers are treated in a bath containing a sulphonated or soluble oil, such as olein oil; then in a bath containing a manganate or permanganate salt; then in a bath of acidulated water; then in a bath having a bleaching action; then washed; and to make the fiber easy to work up it may be further treated in a bath containing olein or soluble soap as an emulsion.

OTHER BLEACHING AGENTS, MATERIALS.

11,786—October 10, 1854. E. N. HORSFORD. *Improved mode of removing chlorine from substances and fabrics.*

"Antichloride of lime," a neutral sulphite of lime, CaO,SO_2, is employed as a neutralizing agent for chlorine.

110,800—January 3, 1871. G. W. SYLVESTER. *Improvement in apparatus and processes of cleaning cotton waste.*

Cotton or woolen waste is cleaned by washing with a hydrocarbon, such as kerosene or paraffine oil. The recovered heavy oil is purified from waste by macerating or filtering with boneblack.

118,668—September 5, 1871. W. ADAMSON. *Improvement in apparatus and processes for treating animal and vegetable fibers.*

Animal and vegetable fibers and fiber-bearing vegetable substances are treated with hydrocarbon or hydrocarbon vapor, or both, under heat and determined pressure, to cleanse and extract oily, fatty, and resinous matters. The solvent is caused to circulate through the material.

119,187—September 19, 1871. C. F. A. SIMONIN. *Improvement in processes for treating textile fabrics with hydrocarbons.*

Textile fabrics are subjected to hydrocarbon vapors to prepare for bleaching or dyeing, or to cleanse and renovate.

203,723—May 14, 1878. W. E. GEER. *Improvement in processes for the manufacture of oakum.*

New fiber of flax, hemp, or the like is saturated in a solution of tar, sal soda, or similar alkali, and water, and the fiber afterwards cleansed of soda by treatment in a dilute aqueous solution of muriatic or similar acid.

225,154—March 2, 1880. J. W. W. MARTIN. *Process and material for fulling and scauring.*

The material or article is dampened and then a soap compound in a powdered form is applied by sifting or sprinkling.

244,674—July 19, 1881. J. J. SACHS. *Preparing and bleaching jute.*

Vegetable fiber, after cutting into lengths and bleaching, is treated in a solution of caustic soda or potash (or other liquid to cause the fiber to contract or curl), then neutralized, and the liquid expressed.

278,409—May 29, 1883. J. G., E. P., & D. W. DAVIS. *Washing compound.*

A detergent composed of water, 1 gallon; white rock potash, 1 pound; borax, one-quarter of a pound; kerosene oil, 4 ounces; and benzine, one-half ounce.

338,806—March 30, 1886. C. TOPPAN. *Process of scouring wool.*

Wool is immersed in a warm solution of expressed oil of mustard seed, petroleum products (paraffine oil and vacuum oil) and alkali.

350,218—October 5, 1886. C. TOPPAN. *Bleaching compound.*

A bleaching compound consisting of expressed oil of mustard seed, paraffine, caustic soda, tallow soap, sulphate of soda, and water.

354,223—December 14, 1886. H. R. RANDALL. *Treatment of silk fiber.*

Silk fiber, raw silk, and cocoons, before removal of the gum, are subjected to the action of an aqueous solution of acetic acid (one ounce of acid to a gallon of water) at a temperature below the boiling point; a small proportion of sulphuric acid may be added.

361,700—April 26, 1887. F. M. IRONMONGER. *Process of bleaching edible nuts.*

They are subjected to a bath of a solution of protochloride of tin ("tin salt" or "tin crystals") dissolved in muriatic acid and diluted 10 parts of water to 1 of salt.

381,444—April 17, 1888. C. TOPPAN. *Scouring composition for fibers and fabrics.*

It consists of benzine, mustard-seed oil, and an alkali, as caustic soda.

386,202—July 17, 1888. F. M. IRONMONGER. *Bleaching edible nuts.*

They are subjected to a bath of a mixture of tartaric and oxalic acids, and then dried.

576,860—February 9, 1897. G. A. LANAUX. *Process of bleaching rice.*

A compound for cleaning and bleaching rice, consisting of ultramarine blueing, soapstone, and petrol oil, is applied to the rice grains, and they are then brushed and polished.

OTHER BLEACHING AGENTS, PROCESSES.

13,928—December 11, 1855. W. M. WELLING. *Improvement in the method of bleaching ivory plates.*

The plates are sustained on their edges, in a suitable case, and placed in a north and south position for exposure to the sun.

15,983—October 28, 1856. J. PHYFE. *Process of bleaching ivory.*

Ivory is exposed to the rays of the sun on a glass table with a reflector below it.

16,100—November 18, 1856. J. A. ROTH. *Mode or process of bleaching vegetable fibers.*

Atmospheric air is forced into the bleaching liquor, thereby creating a rapid action of the bleaching agents.

18,204—September 15, 1857. J. A. JILLSON AND H. WHINFIELD. *Method of treating various materials or substances in a permanent vacuum for washing, bleaching, and analagous purposes.*

The operations are performed in a vacuum either with or without heat.

41,826—March 8, 1864. G. W. BILLINGS. (*Reissue: 1,761—September 13, 1864*) *Improvement in cleaning and separating the fibers of flax, hemp, etc.*

The vegetable fiber is subjected to a retting or fermenting operation after the stalk or other woody portions have been removed in whole or part; the fiber is washed in alternate directions for its cleansing while contained in a closed vessel.

85,875—January 12, 1869. D. K. TUTTLE. *Improvement in bleaching ivory, bone, etc.*

Ivory and bone are bleached by exposure to light in a bath of spirits of turpentine or other liquid.

190,995—May 22, 1877. H. T. YARYAN. *Improvement in processes for bleaching beeswax.*

It is dissolved in a solvent, such as any of the volatile products of petroleum, and exposed to sunlight in glass vessels or in shallow vessels under glass.

194,799—September 4, 1877. H. T. YARYAN. *Improvement in processes of bleaching beeswax.*

Any material which will act as a body, such as cotton cloth, is passed through melted wax, and saturated or coated with a thin layer, which is then exposed to the action of sunlight until the color of the wax is discharged, when the bleached wax is removed, either by heat and pressure, or by dissolving in a volatile solvent, and then the solvent is removed by heat.

202,078—April 2, 1878. A. VIOL AND C. P. DUFLOT. *Improvement in processes for bleaching feathers.*

They are immersed in a resinous bath, such as turpentine, of regulated temperature (89° to 90° F.), and at the same time exposed to both light and air.

281,780—July 24, 1883. J. MILLER. *Method of and apparatus for bleaching ivory.*

Ivory is placed in a hermetically-closed, glass-covered vessel and exposed to the action of the rays of the sun, at a low temperature.

303,342—August 12, 1884. C. TOPPAN. *Process of separating and subdividing vegetable fiber.*

The resinous and glutinous substances are dissolved and removed by boiling vegetable fibers in a solution of "sinapetroline" No. 2 (a product of expressed mustard-seed oil, petroleum products, and alkali: Patent No. 186,640, January 23, 1877).

304,088—August 26, 1884. J. A. ENGELER. *Process of bleaching cotton fabrics.*

Cotton fabrics are exposed to vapors of chloroform under pressure, and then dechlorinized by exposure to a mixture of hydrogen, carbonic acid, and sulphuric ether.

307,801—November 11, 1884. A. L. RICE. *Mode of separating embroideries.*

The goods are ruled on the separating line with a disintegrating acid, whereby the fabric on the line is partially destroyed, and further chemical effect is then arrested.

335,958—February 9, 1886. H. R. RANDALL. *Process of separating the fiber of cocoons.*

Cocoons are subjected to the action of a solution of hydrochloric acid (an ounce of acid to a gallon of water), at about 150° F., to prepare them for separation of the fibers.

354,222—December 14, 1886. H. R. RANDALL. *Treatment of tussah-silk cocoons.*

"Wild tussah cocoons" or other silk fiber, or vegetable fiber also, are washed, then sprinkled with a saponifiable oil, then subjected to the action of a heated solution of sodium stannate (or aluminate, plumbate, silicate, or borate of sodium or potassium, or an alkaline solution of zinc oxide), then washed and dried.

387,579—August 7, 1888. N. CONLON. *Treating crude animal hair.*

The hair is washed; cooked in a solution of water, quicklime, sal soda, and sulphuric acid; rubbed, teased, and washed to complete the cleansing; again cooked in a solution of water, sulphuric acid, and black oxide of manganese to further deodorize and render moth proof, thereby preparing it for dyeing, curling, and drying in one continuous process.

389,944—September 25, 1888. J. SMITH AND P. W. NICOLLE. *Process of bleaching fiber.*

Vegetable material is treated in a bath containing one or more alkaline sulphates, as sulphate of potash, and the solution is then removed, to effect the separation of the gums, resin, and coloring matter from the fibers.

396,325—January 15, 1889. A. & L. Q. BRIN. *Method of bleaching fibrous substances.*

See Group X, Electro-chemistry.

412,080—October 1, 1889. E. J. FISCHER. *Process of cleaning animal-hair.*

To remove the oily matter from the tubular cavities, hair or wool is given a long-continued soaking in clear water until it becomes soft, then soaked in a saponifiable solution to extract said oily matter, washed in clear water, and dried.

442,297—December 9, 1890. F. G. WISELOGEL. *Process of bleaching hair.*

It is first thoroughly washed in cold water, then treated in a bath of hot water to which has been added a small quantity of lime. It is then dried by forcing a strong current of dry, sulphureted air through it.

489,919—January 17, 1893. B. BEYER. *Process of treating raw silk.*

Silk waste or fabric thereof is subjected to the successive action of oil soap, cold water, and salt steam baths and drying, oft repeated, and then to the action of running water. The manufactured fabric is washed in a bath containing permanganate of potash.

496,072—April 25, 1893. H. THIES AND E. HERZIG. *Process of bleaching.*

The material is immersed in a solution containing hydrofluoric acid, then washed in a bath containing an alkaline earth compound, the air adhering to the material is removed, and it is then treated with boiling caustic alkaline lye, which is kept concentrated by a constant discharge of steam.

575,645—January 19, 1897. E. HERMITE. *Apparatus for purifying or disinfecting.*

See Group X, Electro-chemistry.

635,248—October 17, 1899. H. HADFIELD. *Process of bleaching.*

Fabrics are continuously bleached and washed by passing them through a hot wash, then through a chemicking bath, then subjecting them to the simultaneous action of acetic acid and steam, and then washing.

642,387—January 30, 1900. T. TEMPIED AND G. DUMARTIN. *Process of preparing peat for surgical use.*

Natural peat is macerated for several days, then beaten and washed in pure water to cleanse thoroughly, then treated with an ammoniacal bath to restore its color, and sterilized.

GROUP X.—CHEMICAL SUBSTANCES PRODUCED BY THE AID OF ELECTRICITY.

INORGANIC PRODUCTS.

211,070—December 17, 1878. E. WESTON. *Improvement in manufacture of metallic nickel.*

A malleable ductile electro-deposit of nickel; obtained by the addition of borate of nickel (or other compounds of boron) to a nickel-depositing solution.

589,161—August 31, 1897. F. CHAPLET. *Hard body for rifling chromated steel.*

A new hard compound—a carbo titanide of silicium—is produced by the reduction of an intimate mixture of titanic acid, silicic acid, and carbon in an electric furnace. It is capable of scratching chrome steel and cutting and shaping hard stones.

589,415—September 7, 1897. G. DE CHALMOT. *Silicon alloy.*

An alloy of silicon with a metallic silicide, a new product, is produced by smelting material containing a metal—such as a metallic oxide—and silicon (silica) with carbonaceous matter in an electric furnace with a direct current, until the carbonaceous matter is eliminated. At the end of the operation the cathode is covered with the product. Crystalline silicon is produced b y treating said alloy with a solvent of the silicide.

602,975—April 26, 1898. G. DE CHALMOT. *Silicid of iron.*

New ferrosilicides, containing appproximately 25 per cent of silica or upward, and consisting either of Si_2Fe_3 or a mixture of Si_2Fe_3 and Si_2Fe. The lower grade silicides are molten in a common furnace, readily cast, making exact castings—they take a fine polish and do not tarnish in the air—from white (as silver) to gray in color.

656,353—August 21, 1900. C. B. JACOBS. *Alkaline-earth silicid.*

A new chemical compound: the silicide of an alkaline-earth metal, viz, calcium, barium, or strontium silicide, of the formula $R\ Si_2$, wherein R represents the alkaline-earth metal. They are white or bluish-white substances of metallic appearance, having a crystalline fracture, oxidizing slowly in the air to silicon oxide and an alkaline earth-metal oxide, and decomposing with water evolving large volumes of hydrogen, together with silica and the alkaline earth-metal hydrate. They are produced by the reduction of an intimately mixed charge of an alkaline earth, silica, and carbon in an electric furnace, as, for example, lime 60 parts, sand 130 parts, and coke 70 parts.

ORGANIC PRODUCTS—CARBIDES.

492,767—February 28, 1893. E. G. ACHESON. (*Reissue: 11,473—February 26, 1895.*) *Production of artificial crystalline carbonaceous materials.*

A new product: silicide of carbon, Si C (carborundum), characterized by great hardness, refractability, and infusibility; produced by subjecting materials containing carbon and silica, free or combined, to the action of an electric current. The current is passed through a conducting heating core embedded in the charge.

541,138—June 18, 1895. T. L. WILLSON. *Product existing in form of crystalline calcium carbide.*

A new product: crystalline calcium carbide existing as masses of aggregated crystals; produced by the reduction of intimately commingled coke and lime in an electric furnace.

555,796—March 3, 1896. C. WHITEHEAD. *Compound of magnesium, calcium, and carbid.*

A new compound: the double carbide of magnesium and calcium; produced by the treatment of intimately commingled carbon and the double oxide of calcium and magnesium in an electric furnace. Calcined dolomite supplies the double oxide.

615,816—December 13, 1898. J. A. DEUTHER. *Process of treating calcium carbids.*

Metallic carbide is crushed and mixed with an inert binding material, such as resin, and formed into tablets, which represent, by decomposition, a definite amount of gas.

637,681—November 21, 1899. T. G. TURNER. *Carbid cartridge.*

A package, for use in making gas, consisting of a hollow body of fragile material filled with calcium carbide, hermetically sealed.

648,348—April 24, 1900. C. E. YVONNEAU. *Method of treating carbid of calcium.*

Calcium carbide is saturated with oil and then crushed for formation into tablets, cartridges, etc., while so protected from decomposition.

648,349—April 24, 1900. C. E. YVONNEAU. *Process of preparing calcium carbid.*

Calcium carbide is crushed and heated and about 80 parts introduced into a heated mixture of 16 parts of glucose and 4 parts of an oily substance, and molded into shape; it may then be coated with a protective medium impervious to moisture and which will dissolve slowly in water.

648,350—April 24, 1900. C. E. YVONNEAU. *Prepared calcium carbid.*

A gas-producing body formed of calcium carbide crushed in oil, combined with an agglomerating mixture, molded and provided with a protecting coating (No. 648,349).

650,235—May 22, 1900. F. A. J. FITZGERALD. *Carborundum article.*

A dense coherent recrystallized body of carborundum, the product of the process of No. 650,234.

650,747—May 29, 1900. J. BILBIE AND H. DRIVET. *Process of treating carbid of calcium.*

Broken or granulated calcium carbide is treated with an essential oil, such as citronella, mirbane, or eucalyptus, to kill the natural odor of the carbide, then coated with petroleum, and again treated with an essential oil.

656,238—August 21, 1900. C. H. WORSNOP. *Composition of matter for making gas.*

Calcium carbide is immersed in a hot liquid mixture of paraffine wax, grease, (as cocoa butter), and sugar.

659,447—October 9, 1900. M. P. E. LÉTANG. *Preparation of carbid of calcium.*

Calcium carbide is given a protective coating of glucose, or its equivalent, capable of dissolving or liquifying the lime when produced from the decomposition of the carbide; an inert powder, such as carbonate of lime, is also combined therewith and petroleum, and small particles of, or powdered, carbide are formed into a mass.

For the production of acetylene, see Group XVII, Hydrocarbons.

OTHER ORGANIC PRODUCTS.

618,167—January 24, 1899. A. CLASSEN. *Sodium salt of iodin compound.*

A new product: the sodium salt of an iodine compound containing the iodine in the benzene nuclei of phenolphthalein; a nearly odorless and tasteless dark-blue amorphous powder; soluble in water, glycerine, and alcohol. It is produced by the electrolysis of an aqueous solution of phenolphthalein and sodium hydrate with potassium iodide.

618,168—January 24, 1899. A. CLASSEN. *Iodin derivatives of phenols and bismuth salts thereof.*

New products: as a bismuth salt of an iodine compound containing the iodine in the benzene nuclei of phenolphthalein, a nearly odorless and tasteless reddish-brown powder, insoluble in water and acids, and with difficulty soluble in alcohol. They are produced by reacting with agents containing iodine on an alkaline solution of phenolphthalein, with the aid of electrolysis.

PROCESSES.

7,821—December 10, 1850. G. MATHIOT. *Process of preventing the adhesion of the deposit to the recipient in the electrotype process.*

The plate is exposed to the action of a halogen element or compound, as iodine, bromine, or chlorine, and then further exposed to the action of a strong light for several hours before introducing it into the electrotyping apparatus.

59,910—November 20, 1866. A. T. HAY. *Improvement in preventing incrustation of sugar or other boilers.*

The formation of scale or incrustation in evaporating pans or kettles is prevented by passing around the pan an electric current.

87,193—February 23, 1869. C. C. PARSONS. *Improvement in purifying pyroligneous or acetic acid.*

The vapors from the still are passed through carbonaceous or purifying material. The terminals of a galvanic battery are connected respectively with the condensing worm and the water of the condensing tub.

98,110—December 21, 1869. S. RUST, JR. *Improvement in electro-plating with brass and other alloys.*

The depositing bath is formed by dissolving the brass or other alloy directly by the electro-process in a solution of potassium cyanide and sulphuret of carbon. The process of electroplating with brass or other alloy is claimed, and articles coated by the process.

113,331—April 4, 1871. R. O'NEIL. *Improvement in ornamenting the surface of metals by electro-depositions from solutions.*

The surface of the metal is painted with a salt or a solution of a salt of the metal to be deposited by means of a pencil in connection with a galvanic battery, the metal operated upon being in connection with the other pole of the battery.

116,579—July 4, 1871. M. G. FARMER. *Improvement in nickel plating.*

The double sulphate of nickel and ammonia is formed by the electrolysis of a solution of sulphate of ammonia, using a nickel anode.

116,658—July 4, 1871. I. ADAMS, JR. *Improvement in nickel-plating.*

Heat is applied to the solution of sulphate of ammonia—about 150° F.—in forming the double sulphate of nickel and ammonia by the electrolytic process.

130,362—August 13, 1872. E. E. DE LOBSTEIN. *Improvement in plating and coating metals.*

The article to be coated is subjected to a weak cold solution of the required coating metal and to the action of a galvanic battery and is subsequently subjected to the heat required to melt the coating.

179,658—July 11, 1876. N. S. KEITH. *Improvement in apparatus for removing tin from scraps, etc., by electricity.*

Scrap tin plate, separated and extended on an endless chain conveyor, is progressively treated in a heated electrolyzing bath.

229,542—July 6, 1880. J. L. MARTIN. *Process and apparatus for aging liquors.*

Liquors are subjected to the combined action of a current of electricity and a catalytic agent acting upon the liquor through the medium of a porous diaphragm or cell.

256,330—April 11, 1882. E. D. KENDALL. *Process of treating certain derivatives of coal-tar colors.*

Nitro-benzene, or a mixture of nitro-benzene and nitro-toluene (e. g., nitro-benzene or the mixture 1 part, sulphuric acid 2 parts, and water 30 parts), is electrolyzed in the negative compartment of a cell, with acidulated water in the positive compartment, producing the corresponding amido compounds (analine or toluidine). The negative electrode should be gently agitated. The color-yielding products are obtained, at the same time, by placing analine or toluidine in contact with the electrode in the acidulated water of the positive compartment.

264,928—September 26, 1882. H. R. CASSEL. *Process of and apparatus for separating metals.*

The cathode of an electrolytic cell is provided with a protective covering of a dense, porous, nonconductive material—such as leather, parchment, or canvas—which admits the passage of the current and prevents deposition upon the cathode.

271,906—February 6, 1883. A. L. NOLF. *Process of and apparatus for obtaining chlorine and sodium.*

A concentrated solution of sodium chloride is electrolyzed in a closed tank in the presence of mercury, which covers the bottom and constitutes the negative electrode.

272,187—February 13, 1883. C. E. BALL. *Electric gas generator.*

Hydrocarbons or other olefiant liquids are sprayed or injected into or upon an electric arc, whereby the liquid is not only volatilized but converted into a fixed gas.

277,977—May 22, 1883. E. BAUER. *Process of and composition for the manufacture of substitutes for leather, horn, tortoise shell, etc.*

See Group XV, Rubber and Rubber Substitutes.

282,964—August 14, 1883. J. L. DELAPLAINE, J. G. HENDRICKSON, AND F. J. CLAMER. *Removing tin from tin scrap by electricity.*

Scrap metal is placed directly in an electric circuit, in an insulated chamber, and the coating metal melted by the heat generated within the mass, by incandescence.

284,862—September 11, 1883. M. H. LACKERSTEEN. *Process of treating fats and oils.*

Fat acids and glycerine are produced by passing a current of electricity through an emulsion of the fat, or oil and water.

286,208—October 9, 1883. L. LÉTRANGE. *Process of and apparatus for reducing zinc ores.*

Sulphuret and carbonate ores of zinc are simultaneously roasted in the same or communicating chambers and converted into soluble sulphates, which are leached and the solution electrolyzed. Zinc is deposited on metal cathode plates, and sulphuric acid is led off as fast as formed.

291,463—January 1, 1884. C. E. BALL AND C. S. BRADFORD, JR. *Electric gas generator.*

A mixed or combined hydrocarbon-hydrogen gas is produced by generating hydrocarbon gas according to No. 272,187, and in like manner generating hydrogen gas in another electric generator, and mingling the gases.

292,119—January 15, 1884. J. K. KESSLER. *Process of making white lead.*

An acetate of an alkali is electrolyzed, using lead for both anode and cathode, with the formation of acetate of an oxide of lead at the positive pole and a caustic solution of the alkali at the negative pole, the products formed being kept separated in the cell and subsequently mixed; whereby hydrated oxide of lead is precipitated and the original solution of the acetate regenerated. Carbonic acid gas is introduced into the solution with the precipitate in suspension, converting the precipitate into white lead.

292,753—January 29, 1884. J. K. KESSLER. *Process of making sponge lead.*

A solution of the acetate of an alkali is used as the electrolyte, with lead electrodes, the lead of the electrodes being replenished as it is consumed. The sponge-like mass of lead deposited upon the surface of the cathode is from time to time removed for conversion into white lead and red lead.

294,051—February 26, 1884. J. K. KESSLER. *Process of making copper salts by the aid of electricity.*

Basic acetate of copper is produced by first electrolyzing a solution of chloride of sodium or potassium, using a copper anode, keeping the products separate, and then mixing them, whereby hydrated suboxide of copper is precipitated; and, second, mixing the hydrated suboxide of copper, washed and dried, with neutral acetate of copper (in the proportions of 79:198), moistening the mixture with water, and exposing it to the air.

294,619—March 4, 1884. E. HERMITE. *Bleaching of paper pulp or other fibrous or textile materials or fabrics.*

Chlorides of soda or potash are decomposed by an electric current under conditions producing an alkali and a metallic chloride, as chloride of lead (lead cathodes being used). The metallic chloride, diluted or acidified, is then electrolytically decomposed, in the presence of the materials to be bleached (fabrics or paper pulp), and the metal recovered. A rag engine with suitable electrodes is used.

296,357—April 8, 1884. A. J. ROGERS. *Process of and apparatus for reducing metals by electrolysis.*

Fused sodium chloride or potassium chloride is fed into a separate electrolytic cell and electrolyzed, and the chlorine and vapor of sodium, or potassium, led off into separate receptacles, that for the latter containing coal oil: the passage which conducts the sodium, or potassium, vapor into the receptacle being supplied with hydrogen or other suitable gas to prevent contact of oxygen with the vapor.

319,795—June 9, 1885. E. H. & A. H. COWLES. *Process of smelting ores by the electric current.*

Ores or metalliferous compounds are subjected to the action of heat generated by passing an electric current through a granular body of conductive but resistant material forming a continuous part of the circuit, and mixed or otherwise in contact with the material to be treated.

322,940—July 28, 1885. T. KEMPF. *Manufacture of iodoform, bromoform, and chloroform.*

They are produced by the electrolysis of a solution of the corresponding halogen combinations of the alkalis and alkaline earths in the presence of alcohol, aldehyde, or acetone, with the application of heat, and in the case of iodoform, with the introduction of carbonic acid.

323,514—August 4, 1885. W. MAJERT. *Manufacture of methylene-blue by electrolysis.*

Methylene-blue and other homologous colors containing sulphur are produced from paramido derivatives of primary, secondary, and tertiary amines (e. g., paramido-dimethylaniline), and from the hydrazo compounds of the latter, by electrolysis in an acidulated solution and in the presence of such sulphurous substances (e. g., hydrogen sulphide) as, under the action of the electric current, separate out sulphur on the positive pole.

324,658—August 18, 1885. E. H. & A. H. COWLES. *Electric process of smelting ore for the production of alloys, bronzes, and metallic compounds.*

Pieces of base metal, or ore thereof, are mixed with the charge of process No. 319,795, to produce an alloy of the metals present.

324,659—August 18, 1885. E. H. & A. H. COWLES AND C. F. MABERY. *Process of electric smelting for obtaining aluminium.*

A mixture of aluminium compound, carbon, and an alloying metal is reduced in an electric furnace, and then the alloyed metals are separated by amalgamation or lixiviation.

326,657—September 22, 1885. T. KEMPF. *Process of manufacturing permanganates.*

Permanganic-acid salts are obtained, and free metallic hydroxides, by electrolytically treating the solutions of the manganic-acid salts; using a double cell with a diaphragm, the negative electrode being suspended in water and the positive electrode in the solution of the manganic-acid salt.

335,499—February 2, 1886. C. S. BRADLEY AND F. B. CROCKER. *Process of heating and reducing ores by electricity.*

An electric current is passed through the conducting walls of a retort, the same being in contact with a mixture of conducting material and material to be heated, so that electric heat is generated both in the walls of the retort and in the mixture.

339,727—April 13, 1886. E. C. ATKINS. *Art of manufacturing soap.*

A current of electricity passed through the ingredients in the mixing vat hastens the chemical reactions and the soap formation.

353,566—November 30, 1886. M. H. LACKERSTEEN. *Process of manufacturing soap and glycerine.*

An emulsion of a saturated saline solution—such as sodium chloride—and the melted fats and oils is electrolyzed in a two-compartment diaphragm tank.

356,640—January 25, 1887. A. S. HICKLEY. *Process of manufacturing amalgams by electrolysis.*

A metal-producing solution—as sodium chloride—is continuously circulated in a current between an anode of carbon and a cathode of mercury, thereby depositing the reduced metal upon the mercury and forming an amalgam.

357,659—February 15, 1887. D. G. FITZ-GERALD. *Obtaining chlorine by electrolysis.*

An anode of peroxide of lead in the form of dense, highly conductive layers, plates, or masses is employed in conjunction with a suitable cathode and an electrolyte capable of evolving chlorine.

382,159—May 1, 1888. E. HERMITE. *Process of bleaching.*

An electrolyzed solution of chloride of magnesium is used. The bleaching is continuous without regeneration of solution so long as the electric current acts on the solution in presence of coloring matter.

389,781—September 18, 1888. W. WEBSTER, JR. *Process of electrolyzing sewage and sea water.*

For producing ammonia, chlorine, or other products from sewage, sea water, and other liquids, two bodies of one and the same liquid are subjected to the electrolytic action of positive and negative electrodes in the compartments of a porous diaphragmed cell; one of the bodies being repeatedly renewed while the other is retained and the electrolytic action thereon continued.

393,578—November 27, 1888. L. PAGET. *Production of zinc chloride, etc.*

Zinc chloride is produced as a by-product in a voltaic combination in which electro-motive force is set up. A gas, as chlorine, is first generated by the union of sulphuric acid and bleaching powder: sulphate of lime being produced as a by-product. The gas is injected into an electrolyte composed of water holding calcium carbonate in suspension; said electrolyte compound being in contact with the electrodes of the voltaic combination (zinc or iron and lead), whereby zinc chloride (or iron chloride) is produced.

396,325—January 15, 1889. A. & L. Q. BRIN. *Method of bleaching fibrous substances.*

Fibrous material for use in paper making is treated with a mixture of oxygen and chlorine gases (e. g., 90 per cent oxygen and 10 per cent chlorine) which has been subjected to the action of an electric current.

398,101—February 19, 1889. W. WEBSTER, JR. *Process of purifying sewage by electricity.*

Sewage and other impure water is passed in contact with electrically excited positive and negative electrodes of iron, resulting in the formation of a flocculent precipitate of ferrous hydrated oxide, which effects the precipitation of the solid matter and the purification of the impurities held in solution.

414,935—November 12, 1889. T. D. BOTTOME. *Manufacture of white lead.*

Lead anodes are electrolytically dissolved in an alkaline aqueous solution saturated with free carbon dioxide.

415,644—November 19, 1889. G. KERNER AND J. MARX. *Process of electrolyzing salts of the alkalis.*

In the electrolysis of the alkalis, or alkaline and other earths, chemical action is carried on concurrent with electric action, to remove the product resulting from electrolysis before or on reaching the limit at which electrolytic action is arrested, the undecomposed portion of the salt in the solution being further treated. This is effected by passing into the cell a chemical agent to precipitate the portion of the product formed, or by circulating the electrolyte through an outer precipitating chamber, an enriching cistern, and back into the electrolytic cell.

417,943—December 24, 1889. J. B. READMAN. *Process of obtaining phosphorus.*

Materials containing phosphorus are reduced by heat generated within a furnace chamber and directly applied to the material, as in an electric furnace, without introducing oxidizing, reducing, or other gases.

422,500—March 4, 1890. H. Y. CASTNER. *Process of purifying aluminium chloride.*

The anhydrous double chloride compounds of aluminium containing iron are purified and the iron removed by electrolyzing the compounds in a fused condition and in motion.

427,744—May 13, 1890. T. F. COLIN. *Process of obtaining chlorine compounds from natural gas.*

The chlorides of marsh gas (chlormethane, dichlormethane, and chloroform) are formed by the mutual combustion of chlorine and natural gas or methane, mixed in suitable proportions within a chamber or retort. The gases are ignited and the reaction maintained by an electric spark of proper tension, the chamber being maintained at a proper temperature. The hydrogen chloride is absorbed from the resultant gas and the methyl chlorides liquefied.

428,552—May 20, 1890. E. A. COLBY. *Process of melting, refining, and casting metals.*

The mass of the substance in a retaining vessel is melted by inductively establishing electric currents in the substance or the receptacle.

430,453—June 17, 1890. T. L. WILLSON. *Process of melting or reducing metals by electricity.*

Metals or ores are fused in an electric arc formed between an upper electrode and the metal or ore beneath, and a reducing gas is injected into the crater to protect the incandescent surface of the electrode.

442,661—December 16, 1890. T. D. BOTTOME. *Process of desilverizing lead by electrolysis.*

Argentiferous lead anodes are used in the electrolysis of a solution of ammonium salts (for example, ammonium nitrate and ammoniate carbonate, each one-fourth pound in 1 gallon of water) saturated with free carbon dioxide, whereby lead carbonate precipitates and silver deposits upon the cathodes.

448,541—March 17, 1891. T. PARKER AND A. E. ROBINSON. *Process of making iodine by electrolysis.*

An acid solution of an iodide, such as iodide of sodium or potassium, is electrolyzed in contact with the positive electrode, and an alkaline solution (caustic) in contact with the negative electrode, the two solutions being separated by a porous diaphragm. The iodine is then drained off and washed.

452,030—May 12, 1891. H. Y. CASTNER. *Process of manufacturing sodium and potassium.*

Caustic alkali is maintained at a temperature of not more than 20° C. above its melting point and electrolyzed. A gauze or screen is interposed between the electrodes and a superposed vessel or dome for collecting the separated metal.

459,236—September 8, 1891. C. G. COLLINS. *Process of purifying brine.*

Brine is subjected to a current of electricity having an electro-motive force not exceeding $2\frac{1}{2}$ volts to decompose the impurities, but below the intensity necessary to decompose the sodium chloride, whereby the impurities are rendered insoluble by decomposition. Simultaneously the impurities are removed by filtration.

459,946—September 22, 1891. D. V. KYTE. *Manufacture of white lead.*

Lead anodes are electrolytically dissolved in an acid electrolyte to form oxygen-bearing salts, the silver, if any, is removed from the electrolytic solution by electro-deposition, the remaining solution is rendered neutral, or nearly so, and it is then treated with carbon dioxide.

460,277—September 29, 1891. J. B. GARDNER. *Method of obtaining fluids for primary batteries.*

The method of recovering elements employed with galvanic batteries comprises the following steps: Treating a salt—as chromate of lead or other chromate—with an acid so as to separate it into two parts, one of which contains the depolarizing element, using the depolarizing element thus obtained alone or in combination with an acid or acid salt in a battery fluid; treating the spent depolarizing fluid so as to recover the metal employed or the oxide of that metal; and combining the remainder of the spent depolarizing fluid with the unused part of the salt obtained in the first step to recover the original salt employed.

462,567—November 3, 1891. F. M. LYTE. *Process of making alkaline carbonate and chlorine.*

Sodic or potassic carbonate and chlorine are continuously produced by heating sodic or potassic nitrate with calcic carbonate (in the proportions of two to two and one-fourth), lixiviating out the sodic carbonate and converting the nitrous fumes evolved into aqueous nitric acid, dissolving plumbic oxide in the nitric acid, precipitating plumbic chloride by means of sodic or potassic chloride, fusing the plumbic chloride, and decomposing it electrically to form chlorine and lead for use over again.

462,694—November 10, 1891. A. FOELSING. *Process of purifying tannin solutions by electrolysis.*

Ooze is clarified and decolored by electrolyzing a tannic solution mixed with oxalic acid and sodium chlorides.

464,097—December 1, 1891. L. GRABAU. *Process of obtaining metallic sodium.*

Sodium chloride is combined with another chloride of the metals of the alkalis—as potassium chloride—and with a chloride or chlorides of the metals of the alkaline earths—as strontium chloride—in the proportion of one molecule of the latter to three molecules of the chlorides of the metals of the alkalis, forming a trisalt combination the melting point of which is lower than that of sodium chloride. The trisalt is melted and the sodium separated by electrolysis. Potassium may be eliminated therefrom by oxidizing fusion.

466,460—January 5, 1892. T. A. EDISON. *Art of electrolytic decomposition.*

Substances not readily decomposable at low temperatures—such as chloride of aluminum—are decomposed by subjecting them to the action of an electric current at a high temperature and under pressure. They are confined in a suitable vessel, heated sufficiently to vaporize material in the vessel and produce pressure and raise the temperature above the boiling point, and then electrolyzed.

466,720—January 5, 1892. S. C. C. CURRIE. *Process of obtaining insoluble chlorides by electrolysis.*

The metal—as, for example, silver, lead, or mercury—to be converted into a chloride is made the anode in an electrolytic cell containing a neutral metallic chloride solution, such as chloride of zinc, and electrolytically converted into an insoluble chloride.

470,181—March 8, 1892. C. G. COLLINS. *Purification of brine.*

As an improvement on the process of No. 459,236, oxygen is independently supplied to the brine whereby ozone is formed without decomposing the chloride of sodium. The nascent oxygen generated in the brine combines with the dissolved oxygen, producing a maximum amount of ozone.

471,454—March 22, 1892. A. E. WOOLF. (*Reissue: 11,244—June 7, 1892.*) *Process of and apparatus for bleaching by electrolysis.*

Sea water, or a like saline solution, is electrolyzed in the vat containing the material to be bleached, atmospheric air being forced in between the electrodes, thereby generating ozone and chlorine as the bleaching agents.

472,230—April 5, 1892. J. H. SCHARLING. *Process of decorating glass.*

Metal is applied to articles having nonconducting surfaces by repeatedly pouring a solution of metallic salts over the article until it is completely covered, slowly turning it or moving it during the process, and finally subjecting it to the action of an electroplating bath.

477,735—June 28, 1892. J. BLAIR. *Process of making white pigments.*

A charge of sulphuric acid, an alkaline nitrate and water, with metallic lead, forming the anode of an electric circuit, is heated by injected steam, and the lead corroded. The reduced lead, sulphate, and nitrate, is then washed in a solution of an alkaline hydrate. The process without the electrolytic action is also claimed.

478,048—June 28, 1892. C. G. COLLINS. *Process of purifying water.*

The process of No. 470,181 is applied to water purification. Free oxygen is independently supplied to water while it is under the decomposing action of an electric current.

479,781—August 2, 1892. C. W. BRUNSON. *Process of purifying liquid.*

Liquids, including spirituous liquors, and those of an oily nature, are purified by the application or electrolysis at a temperature approximating to its freezing point. The impurities rise to the surface and are removed by skimming or otherwise.

480,492—August 9, 1892. E. B. CUTTEN. *Method of electrolytically producing potassium chlorate.*

Magnesium chloride (e. g., 15 to 20 per cent solution) is electrolyzed in the presence of potassium chloride and slacked lime, the electrolyte being agitated during electrolysis.

For the production of magnesia and potassium chlorate, a solution of magnesium chloride is electrolyzed in the cathode compartment, and potassium chloride, magnesium chloride, and slacked lime in the anode compartment of a cell having a porous partition, whereby potassium chlorate is produced at the anode and magnesia at the cathode.

480,493—August 9, 1892. E. B. CUTTEN. *Method of electrolytically producing potassium chlorate.*

Magnesium chloride is electrolyzed in the presence of potassium chloride and magnesium oxide; the electrolyte should be agitated pending electrolysis.

481,407—August 23, 1892. F. M. LYTE. *Production of caustic alkalis and chlorine.*

Caustic alkali and chlorine are conjointly and continuously produced by decomposing an alkaline nitrate by heating it with ferric oxide to evolve nitrous fumes, decomposing the residue by boiling with water into caustic alkali and a precipitate of ferric hydrate, converting the nitrous fumes into aqueous nitric acid, dissolving plumbic oxide therein, precipitating plumbic chloride, fusing it, and decomposing it electrolytically into chlorine and lead, and finally converting this (or other) lead into plumbic oxide and the ferric hydrate into ferric oxide for recommencing the cycle.

484,990—October 25, 1892. H. BLACKMAN. *Electrolytic process and apparatus.*

A centrifugal electrolytic cell is employed, whereby the products resolve themselves into distinct layers, and the process becomes continuous, with a constant inflow of brine and discharge of chlorine and caustic soda, or other material and products, as the case may be. Under the centrifugal action the gas products are thrown inwardly, and the caustic soda outwardly, and both separated from the electrolyte and discharged through separate conduits.

486,575—November 22, 1892. T. L. WILLSON. *Process of electrically reducing refractory compounds.*

A pulverized metallic compound—as alumina—is first saturated with a reducing agent in a liquid condition—as coal tar—and the impregnated compound is then reduced by electric heat.

489,632—January 10, 1893. F. GRUESSNER. *Process of regenerating solutions.*

Electrolytic solutions used for refining purposes, and which have become charged with arsenic and like impurities, are regenerated by mixing therewith metastannic acid and boiling until the impurities are precipitated.

491,394—February 7, 1893. T. L. WILLSON. *Process of electrically reducing aluminum and forming alloys thereof.*

Refractory metallic oxides, as alumina, are subjected, in the presence of comminuted carbon as a reducing agent, to the heat of an electric arc passing between a molten metallic bath and a carbon electrode above. A bath of base metal produces an alloy, and the comminuted carbon protects the electrode from oxidation.

491,700—February 14, 1893. E. B. CUTTEN. *Method of electrolytically producing soda and chlorine.*

The electrolysis of a saline solution takes place in a cell having a closed anode compartment with means for exhausting the atmosphere, whereby the chlorine is withdrawn from the body of the solution, and access of the same to the freed sodium is prevented, and substantially all of the soda gravitates to the bottom.

491,701—February 14, 1893. E. B. CUTTEN. *Method of electrolytically producing potassium chlorate.*

A solution of magnesium chloride, to which potassium chloride is added, is electrolyzed by means of a slowly alternating current, the potassium chlorate being constantly removed and potassium chloride added.

492,003—February 21, 1893. H. GALL AND A. DEVILLARDY DE MONTLAUR. *Manufacture of chlorates of the alkaline metals and metals of the alkaline earths.*

An aqueous solution of the chloride corresponding to the required chlorate is electrolyzed in a cell having a porous partition and a heating coil, and the contents of the negative compartment is continuously conveyed into the positive compartment where the chlorate is formed.

492,377—February 21, 1893. T. L. WILLSON. *Electric reduction of refractory metallic compounds.*

Refractory compounds are commingled with subdivided carbon in sufficient proportion to prevent the formation of a bath of the fused compound, and reduced by an electric arc maintained close above the material, whereby fluctuations in the resistance of the arc due to the ebullition of a bath are avoided.

493,023—March 7, 1893. W. T. GIBBS AND S. P. FRANCHOT. *Process of obtaining chlorates of the alkalis or of the alkaline earth metals by electrolysis.*

A solution of chloride of potassium is electrolyzed in a cell having a cathode composed of an oxide (copper oxide) which readily yields up its oxygen in the presence of nascent hydrogen, until about one-half of the potassium chloride is converted into potassium chlorate, when the solution is drawn off, cooled, and the potassium chlorate allowed to crystallize. The cathode is removed, washed, dried, reoxydized at a dull red heat, and replaced. The liquor is regenerated and returned to the cell and the process repeated.

496,109—April 25, 1893. A. B. BROWNE. *Process of manufacturing white lead.*

A body of metallic lead constitutes the anode in an electrolytic solution of a nitrate of an alkaline base—as nitrate of soda—whereby a lead is precipitated. The solution and product is drawn off, the lead hydrate settled, the solution drawn off therefrom, and the lead hydrate dried in the air or an atmosphere containing carbonic acid gas.

498,769—June 6, 1893. T. CRANEY. *Method of electrolyzing salts.*

In an apparatus for the manufacture of sodic hydrate, a series of covered electrolytic diaphragm cells is arranged on descending levels with inlet and outlet connections between the successive chambers of the series. Fresh solution is supplied to the anode compartment in quantity to maintain the solution in concentration; a limited amount of the solution is supplied to the cathode chamber, and the supply is regulated to produce a discharge of the product in a uniform state of concentration.

501,121—July 11, 1893. C. N. WAITE. *Art of manufacturing chlorine or caustic alkali by electrolysis.*

Prior to electrolyzing a saline solution, the brine, or so much thereof as is to be used on the anode side of the cell, is treated with an alkaline chloride—as barium chloride—to convert all trace of sulphuric acid into an insoluble precipitate.

501,578—July 18, 1893. H. PFANNE. *Method of manufacturing varnish, and apparatus therefor.*

Purified linseed oil is thoroughly mixed and agitated with sulphuric acid and water and subjected to the passage of an electric current for two or three hours; the oxygen produced in the nascent state converts the oil into varnish.

501,732—July 18, 1893. H. ROESKE. *Method of and apparatus for purifying water.*

The water is filtered through a stratum or body of comminuted iron which is simultaneously agitated and subjected to the action of an electric current.

501,783—July 18, 1893. E. HERMITE AND A. DUBOSC. *Method of and apparatus for electrolyzing solutions.*

In the electrolysis of an alkaline solution a thin sheet of mercury flowing over inclined electrodes forms an amalgam of the metal of the base; which amalgam, received in a trough, is separated from the saline solution by a layer of liquid—as sulphuret of carbon—lighter than the amalgam and heavier than the saline solution. The mercury separates from the amalgam by gravity, and the latter discharges into a water tank and gives up its sodium, or base, to form the caustic soda or like product.

502,431—August 1, 1893. H. H. EAMES. *Process of desulphurizing metallic ores.*

Impurities and foreign substances, as sulphur and phosphorous, are eliminated from metallic ores or obtained from minerals by subjecting the ore, in a closed vessel, to the action of heat (sufficient to liquify sulphur but insufficient to fuse the ore) and an electric current.

503,429—August 15, 1893. F. M. & C. H. M. LYTE. *Process of producing chlorine and purifying lead.*

A soluble chloride—calcic chloride or magnesic chloride—is decomposed with lead nitrate, forming lead chloride and a nitrate; then, on the one hand, the lead chloride in a fused state is electrolytically decomposed to produce chlorine and lead; and, on the other hand, the nitrate is decomposed to obtain nitric acid, which is used over again for the production of more nitrate of lead by oxidizing lead (freed from zinc), and dissolving the lead oxide in the nitric acid, precipitating any silver from the nitrate of lead solution to form pure nitrate of lead with which to continue the cycle of operations.

505,846—October 3, 1893. P. DEP. RICKETTS. *Process of separating metallic nickel.*

Nickel is separated from other metals, salts of metals, and impurities combined therewith in nickeliferous bodies by purifying and concentrating when necessary, forming the purified mass into plates or shapes, immersing the plates in sulphuric acid, adding thereto sulphates of alkaline bases or other similar reagents in such quantities as not to interfere with the said reaction; thereby forming a bath of such composition as to dissolve the copper and nickel and retain the former in solution, and form with the latter insoluble salts; then causing an electric current to traverse the bath from the nickeliferous body as anode to a suitable cathode placed therein, whereby the copper is deposited upon the cathode; and, finally, in separating the precipitated salts and subjecting them to further treatment.

506,248—October 10, 1893. G. OPPERMANN. *Process of and apparatus for purifying water.*

It is successively electrolyzed, agitated, and heated.

508,804—November 14, 1893. H. S. BLACKMORE. *Process of and apparatus for dissociating salts of alkalis by electrolysis.*

The electrolytic cell is composed of three compartments, the end compartments, which are charged with water and contain the electrodes, being connected with the middle compartment by siphons. A uniform and constant level of the bath and of the liquid of the electrode compartments is maintained, and the saturated portions of the liquid of the electrode compartments are from time to time drawn off.

510,276—December 5, 1893. F. M. LYTE. *Process of electrolytically decomposing fused metallic chlorides.*

In an apparatus for the electrolysis of fused metallic chlorides, the mouth of a bell chamber is sealed against the escape of chlorine by dipping into a bath of molten metal corresponding to the base of the chloride treated, and resulting, in part, from the decomposition of the chloride.

510,834—December 12, 1893. H. S. BLACKMORE. *Process of and apparatus for dissociating soluble salts by electrolysis.*

The process consists in providing a bath of the electrolyte and two independent bodies of liquid, establishing a dialytic communication between the bath and each of the independent bodies of liquid, maintaining the latter at a higher level than the level of the bath, and passing a current of electricity through the independent bodies of liquid and through the bath. The solutions of the ions from the independent bodies of liquid are withdrawn while the current is maintained.

511,330—December 26, 1893. E. FAHRIG. *Process of and apparatus for manufacturing ozone gas.*

Oxygen is absorbed from the air by a suitable absorbent, as manganate of soda and lime in a heated retort, and is then liberated by steam, the temperature of the composition being raised from 1,500° to 1,800° F. The steam is then eliminated from the gas by cooling and condensing, and the oxygen is dried and passed through an ozonizing apparatus.

511,450—December 26, 1893. A. A. NOYES AND A. A. CLEMENT. *Process for the manufacture of para-amido-phenol-sulphonic acid.*

A strong sulphuric-acid solution of nitro-benzol is electrolyzed; the product is diluted and filtered; the solid washed and treated with caustic soda, or other alkali, which dissolves out the para-amido-phenol-sulphonic acid as a sodium salt, the sulphonic acid being precipitated by neutralizing with hydrochloric acid.

514,276—February 6, 1894. P. DEP. RICKETTS. *Process of electrolytic separation of nickel from copper.*

A division of No. 505,846: the nickeliferous body in this case being first dissolved in any suitable acid, and then, if necessary, concentrated in solution, the acid reaction being maintained, and the separation effected by the subsequent addition of the desired reagents in connection with the electric current.

515,763—March 6, 1894. C. VON GRABOWSKI. *Process of and apparatus for purifying sulfate lyes.*

Sulphate lyes or liquors containing free sulphuric acid, and, in addition to metallic sulphates, containing also arsenic and antimony, are purified by evaporating to a s. g. of 52° Baumé and allowing the sulphates to crystalize out. The liquor is then electrolyzed with a current of high strength using lead or copper electrodes, and the arsenic and antimony are deposited.

517,001—March 20, 1894. J. D. DARLING. *Mode of producing nitric acid and metals from nitrates.*

Nitrate of soda or potash is electrolyzed in a state of fusion in a closed vessel, the nitrogen peroxide being led off and converted into nitric acid, and the metallic base being drawn off as formed. By preference the temperature is limited to an extent to prevent the breaking down of the nitrate and the liberation of oxygen. Some of the oxygen may be driven off by preheating at a high temperature.

518,710—April 24, 1894. H. CARMICHAEL. *Method of and apparatus for electrochemical decomposition.*

The process, applicable to the electrolysis of any available solution as well as sodium chloride, consists in maintaining within the electrolytic cell a zone of undecomposed solution of sodium chloride interposed between the sodium hydrate and chlorine at their respective electrodes, by supplying to such zone fresh quantities of sodium chloride solution so as to displace the sodium hydrate toward its appropriate electrode, and by withdrawing from the cell the sodium hydrate thus displaced; the supply of sodium chloride solution and the withdrawal of sodium hydrate being made to proceed at such a rate as to maintain the zone of undecomposed sodium chloride between the ions substantially constant in volume.

519,400—May 8, 1894. H. BLUMENBERG, JR. *Electrolysis.*

An electrolyte containing a haloid salt—bromide or chloride—is electrolyzed, and the liberated gas is transferred from the positive to the negative electrode, forming a chlorate or bromate. The liquid electrolyte is then drawn off, settled, and the liquor resaturated and returned to the cell.

522,616—July 10, 1894. I. L. ROBERTS. *Method of electrolytic decomposition of salts.*

The salt crystals are continuously fed into the anode compartment, instead of into the cathode, and maintained in contact with the anode and up to the level of the solution, whereby no impoverishment of the solution in any part can occur.

523,263—July 17, 1894. G. A. CANNOT. *Process of manufacturing hypochlorous acid.*

Oxygen and chlorine gases are thoroughly dried and mixed and electric sparks are passed through the mixture to convert the gases into chlorine monoxide. The gases are cooled while subjected to the electric sparks, during their passage through an ozonizing tube, and the resultant gaseous products are conveyed into a suitable solvent.

526,147—September 18, 1894. T. A. EDISON. *Art of plating one material with another.*

The body to be plated is supported in an exhausted chamber together with an electrode (or electrodes) of the material to be deposited, and the material is electrically vaporized in the chamber, the body being moved to bring different portions of it successively into proximity to the electrode. An alloy deposit is formed by means of electrodes of different conducting material and maintaining an arc between them. Metallic foil is made by depositing on a suitable body and subsequently stripping off the deposited metal.

527,326—October 9, 1894. J. T. DONOVAN AND H. L. GARDNER. *Process of producing ozone.*

Ozone is produced by the electrolysis of a solution of a permanganate of a solid metallic base, such as potassium permanganate, in water.

528,322—October 30, 1894. H. Y. CASTNER. *Process of and apparatus for electrolytic decomposition of alkaline salts.*

A moving body of mercury, or other liquid metal or alloy, occupies the bottom, and communicating passage, of the compartments of a decomposing cell, separating the solutions therein, and the electric current passes from the electrode and liquid of one compartment into and through the mercury to the liquid and electrode of the other compartment; whereby, while the alkaline metal is being deposited and amalgamated with the mercury in one compartment, a like amount of the alkaline metal is being set free in the other compartment, reducing the counter electromotive force.

531,235—December 18, 1894. C. T. J. VAUTIN. *Process of and apparatus for the production of caustic alkali.*

A fused salt of sodium, or potassium, in an open hearth or a closed chamber, is electrolyzed upon a molten bath of lead, which constitutes the cathode, and with which the sodium alloys. In a second heated chamber connected with the molten cathode by an open conduit, the sodium of the alloy, the same being a part of the cathode *in situ*, is subjected to steam and converted into a caustic alkali which is drawn off. The feed is continuous and the chlorine is collected.

535,802—March 12, 1895. O. LUGO. *Process of purifying water.*

It is electrolyzed, using aluminum anodes (which form insoluble aluminum oxyhydrate), and the water flows in a continuous course through the tank containing the electrodes. The coagulated matter is then removed by filtration or otherwise.

536,848—April 2, 1895. H. BLUMENBERG, JR. *Electrolysis.*

An electrolyte containing a haloid salt—bromide or chloride—is electrolyzed in a cell having a closed positive compartment, and the gas generated, under its own pressure, passes therefrom to a holder. The base product is conveyed to a tank, the gas from the holder passed into said tank, and the product—bromates or chlorates—therein formed.

537,179—April 9, 1895. H. BLUMENBERG, JR. *Electrolysis.*

An electrolyte containing a haloid salt—bromide or chloride—is electrolyzed in a cell having a closed positive compartment, and the gas generated, under its own pressure, passes therefrom to a holder. Additional fluid pressure is then applied to said gas; the base product is conveyed to a tank, the gas passed into the tank, and the product—bromates or chlorates—therein formed.

537,403—April 9, 1895. G. D. BURTON. *Art of extracting grease from wool.*

The greasy, fibrous substance is immersed in an electrolyzed solution, as of bichromate of potash, the current causing a dielectric polarization and movement of the fibrous substance; the electrodes may be of lead. For 30 gallons of solution of a gravity of 1.05 an electric current of 220 volts and 65 amperes may be used, the current to be reduced to 20 amperes as soon as the temperature of the bath rises to about 155° F.

538,998—May 7, 1895. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing chromate of lead.*

Chrome hydrate, precipitated from a solution of chrome alum, is mixed with an excess of caustic alkali and redissolved, and the resulting solution is mixed with a solution of chloride of sodium, and the joint solution electrolyzed to decompose the alkaline solution and produce a mixture of bichromate and chromate of potash. The combined chromates are then mixed with a solution of a soluble salt of lead (as the nitrate, acetate, or chloride) to precipitate lead chromate, which is filtered, washed, refiltered, and dried.

541,137—June 18, 1895. T. L. WILLSON. (*Reissue: 11,511—Oct. 22, 1895.*) *Calcium-carbide process.*

Pulverulent and thoroughly commingled carbon and lime is fed into the interspace between two electric poles by means of an alternating current of electricity (the action not occurring to the same extent when a direct current is used) and is converted into calcium carbide by the electric arc formed between said poles.

541,146—June 18, 1895. H. BLACKMAN. *Electrolytic process and apparatus.*

The electrolyte is cooled, to prevent excessive heating, by continually drawing it off from the cell, passing it through a cooler, and returning it to the cell, at the same time maintaining it cool in the cell by cooling pipes.

541,147—June 18, 1895. H. BLACKMAN. *Process of and apparatus for bleaching.*

The hypochlorite electrolyte of an electrolyzed bleaching solution of a chloride of an alkali or alkaline earth is heated and employed for bleaching at an elevated temperature, then drawn off, cooled, and again electrolyzed at a low temperature, to again generate the hypochlorite and reconstitute it as a bleaching agent.

541,335—June 18, 1895. C. SALZBERGER. *Process of and apparatus for disinfecting and purifying water.*

The water is mixed with lime paste, then charged with carbon dioxide to form bicarbonate of lime, and then electrolyzed to set free carbonate of lime and carbon dioxide.

541,465—June 25, 1895. C. T. J. VAUTIN. *Electrolytical process and apparatus.*

Alloys of lead, tin, and alkaline metals are produced by supplying lead and (or) tin intermittently to an electrolytic furnace together with a fused alkaline salt superposed thereon, discharging intermittently alloys of lead and tin with volatile metals when formed electrolytically, treating said alloys by distillation while still molten, condensing the pure distilled volatile metals, and returning the nonvolatile metal to the reducing furnace.

541,597—June 25, 1895. J. D. DARLING. *Method of and apparatus for manufacturing sulfuric acid and by-products.*

A fused nitrate, as nitrate of soda, is electrolytically decomposed in a closed cell, and the disengaged gases directly conducted to a Glover tower for use in the sulphuric-acid chambers. The basic residuum—mainly sodium monoxide if nitrate of sodium has been used—is drawn off after each run.

541,598—June 25, 1895. J. D. DARLING. *Process of utilizing niter cake or other acid sulfates.*

A solution of acid sulphates—niter cake—is electrolyzed in the negative compartment of a double cell having a porous diaphragm, the positive compartment being charged with a base-supplying electrolyte—as a saturated solution of sodium chloride—whereby the base is transferred to the sulphate by electrolytic travel, producing a neutral sulphate. The chlorine gas is collected.

542,057—July 2, 1895. L. P. HULIN. *Electrolytic process and apparatus.*

An alloy of an alkali metal or an alkaline earth metal with a heavy metal (or metals) is formed by employing as an electrolyte the fused salts of the metal of one ingredient of the proposed alloy and an anode consisting of a carbon member and a metal member (or members) composed of the other ingredient (or ingredients) of the proposed alloy. The distribution of the positive current through the anodes governs the composition of the alloy. With metals difficult to obtain in the metallic state an anode formed of an intimate mixture of an oxide of the metal and carbon can be used. For metals fusible at the temperature of the electrolysis a dish-shaped anode-metal container is employed.

551,461—December 17, 1895. W. C. CLARKE. *Art of producing carbide of calcium.*

In an electric furnace having horizontal electrodes embedded in a mass of pulverized and intimately commingled lime and carbon of such extent that a material portion will remain undecomposed, the current is started and the electrodes are gradually separated, as the material between them is reduced, so as to produce between the electrodes a body of calcium carbide surrounded by an undecomposed mass of the mixture.

552,890—January 14, 1896. W. C. CLARKE. *Manufacture of carbide of calcium.*

The furnace wall is built up as the formation of carbide progresses—fresh charges of material being added from time to time—the lower end of the upper electrode being at all times kept near the upper edge of the furnace wall.

552,895—January 14, 1896. T. CRANEY. *Process of and apparatus for making carbonates of soda.*

In the electrolysis of a sodium chloride solution, the cathode solution, continuously circulating through a series of electrolytic cells, is passed through an outer vessel in circuit, where the warm solution is charged with carbonic-acid gas, then into a cooler to precipitate the increment of carbonate, and then back into the cathode compartments.

552,955—January 14, 1896. T. CRANEY. *Process of and apparatus for manufacture of sodium bicarbonate.*

In the electrolysis of a sodium-chloride solution the cathode solution, continuously circulating through a series of electrolytic cells, is passed in circuit through an outer vessel, where it is treated with carbonic-acid gas, and the bicarbonate of soda precipitate deposited. The aqueous solution of bicarbonate of soda is then returned to the cathode compartments and reconverted into monocarbonate by the additional supply of caustic soda.

552,960—January 14, 1896. C. HOEPFNER. *Process of producing cuprous oxides.*

Cupriferous material is leached with a cupric-chloride solution containing calcium chloride, whereby a solution containing cuprous chloride is obtained. The cuprous chloride in a portion of the solution is converted into cupric chloride by means of an acid—as sulphurous acid in the presence of oxygen—and employed for leaching a fresh batch of crude material, and the other portion of the solution is freed from metals other than copper by a suitable precipitant, and the cuprous chloride therein is converted into cuprous oxide by a suitable reagent, as caustic lime.

553,593—January 28, 1896. M. OTTO AND A. VERLEY. *Manufacture of vanillin.*

A solution of iso-eugenate of soda is electrolyzed, converting it into vanillate of soda, and the solution is then treated with an acid—oxalic acid or sulphuric acid—to set free the vanillin.

554,718—February 18, 1896. R. McKENZIE. *Process of producing lakes or coloring compounds by electrolysis.*

A solution or mixture of the fundamental bases of coloring matters—such as chromic acid, alizarine or cochineal—in a suitable liquid, is electrolyzed, using an anode of oxidizable metal, or alloys of metals, according to the color desired. The lakes or pigments are then separated from the menstrum, dried and powdered.

555,232—February 25, 1896. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing white lead by electrolysis.*

A solution of sodium nitrate is flowed through the anode compartments of a plurality of electrolytic cells having lead anodes, whereby a quantity of lead nitrate forms in each of the cells and is held in solution, thus making a mixture of sodium nitrate and lead nitrate. A portion of said mixed nitrates is mixed with sufficient sodium hydrate (from the cathode compartments) in a separate vessel to precipitate lead hydrate, which is filtered, carbonated, and washed. A portion of the mixed nitrates of soda and lead is mixed with fresh sodium nitrate and returned into the electrolyte to maintain a uniform electrical resistance.

557,057—March 24, 1896. E. N. DICKERSON. *Process of and apparatus for producing metallic compounds by electricity.*

A finely divided mixture of calcic oxide and carbon is fed into an electric furnace and the carbon monoxide produced is utilized to preheat the charge, by burning the same with added air. The furnace comprises an interior chamber through which the charge is fed, a surrounding heating chamber, and a furnace chamber and electrodes at the foot of the said interior chamber, with a connecting feed flue.

557,324—March 31, 1896. G. D. BURTON. *Art of electric dyeing.*

The fibrous substance to be dyed is immersed in the dye liquor, and an electric current of forty or more volts and of sufficient volume to warm it is passed through the liquor where the substance is intermingled, whereby the fibers are forced apart and exposed to the action of the dye liquor.

557,325—March 31, 1896. G. D. BURTON. *Art of and apparatus for electrodyeing.*

To prevent contamination of the dye liquor by dissolved metals and injury to the color, carbon electrodes are used in the process of No. 557,324.

558,240—April 14, 1896. C. N. WAITE. *Method of utilizing saline solutions.*

A saline solution is electrolyzed, producing chlorine and hydrate; the hydrate solution is digested with wood fiber, the fiber separated from the liquor, the latter evaporated, and the residuum roasted, producing black ash, which is dissolved and enough quicklime added to causticise the carbonate of soda. This solution is then used in the cathode compartment of an electrolytic cell, and the operation repeated.

558,241—April 14, 1896. C. N. WAITE. *Method of utilizing saline solutions.*

In the practice of the process of No. 558,240, the black ash is lixiviated with a limited amount of water to remove a portion of the carbonate, and the residuum is then dissolved and treated with quicklime, etc., according to the said process.

558,717—April 21, 1896. H. L. BREVOORT. *Process of electrically treating fabrics for waterproofing or other purposes.*

The fabric, moistened with water, is placed between and in contact with an anode of an oxidizable metal and a suitable cathode, and a current of electricity passed through the moistened fabric, oxidizing the anode and depositing the oxide on or in the fabric.

558,718—April 21, 1896. H. L. BREVOORT. *Art of fixing dyes in fabrics.*

The natural dye in a suitable solvent is applied to the fabric, the fabric pressed between an anode of an oxidizable metal and a suitable cathode, and a current of electricity passed therethrough, oxidizing the anode and combining the oxide with the natural dye to form a lake.

558,970—April 28, 1896. O. LUGO AND H. T. JACKSON. *Method of electrolytic treatment of soap lyes.*

Caustic alkali is extracted and recovered from crude glycerine and spent soap lyes or saponification liquors by electrolyzing the liquor in a porous partition cell, using an anode of zinc in contact with the liquor, and a cathode of metal not attacked by caustic alkali. The precipitates formed are filtered, and the filtrate distilled or condensed.

559,454—May 5, 1896. C. KELLNER. *Process of and means for producing bleaching agents.*

The chlorine liberated at the anode, and the alkaline hydrate formed at the cathode, of an electrolytic cell, in the electrolysis of an alkaline chloride solution, are combined as a bleaching agent, in a separate vessel, by spraying the alkaline hydrate down through an ascending column of the chlorine gas.

560,291—May 19, 1896. E. G. ACHESON. *Electrical furnace.*

Silicide of carbon is produced by interposing between the electrodes of an electric circuit a core of granulated refractory material of comparatively low resistance (coke), forming a conducting path for the electric current, and surrounding this core with the mass to be treated—comprising silicious and carbonaceous material—of relatively high resistance. The mass to be treated, for the production of silicide of carbon, comprises a carbonaceous material, as anthracite coal, 20 parts; a silicious material, as sand, 29 parts; and a fibrous material, as sawdust, 29 parts; with or without a flux, as common salt, 5 parts.

560,411—May 19, 1896. C. KELLNER. *Process of and apparatus for bleaching vegetable fibers.*

The material to be bleached is first subjected to the chlorine solution produced by the electrolysis of an alkali metal chloride, whereby the coloring matter in the material is converted into combinations that are soluble in water, and into combinations that are insoluble in water, and it is then subjected to the action of the alkali solution, which removes the insoluble coloring matter. The solutions are then mixed and returned to the electrolytic cell. The apparatus permits of the alternate flow of the chlorine and alkali solutions through the same bleaching vat and the suspension and movement of the material while under treatment.

560,518—May 19, 1896. J. MEYRUEIS. *Treatment of sodium chlorid.*

For the manufacture of chlorine, white lead, and bicarbonate of soda, an acidulated solution of sodium chloride is electrolyzed in a cell having a porous diaphragm. Chlorine gas is drawn off from the positive compartment. The negative solution is drawn off, litharge is dissolved therein, and white lead precipitated therefrom by carbonic-acid gas. The alkaline liquor remaining is again treated with carbonic acid and bicarbonate of soda obtained on evaporation.

562,402—June 23, 1896. W. R. KING AND F. WYATT. *Process of forming calcium carbid.*

A mound is formed of mixed coke and lime around a vertical core of conducting material—such as a small carbon rod supported between two superposed electrodes—or the core is forced down through the center of the heap. A current is passed until a nugget of calcium carbide is formed in the center of the mound, the upper electrode descending freely as the supporting mixture is fused and reduced. The nugget is removed with tongs, a new core inserted, the material thrown up around it, and the process repeated.

563,288—July 7, 1896. W. LOBACH. *Electrical production of chemical reactions.*

The substance to be acted upon—a nongaseous substance for reaction with oxygen or other gas, as oil to be bleached—is passed between electrodes by sprinkling or scattering, an electric "silent" discharge being produced between the electrodes. Oxygen, or an oxygen product, is also passed between the electrodes to produce oxygen in the nascent state, with which the substance (oil) is thus brought into intimate contact at the moment of formation, and combination takes place.

563,527—July 7, 1896. T. L. WILLSON. *Process of producing calcium compounds.*

Mingled lime and carbonaceous deoxidizing agent, such as coke, is subjected to the heat of an electric arc in an electric furnace, the carbonaceous matter being in excess of that required to combine with the freed oxygen—say 65 per cent of lime and 35 per cent of carbon. The carbon may be supplied by saturating lime with a liquid hydrocarbon and drying it before feeding to the furnace.

563,528—July 7, 1896. T. L. WILLSON. *Process of manufacturing hydrocarbon gas.*

Calcium carbide is produced from a lime and carbon mixture subjected to the heat of an electric arc in an electric furnace, the carbon being in excess of that required to combine with the freed oxygen, and then decomposed with water to generate a hydrocarbon gas (acetylene).

563,553—July 7, 1896. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing white lead.*

A solution, electrolytically separable into a solvent of lead and an alkaline hydrate, is electrolyzed in a cell having two diaphragms and an intermediate compartment between the anode and cathode to separate the electrolyte into a solvent of lead and an alkaline hydrate, and the same are maintained separate on the outer sides of the diaphragms, by preponderance of pressure of the electrolyte in the intermediate compartment, on the inner sides of the diaphragms. Metallic lead is dissolved in the lead solvent in the anode compartment and an oxidizing agent—nitric acid—is continuously added thereto to prevent the formation of insoluble lead salts. The anode and cathode solutions are withdrawn and mixed and hydrate of lead formed and carbonated.

563,554—July 7, 1896. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing oxids of lead.*

Metallic lead, as an anode, is electrically dissolved in an alkaline hydrate formed by the prior electrolytic separation of an alkaline base into an alkaline hydrate and a neutralizing agent, such as nitric acid. The oxide of lead produced is dissolved in the alkaline hydrate to form a plumbate of an alkaline base, and the solution is neutralized by the aforesaid neutralizing agent to precipitate the desired lead oxide. The remaining solution is again used as the alkaline base electrolyte.

563,555—July 7, 1896. A. B. BROWNE. *Manufacture of white lead.*

A solution, electrolytically separable into a solvent of lead and an alkaline hydrate, is introduced between two pervious diaphragms interposed between the anode and cathode of a cell, and electrolyzed, and the liquid withdrawn from between the diaphragms as it becomes alkaline; to which liquid may be added alkaline hydrate withdrawn from the cathode department. Metallic lead is electrolytically dissolved in the lead solvent. The resulting solution is withdrawn and mixed with the withdrawn alkaline liquid, forming a hydrate of lead.

564,940—July 28, 1896. G. H. SELLERS. *Method of purifying water.*

Pieces of iron in direct contact with pieces of another metal (copper, tin, lead) with which the iron can form a galvanic couple, are agitated in water. Air is forced through the water to form a coagulent and precipitate the iron salts and impurities.

565,324—August 4, 1896. H. BLUMENBERG, JR. *Electrolysis.*

A chloride solution is caused to flow through the closed positive compartment of an electrolytic cell (a series of cells, into and from the bottom of each), and a separate electrolyte through the negative compartment in an opposite direction, and to the bottom of a separate tank; the chlorine gas from the positive compartment being also conveyed to the bottom of the same tank, where the chlorate is formed. Retort carbon, for an electrode, is saturated with a hydrocarbon which has been charged with chlorine gas, and then coked.

565,706—August 11, 1896. B. S. SUMMERS AND C. O. BORING. *Electrolytic separation of vegetable fibers.*

The gum or cementing material of vegetable fibers (ramie, etc.) is removed by electrolyzing the fibers in a bath containing a fluoride of the alkaline metals (as sodium fluoride) in the positive compartment of an electrolytic cell.

568,258—September 22, 1896. V. J. KUESS. *Process of and apparatus for distilling fatty substances.*

Fats or resinous substances in liquid condition are distilled by passing therethrough an electric current and simultaneously injecting steam, whereby the steam is decomposed and acts as an electric conductor through the mass.

568,323—September 29, 1896. E. G. ACHESON. *Manufacture of graphite.*

A carbide is subjected to a temperature sufficiently high to drive off and volatilize the noncarbon constituents and separate the combined carbon as graphite. A mixture of carbon and one or more oxides is converted into a carbide in an electric furnace and the heating continued, as above, until graphite is formed.

569,325—October 13, 1896. P. DANCKWARDT. *Process of and apparatus for producing cyanids.*

A molten bath of the chloride of an alkali or alkali-earth metal is formed and electrolyzed while in contact with carbon and nitrogen, which are introduced into the bath, the cyanide formed being continuously removed from the action of the electric current. Coal and ammonia gas may be used to supply the carbon and nitrogen.

569,680—October 20, 1896. B. S. & L. L. SUMMERS. *Electrolytic process of bleaching and refining.*

The material (ramie) is bleached in the positive compartment of an electrolytic cell, in a bath containing a fluoride and a material yielding a hydrate (sodium hydrate) bleaching agent. The fluoride prevents the impairment of the fiber. It may subsequently be electrolyzed in a fluoride bath.

571,084—November 10, 1896. H. ELDRIDGE, D. J. CLARK, AND M. W. WAMBAUGH. *Composition of matter for manufacturing calcium carbide.*

Calcium sodic carbide is produced by subjecting a mixture of quicklime, 72 parts by measure; carbon, 40 parts; soda, 4 parts; and borax, one-eighth part, to the fusing heat of an electric furnace. The water of crystallization of soda and borax is expelled by heat before mixing.

571,531—November 17, 1896. R. LANGHANS. *Process of producing coatings composed of earthy oxids.*

For the formation of incandescent mantles, basic earth salts are prepared by dissolving hydrated oxides of earth metals in solutions of neutral earth salts, to form an electrolyte, and the hydroxides of the earth metals are separated by an electric current of high density, they being deposited on electric-conductive foundations. The deposited hydroxides are dipped in an aqueous solution of an acid capable of converting the hydroxides into salts which are indissoluble in the solution and which are reduced to oxides by heat, and then dried and calcined; or an alkaloid salt is combined with the solution containing basic earth salts, thereby depositing in an intimate union hydroxides of earth metals and the alkaloid upon the foundation, which is dried and calcined to destroy the organic substance and convert the hydroxides into oxides.

571,532—November 17, 1896. R. LANGHANS. *Process of producing coatings composed of earthy oxids.*

Porous coatings of incandescent mantles are formed by electrolyzing a dilute aqueous solution of a metahydroxide of an earth or alkali-earth metal by an electric current of low density, depositing thereby upon an electro-conductive foundation, as the cathode, a coating of hydroxide, and drying and calcining the deposit. An organic base may be added to the solution of a meta-earthy hydroxide, which organic base is deposited along with the earthy hydroxide and is destroyed by the calcining process, leaving a porous coating of earthy oxide.

571,533—November 17, 1896. R. LANGHANS. *Electrolytic process of converting hydroxids of earth and earth-alkali metals into indissoluble organic or inorganic salts, etc.*

The process of electrolytically transforming into salt the hydroxide of earth metal deposited upon electro-conductive foundations consists in placing such coated foundation as an anode in an electrolyte: which consists of an aqueous solution of selenious acid, or its described equivalent, and subjecting the electrolyte to the action of a current of low density. The salt is afterwards reduced to oxide by calcination.

572,512—December 8, 1896. H. ALBERT. *Process of manufacturing phosphates of alkalis.*

An anode bath of phosphoric acid and a cathode bath of one or more of the soluble salts of the alkali metals, separated by a porous diaphragm, are electrolyzed, whereby a mono-, di-, or tri- basic phosphate of the alkali employed is produced at the cathode. The alkaline phosphate may be directly converted into caustic alkali with lime.

572,636—December 8, 1896. J. E. HEWES. *Electric furnace.*

The carbide and associated half-formed product of an electric furnace is discharged into a closed chamber, the dust drawn off by suction, the material screened, and the cleansed carbide removed. The furnace has an inclined hearth: one movable electrode is parallel and close to the hearth, up the slope, and the other electrode—constituting a trapdoor—is stationary at the foot of the hearth, and stands at an angle thereto. Feed is provided for the material and for the movable electrode.

573,290—December 15, 1896. M. PRIDHAM. *Process of purifying and decolorizing saccharine or other liquids.*

As a modification of the process of No. 573,289, the ozone is passed through subsequent to electric action.

575,645—January 19, 1897. E. HERMITE. *Apparatus for purifying or disinfecting.*

A disinfecting solution is made by electrolyzing a solution containing chloride of magnesium, or chloride of magnesium and chloride of sodium (sea water or mother liquor from salt works).

575,788—January 26, 1897. T. L. WILLSON. *Electric smelting.*

Pulverized material to be smelted, as alumina, is fed into the neighborhood of an electric arc of an alternating current of a frequency adapted to set the mass of material into vibration, whereby the arc pulsations draw the material within its influence. A pool of molten material may form the lower electrode and the same may be of a base-alloying metal.

577,329—February 16, 1897. N. SLAWIANOFF. *Electric casting of metals.*

An electric arc is formed between a rod of the casting metal and the mold, or the fused metal in the mold, and the mold filled from the fusing of the metal electrode, the arc being continuously regulated.

577,523—February 23, 1897. G. J. ANDERSSON AND J. C. DITTRICH. *Process of manufacturing ozone and by-products.*

Air is first freed from carbon dioxide and dried, then passed through an ozonizing apparatus, forming ozone and nitrous oxides by the simultaneous oxidizing of the nitrogen, and the nitrous oxides are then separated from the ozone by absorbing them in suitable liquids, as water forming nitric acid, or a solution of caustic alkali forming nitrite or nitrate of the alkali.

577,802—February 23, 1897. G. M. WESTMAN. *Process of and apparatus for treating arsenic ores.*

The ore is melted in a closed electric furnace with a lead bath for the bottom electrode beneath the ore, with which the precious metals alloy, the arsenical vapors being led off and condensed.

578,457—March 9, 1897. C. KELLNER. *Process of and apparatus for simultaneously producing ammonia, sodium hydroxid, and chlorin.*

Sodium chloride—or other alkali metal chloride—is electrolytically decomposed in a closed cell having a mercury cathode in the form of a thin layer in continuous motion in a helical direction toward a central point where it flows off. The chlorine product is drawn off and the alkali metal amalgam passes to a closed decomposing vessel and flows over a conductive surface beneath a hot solution of sodium nitrate (or nitrate of other alkali metal) and an electrode, thereby forming ammonia and sodium hydroxide and developing electrical energy which may be utilized. The mercury then passes through a cooler and is returned to the electrolytic cell.

578,685—March 9, 1897. E. R. WHITNEY. *Process of and apparatus for producing calcium carbid.*

Mechanically compacted columns of fragmentary charcoal are moved longitudinally toward each other, and constitute the electrodes of an arc furnace, into and through which arc a mixture of pulverized lime and charcoal is fed. A number of separate electric arcs proceeding from charcoal electrodes and crossing each other are used.

579,317—March 23, 1897. E. J. CONSTAM AND A. VON HANSEN. *Process of manufacturing percarbonates.*

Percarbonates of the alkali metals and ammonium, as new chemical compounds which are readily soluble in water and possess strong oxidizing properties, are produced by electrolyzing a saturated solution of their carbonates at temperatures below zero centigrade.

580,919—April 20, 1897. A. E. WOOLF. *Method of and apparatus for disinfecting and deodorizing.*

Infected water or sewage (running streams, sources of supply for cities, etc.) is disinfected and deodorized by discharging or injecting thereinto an electrolyzed solution of salt water.

583,131—May 25, 1897. H. G. STIEBEL, JR. *Apparatus for and method of sterilizing liquids.*

The liquid is caused to drop through an atmosphere of ozone produced by a series of disruptive electric discharges, and in the path of such discharges, between the electrodes but out of contact therewith.

583,330—May 25, 1897. E. A. LE SUEUR. *Process of electrolysis.*

In the electrolysis of saline solutions, the solution in the anode compartment is maintained in the chemical condition in which it exists at the commencement by adding hydrochloric acid to combine with the hydrate that leaks or diffuses through the diaphragm.

583,498—June 1, 1897. J. T. MOREHEAD. *Manufacture of carbid of calcium.*

The furnace wall is built up as the formation of carbide progresses, fresh charges of material being added from time to time. (Same as No. 552,890.)

586,236—July 13, 1897. L. P. HULIN. *Process of electrolytic decomposition of solutions.*

The electrolyte is confined between two permeable electrodes, and the ions are filtered therethrough, whereby an immediate separation of the ions from the electrolyte is effected at the point and instant where and when they are generated.

586,729—July 20, 1897. C. KELLNER. *Method of and apparatus for effecting electrolysis.*

In an apparatus for the electrolytic decomposition of salts of metals capable of combining with mercury, a mercury cathode flows uninterruptedly from a higher to a lower level, and flows alternately and repeatedly out of contact with the salt solution and into contact with a decomposing agent for the amalgam.

587,138—July 27, 1897. I. L. ROBERTS. *Process of and apparatus for manufacturing metallic carbids.*

A conducting path of material to be heated to incandescence is established between electrodes within a mixture of pulverized ore or oxide (as calcium oxide) and carbon, and as the heat thereof converts the adjacent portions of the mixture into a conductive body the electrodes are gradually withdrawn and the mixture is gradually moved transversely to the line of the current, whereby successive portions of the mixture are brought into the heating field, and a slab of carbide is formed. The floor of the furnace chamber is a slowly moving horizontal conveyor, and the electrodes, entering at one end of the chamber in the same horizontal plane, are angularly adjustable so that they can take a parallel position.

587,343—August 3, 1897. G. S. STRONG. *Electric furnace.*

The electrodes are formed of a mass of material, including a binder, which is agglomerated, formed, and fed forward to the arc by pressure, and exposed in the guides to a high temperature before actually entering the furnace. One or more or all of the materials used in the smelting operation may constitute the said mass of material; the electrodes constituting the smelting charge.

587,437—August 3, 1897. F. HURTER. *Apparatus for manufacturing chlorate of potash by electrolysis.*

The cathode consists of a metallic vessel having a porous protective lining, essentially of cement.

587,509—August 3, 1897. I. L. ROBERTS. *Process of and apparatus for making metallic carbids.*

A mixture of the metallic compound and carbon is passed beneath a horizontal electric arc and in direct contact therewith in the nonoxidizing atmosphere of a closed chamber. The arc is deflected downward by means of an electro-magnet, and the carbide formed is continuously removed. The material, fed in through a double hopper, is carried by a horizontal endless belt under the arc, and the unchanged material, the carbide being scraped off, is carried back and again fed onto the belt.

587,830—August 10, 1897. L. P. HULIN. *Process of and apparatus for manufacturing metallic peroxids and caustic alkalies.*

The higher peroxides of heavy metals, such as lead, antimony, bismuth, chromium, and manganese, are formed by alloying said metals with an alkali metal or alkali-earth metal (fused by an electric current), and subjecting the alloy to the action of heat—a dull red—and atmospheric air to form the desired peroxide in combination with the anhydrous alkaline oxide formed conjointly therewith; continuously withdrawing the peroxide and alkaline oxide from the presence of the alloy under treatment, and decomposing the salt of the metallic acid thus formed to separate the peroxide.

588,012—August 10, 1897. I. L. ROBERTS. *Process of and apparatus for making metallic carbids.*

The process and apparatus of No. 587,509 is supplemented by a reflecting dome placed above the arc, whereby the reflected heat assists in the formation of the carbide.

588,084—August 10, 1897. G. H. POND. *Process of and apparatus for electro-chemical treatment of straw or other fibrous materials.*

The straw packed in a tank, with an open anode cell at the side thereof, is subjected to the action of a solution of sodium chloride, which is circulated throughout the mass of straw while a current of electricity is passing through the solution. The solution is caused to circulate quickly at the beginning of the operation and then the speed of circulation is decreased.

588,085—August 10, 1897. G. H. POND. *Method of and apparatus for electro-chemical treatment of fibrous material.*

Straw or other fiber is packed in an electrolytic tank having removable partitions and containing a chloride of sodium solution, so as to form anode and cathode compartments on opposite sides of the mass; and, during the electrolytic action, the solution is caused to circulate throughout the straw, first from the cathode side to disintegrate it, and then from the anode side to bleach it.

588,266—August 17, 1897. G. DE CHALMOT. *Treatment of phosphates.*

Natural phosphate rock containing silica, alumina, or iron oxide, is fused in an electric furnace—whereby the proportion of soluble phosphoric acid is increased—and immediately removed from the furnace and brought into contact or mixed with silica, and then dropped into water while hot, which cracks it so that it is easily pulverized; it is then available as a fertilizer.

588,276—August 17, 1897. C. KELLNER. *Electrolytic process and apparatus therefor.*

In the electrolysis of compounds whose electropositive constituent will combine with mercury, the mercury is moved continuously out of and back into the field of action of the electric currents to successive points where the amalgam acts as an anode, and is decomposed successively at such points by a decomposing agent in presence of a cathode; the successive electrodes being connected in series, whereby an independent current of electricity is generated of higher potential than the electrolyzing current.

588,883—August 24, 1897. P. G. SALOM. *Process of making litharge or protoxid of lead from lead ore.*

Pulverized lead ore—galena—is subjected to the action of nascent hydrogen electrolytically developed, as in the cathode compartment of a cell, producing thereby a spongy mass, which is then heated in the open air, first at a temperature below the melting point of lead and afterwards at a higher temperature.

589,523—September 7, 1897. J. BOELSTERLI. *Process of and apparatus for electrolyzing fused salts.*

A fused alkali-metal salt is electrolyzed and the alkali metal liberated exclusively at the surface of the electrolyte. The cathodes, just dipping below the surface of the electrolyte, and the anodes, each provided with an insulated gas-conducting sheath, depend from supporting rods and have means for vertically and horizontally adjusting the cathodes.

589,592—September 7, 1897. S. BLUM. *Composition of matter for manufacturing calcium carbid.*

A mixture of air-slaked lime, 22 parts by measure; carbon, 8 parts; plumbago containing iron, 4 parts; and potash, one-half part; is used for the manufacture of calcium carbide in an electric furnace. The fluxing quality of certain of the ingredients hastens the operation.

589,801—September 7, 1897. H. C. WOLTERECK. *Process of manufacturing white lead.*

A lead anode is dissolved in an alkaline electrolyte consisting of a solution of a salt of an alkali in combination with any acid which will produce a soluble lead salt and of a bicarbonate of an alkali (4 parts of acetate, nitrate, or other salt of soda, potash, or ammonia, and 1 part of bicarbonate), causing the formation of a soluble compound of lead, which is transformed into the hydrated carbonate by the simultaneous generation of free carbonic acid at the anode and by the presence of caustic alkali generated at said cathode, a current of carbonic-acid gas being passed through the electrolyte to regenerate the spent alkaline bicarbonate.

589,967—September 14, 1897. R. F. S. HEATH. *Composition for manufacturing calcium carbids.*

A mixture of quicklime, 9 parts; carbon, 4 parts; and sodium or potassium chloride, one-quarter ounce to the pound of mixture is used for the manufacture of a carbide of calcium in an electric furnace.

590,514—September 21, 1897. A. H. COWLES. *Process of producing metallic carbides.*

Same as No. 551,461.

590,548—September 21, 1897. C. KELLNER. *Process of producing hydrates or other salts of alkaline metals.*

An amalgam is formed by the electrolysis of a solution of a suitable salt with a mercury cathode and simultaneously an equivalent quantity of the alkaline metal of the amalgam is oxidized by making the amalgam the anode of a galvanic cell containing a liquid reagent and a cathode electro-negative to the amalgam and short circuited therewith. The mercury in a narrow compartment forms a partition between the electrolytic and the galvanic cells.

590,673—September 28, 1897. F. H. SODEN. *Process of and apparatus for electrically treating ores.*

Ores are purified, preparatory to smelting, by heating in a closed chamber by contact with unbroken electric resistance conductors embedded in the ore, and by the resistance of the ore to the current shunted therethrough, and by introducing into the ore at the same time, first, super-heated air, and then a purifying gas, such as hydrogen.

591,355—October 5, 1897. H. MOISSAN. *Process of obtaining cast titanium.*

Cast metallic titanium combined with carbon is obtained by subjecting an oxide of salt of titanium in presence of carbon to an electric arc produced by a current of from 1,000 to 2,000 amperes and 60 to 70 volts.

591,730—October 12, 1897. W. BEIN. *Process of and apparatus for electrolyzing.*

The electrolytic cell has a series of vertical partitions which permit the passage of the electrolyte above or below them; horizontally disposed electrodes arranged in different vertical planes; a feed pipe for fresh solution; and outlet pipes for the decomposed layers. The process, resulting from the cell structure, permits of the feeding in of fresh solution and withdrawal of the decomposed anodic and cathodic solutions, and the maintenance, in predetermined positions, of the layers of decomposed products outside of the influence of the current. It is applicable to the electrolysis of brine and the production of acids, as nitric acid by electrolyzing saltpeter, sulphuric acid from sulphates, etc.

594,740—November 30, 1897. H. L. HARTENSTEIN. *Process of and apparatus for carbureting calcium.*

Limestone is calcined, and while still hot carbonaceous material—as pulverized coke—is forced into the mass by the aid of a combustible gas under pressure, the mass being simultaneously subjected to the action of an electric current.

The apparatus comprises a calcining chamber above a removable electric furnace chamber, mounted on a track; mechanism and connections being provided for forcing gas and with it coke dust into the furnace chamber.

596,704—January 4, 1898. H. L. HARTENSTEIN. *Process of and apparatus for utilizing waste products of blast furnaces.*

As a modification of the process of No. 596,749, the gas injected is a reducing gas.

The apparatus comprises a converter having a slag-receiving portion, a mixing portion with tuyers, and an electric-treatment portion having electrodes, by which the several steps of the process are successively performed in the converter.

596,705—January 4, 1898. H. L. HARTENSTEIN. *Process of utilizing waste products of blast furnaces.*

The process of No. 596,749 is applied to solidified slag, which is reduced to a molten state and then treated.

596,749—January 4, 1898. H. L. HARTENSTEIN. *Process of utilizing waste products of blast furnaces.*

Carbonaceous material is diffused through molten slag in suitable proportions—as 1 part coke to 3 parts slag—by blowing it in with gas pressure; the mixture is then agitated to enhance the impregnation, and then subjected to the fusing action of an electric current, producing a carbide of calcium, aluminium, and silicon.

596,936—January 4, 1898. F. K. IRVING. *Process of producing ozone.*

Ozone is produced by the electrolysis of a metallic salt—as sulphate of copper—the base of which is reducible, and thereby serves to dispose of the hydrogen by secondary action during electrolysis; the freed ozone being conveyed into a suitable menstruum, as glycerine and distilled water.

596,999—January 11, 1898. J. E. HEWES. *Process of making calcium carbids.*

A carbide of calcium mixture is fused in an electric furnace with a flux consisting of manganese oxide and calcium carbonate. Carbon and lime may be introduced into a fused bath containing manganese and calcium and oxygen, and a continuous electric current passed therethrough to effect chemical combination.

598,549—February 8, 1898. H. H. WING. *Process of manufacturing graphite.*

Graphite is produced by passing an electric current through powdered carbonaceous material—as coke—in an electric furnace, whereby the heat converts part of the carbon into graphite, and then separating the unconverted carbon from the graphite. The material is continuously fed into the furnace; and the product is continuously withdrawn at the bottom, which is water-jacketed to cool the product before discharge.

601,064—March 22, 1898. I. L. ROBERTS. *Process of preserving carbids.*

The interspaces of the carbide in a vessel are filled with dehydrated wheat chaff, and the vessel is then charged with a gas—as acetylene gas—which will not form an explosive mixture with acetylene generated in the vessel, and it is then hermetically sealed.

601,366—March 29, 1898. C. L. WILSON, C. MUMA, J. W. UNGER, H. SCHNECKLOTH, A. P. BROSIUS, AND J. C. KUCHEL. *Method of and apparatus for producing calcium carbid.*

The furnace pot or chamber is to be lined with granulated calcium carbide. Compressed sticks of pulverized lime and carbon, connected together, are fed into the arc of a furnace having the said lining.

602,872—April 26, 1898. J. W. RICHARDS AND C. W. ROEPPER. *Process of producing chemical compounds by electrolysis.*

An alternating current is passed through electrodes of similar composition immersed in an electrolyte, one or more of whose constituents forms alternately at each electrode, by electrolytic attack thereon, a compound partially derived from the consumption of that pole, which is insoluble in either the electrolyte or the products formed at the opposite pole for the time being; as, for example, with electrodes of metallic cadmium, in a 10 per cent solution of sodium hyposulphite, an insoluble sulphide of cadmium is formed, which is disengaged from the metal pole by the mechanical action of the bubbles of hydrogen and falls to the bottom.

602,747—April 19, 1898. C. K. HARDING. *Process of smelting phosphorus.*

A phosphoric oxide substantially free from lime is first made from a phosphatic base, and roasted in the presence of carbon until the combustible impurities have been consumed and substantially 2 parts of the oxygen has been smelted out. The phosphoric oxide remaining is mixed with carbon and subjected to the action of an electric arc developed within the mass of the material, and between a negative electrode and the material, in an atmosphere of hydrogen. A part of the carbon for the reaction is supplied in a fluid form, as gasoline, forced in through a hollow negative electrode.

Phosphatic material, as phosphatic rock, is treated with sulphuric acid to eliminate substantially all of the lime, and then roasted with carbon to eliminate the major part of the sulphur and smelt out a part of the oxygen.

602,873—April 26, 1898. J. W. RICHARDS AND C. W. ROEPPER. *Process of electrolytically manufacturing metallic sulfids.*

The metal or metals whose sulphide is desired—for example, cadmium sulphide—is employed as an anode in the electrolysis of a solution containing a hyposulphite salt—as sodium hyposulphite—the sulphide sought being formed from the anode and precipitated.

602,976—April 26, 1898. G. DE CHALMOT. *Process of producing silicids of iron*

The ferrosilicides of No. 602,975 are produced by subjecting a silicon compound with iron and carbonaceous matter (coke)—the silicon compound being in excess—to the heat of an electric furnace until the carbonaceous matter is eliminated and the silicon is reduced.

605,330—June 7, 1898. H. S. BLACKMORE. *Process of producing aluminum sulfid and reducing same to metallic state.*

Aluminum sulphide is produced by exposing aluminum oxide to the action of thio carbonate-of-alkali bases in a heated state. The electrolysis of a molten bath of sodium and potassium sulphides, using carbon anodes, produces thiocarbonates (sulphocarbonates). Alumina, converted by the bath into aluminum sulphide, is electrolytically decomposed and aluminum deposited.

606,981—July 5, 1898. W. S. ROMME. *Process of and apparatus for decomposing solid substances.*

Solid substances, as the chlorides of sodium and potassium, are electrolytically decomposed by continuously supplying the mass, placed between electrodes, in a solid, granular state, with such quantity of solvent as will be retained by the mass by capillarity without submerging the body.

607,646—July 19, 1898. P. MARINO. *Electrolytic bath.*

The process of electrolytic production of metals consists in adding to a solution of a salt of the metal to be deposited alkali metal salts of the same acid and an alkali-earth-metal salt of another acid in such quantity as to give, by an incomplete double decomposition, an insoluble precipitate and a mixed solution of different soluble salts of the metal to be deposited, and electrolyzing the mixed solution; an organic acid and an acid such as chlorhydric or sulphuric acid, capable of attacking the mineral, is added to the electrolyte, to facilitate the decomposition, and maintain a constant density in the bath; the mineral itself is used as the soluble anode. For example, a solution containing one equivalent of sulphate of magnesium is mixed with a solution containing less than one equivalent of chloride of barium, giving an insoluble precipitate of sulphate of barium in a solution of sulphate and of chloride of magnesium; the liquid forming an electrolyte for depositing magnesium.

607,943—July 26, 1898. H. MEHNER. *Method of producing ammonia.*

A mixture of coal and alkali or an alkaline earth-metal carbonate is heated in an electric furnace while air is caused to pass through the same, and the cyanide vapors produced escape at the zone of the electrodes into a receiver and are therein condensed upon a body of coal. Steam is then admitted to the receiver, decomposing the condensed cyanide into ammonia and alkali carbonate; the ammonia is led off and the alkalinized coal returned to the electric furnace and the operation continued. The receiver is above the furnace, so that the residual mixture of coal and alkali can fall into the furnace on opening a slide door.

609,864—August 30, 1898. M. P. WOOD. *Process of and apparatus for producing calcium carbide.*

The pulverized mineral and carbon with a suitable binder having been formed into cartridges, a number of the cartridges are subjected to the highest heat of a combustion furnace, an electric current being at the same time passed through each of the cartridges successively until it is melted down, when it is replaced with a new one. The cartridges are held in a vertical position and the initial contact and fusion occurs at the top of the cartridge.

612,009—October 11, 1898. G. B. BALDO. *Process of and apparatus for electrolyzing sea water.*

Two bodies of sea water are decomposed, in a three-compartment cell, at the anode and cathode, respectively, in presence of a body of fresh water on the opposite side of the cathode to the sea water, precipitating magnesium and calcium hydrates at the cathode and caustic soda in the fresh-water compartment. Chlorine gas is evolved at the anode, and subsequently the liquid of the anode compartment containing sulphuric acid is vaporized to one-fourth of its bulk, distilled, and the vapor collected as hydrochloric acid.

612,694—October 18, 1898. H. ASCHERMANN. *Process of simultaneously producing carbids and metals or alloys.*

A mixture of carbon with an oxygen compound and a sulphide of metals having different affinities for carbon is electrically heated. If nonvolatile, the uncombined metal sinks to the bottom of the mass; if volatile, its vapors can be collected. For example, a mixture of iron pyrites and lime and carbon treated in an electric furnace gives calcium carbide and metallic iron, with a greatly reduced consumption of current.

614,927—November 29, 1898. G. D. BURTON. *Process of and apparatus for separating metals and by-products from ores by electricity.*

Ore, under exclusion of air, is subjected to electric heat below the fusing point of the metals, to drive off the by-products, as sulphur. A gas containing oxygen is then admitted, causing combustion, and the ore is subjected to the combined heat of combustion and electricity at a temperature above the fusing point of the metals. With ores containing metals of different melting points, the temperature is first raised and maintained, by regulation of the current, above the fusing point of one and below that of the other, for melting out the low fusing metal, and the temperature is then raised to melt the remaining metal. The furnace has a hollow perforated electric-conducting shaft and spiral wings admitting air or gas to the charge.

614,929—November 29, 1898. G. D. BURTON. *Process of tanning hides or skins of animals.*

The hides are electrolyzed in a tanning solution; coloring matter is then added to the solution; and it is again electrolyzed.

614,930—November 29, 1898. G. D. BURTON. *Process of and apparatus for separating metals from ores by electricity.*

The ore is simultaneously subjected to pressure and the passage of a heating electric current, the pressure following the diminishing mass of ore. The furnace has perforated electrode plates, one of them movable, to clamp the ore mass between them; and a chamber below receives the molten metal.

616,139—December 20, 1898. G. H. POND. *Method of electrolytically treating straw or other fibrous material.*

Straw or like fibrous material for the manufacture of paper pulp is disintegrated in a heated solution formed by electrolyzing a solution of sodium chloride in the presence of calcium hydrate, allowing it to settle and drawing off the solution. After use, the solution is returned to the electrolyzing tank, reenforced with fresh sodium chloride, and the operation repeated.

616,988—January 3, 1899. B. S. SUMMERS. *Method of refining vegetable fiber.*

The material (ramie) is degummed and refined by subjecting the fibers to the action of a chemical bath containing a hydrate of an alkali metal, and then to the electro-chemical action of a bath containing a hydrate of an alkali metal and a soluble fluoride with a current of electricity passing therethrough.

617,979—January 17, 1899. E. G. ACHESON. *Method of manufacturing graphite articles.*

Articles containing a greater or less percentage of graphite, as brushes for electric motors, crayons, stove polish, crucibles, etc., are produced by forming the articles from a mixture of carbon and a metallic salt having a base capable of being reduced by and combining with carbon, and then subjecting them to a temperature sufficiently high to form and then decompose a carbide, thereby converting the carbon into graphite. The articles to be graphitized are embedded in the heating core of fine carbon of an electric furnace.

618,575—January 31, 1899. F. M. LYTE. *Method of and apparatus for producing chlorine; zinc, or other metals from mixed ores.*

Complex sulphide ores of zinc, usually carrying lead and silver, are ground and calcined at a low red heat to convert the zinc sulphide into zinc sulphate; the latter is extracted by lixiviation and converted into zinc chloride by treating with an alkaline chloride and refrigerating; the zinc chloride is concentrated and rendered anhydrous by heating it in the presence of metallic zinc, assisting the action of the zinc by electrolysis, in order to decompose the water of hydration, subsequently decomposing, first the zinc oxide and then the zinc chloride by electrolysis with a carbon anode and a cathode of fused metallic zinc for the production of chlorine and zinc; the lead and silver are recovered by smelting.

620,683—March 7, 1899. T. A. UEHLING. *Process of and apparatus for reducing and oxidizing salts.*

An electrolytic diaphragm of palladium, or a suitably supported layer or film of palladium, is used. Substances are electrolytically oxidized and reduced by the transferring of hydrogen from one compartment of an electrolytic cell to the other through a diaphragm, like palladium, that is nonporous, electrically conducting, and capable of absorbing and transmitting hydrogen, but not other elements, under the influence of the electric current.

623,691—April 25, 1899. C. E. ACKER. *Process of and apparatus for manufacturing alkali metals.*

The fused salt of an alkali metal is electrolyzed with a molten metal cathode (lead) with which the liberated metal will alloy, and a forced circulation is imparted to the molten metal to conduct the alloy as formed to a separate chamber, where it stratifies and then volatilizes—in an inert atmosphere in said chamber—the alkali metal out of contact with the electrolyte; the volatilized metal is then collected. The same body of inert gas circulating through the chamber assists in carrying off the volatilized metal.

623,692—April 25, 1899. C. E. ACKER. *Process of and apparatus for manufacturing metallic alloys.*

Following the process of No. 623,691, an alloy of the alkali metal with the heavy metal (as lead, tin, zinc, etc.) is made by flowing off the lighter portion from the surface of the metal in the separate chamber after it stratifies, the heavier portion circulating back into the electrolytic compartment.

624,041—May 2, 1899. C. B. JACOBS. *Process of manufacturing soluble barium compounds.*

Barium oxide is produced by heating in an electric furnace a mixture of barium sulphate and sufficient carbon to extract part only of the oxygen of the sulphate—for example, sulphate 20 parts and carbon 1 part—until sulphur dioxide ceases to escape.

625,918—May 30, 1899. E. BAILEY, G. R. COX AND W. T. HEY. *Process of and apparatus for producing white lead.*

An electric arc is formed at the surface of a body of molten lead, and the necessary gases or fumes—commingled steam, carbonic-acid gas, and acetic-acid fumes—are introduced through the upper electrode into the arc, the products conveyed away and the white lead caught.

626,330—June 6, 1899. C. LUCKOW. *Process of producing peroxid of lead.*

Lead anodes are used in an electrolyte containing from 0.3 to 3 per cent of the sodium, potassium, or ammonium salts of sulphuric acid in mixture with the sodium, potassium, or ammonium salts of chloric acid; the mixture should be about 99.5 per cent of the sulphuric-acid salt, and about 0.5 per cent of the chloric-acid salt. The process is continuous, air being blown in to facilitate the reaction and keep the electrolyte in motion.

626,331—June 6, 1899. C. LUCKOW. *Process of producing neutral chromate of lead.*

Neutral chromate of lead is produced by using a lead anode in the electrolysis of an aqueous solution containing from 0.3 to 3 per cent of the sodium, potassium, or ammonium salts of chloric acid in mixture with the sodium, potassium, or ammonium salts of chromic acid. The bath is maintained constant by the addition of water and chromic acid. The mixture should be about 80 per cent of the chloric-acid salt and 20 per cent of the chromic-acid salt.

626,547—June 6, 1899. C. LUCKOW. *Process of producing oxid of copper.*

Oxide of copper is produced by using an anode of copper in the electrolysis of an aqueous solution containing from 0.3 per cent to 3 per cent of the sodium, potassium, or ammonium salts of boric acid in mixture with the sodium, potassium, or ammonium salts of chloric acid. The mixture should be about 95 per cent of the boric-acid salt and 5 per cent of the chloric-acid salt.

626,635—June 6, 1899. G. SCHWAHN. *Process of reducing aluminium from its compounds.*

An aluminium compound is vaporized and the vapor subjected to the action of a hot carbon-gas deoxidizer in the presence of incandescent carbon for an appreciable length of time—not less than fifteen seconds—air being excluded. The mixed vapor and gas, which may contain fluorine as an admixture, may be passed through a carbon mass made incandescent by an electric current.

627,000—June 13, 1899. P. IMHOFF. *Process of making oxyhalogen salts.*

Oxyhalogen salts of the alkali metals are produced by electrolyzing (without a diaphragm) a solution of an alkali-metal chloride in which is suspended a metallic oxide, such as aluminic oxide or boron trioxide, which can act both as a basic and acid radical, thereby forming chlorine and an alkali-metal compound wherein said metallic oxide acts as the acid radical, and causing the chlorine to react upon such compound to form oxyhalogen salts of the alkali metal. The bath is regenerated with the metallic oxide.

627,002—June 13, 1899. C. LUCKOW. *Process of producing white lead by means of electrolysis.*

White lead is produced by using lead anodes in the electrolysis of an aqueous solution containing from 0.3 to 3 per cent of sodium, potassium, or ammonium salts of chloric acid in mixture with the sodium, potassium, or ammonium salts of carbonic acid. The bath is maintained constant by the addition of carbon dioxide and water. The mixture should be about 80 per cent of the chloric-acid salt and 20 per cent of the carbonic-acid salt.

627,063—June 13, 1899. P. IMHOFF. *Manufacture of oxyhalogen salts.*

Oxyhalogen salts of the alkaline chlorides, or other chlorides, are produced by electrolyzing—without a diaphragm—a neutral or alkaline solution of the chloride to which has been added an inorganic oxidizing salt of the oxygen acid—such as potassium chromate in the electrolysis of potassium chloride—thereby effecting a diminution in the reduction brought about by nascent hydrogen and a diminution of the decomposition of water.

627,266—June 20, 1899. C. LUCKOW. *Process of producing acid chromate of lead.*

Acid chromate of lead is produced by using lead anodes in the electrolysis of an aqueous solution containing from 0.3 to 3 per cent of the sodium, potassium, or ammonium salts of chloric acid in mixture with the sodium, potassium, or ammonium salts of chromic acid. The bath is maintained constant by the addition of water and chromic acid. The mixture should be about 80 per cent of one of the salts of chloric acid, and about 20 per cent of one of the salts of chromic acid.

627,267—June 20, 1899. C. LUCKOW. *Process of producing basic phosphate of copper by means of electrolysis.*

Basic phosphate of copper is produced by using copper anodes in the electrolysis of an aqueous solution containing from three-tenths to 3 per cent of the sodium, potassium, or ammonium salts of chloric acid in mixture with the sodium, potassium, or ammonium salts of phosphoric acid. The bath is maintained constant by the addition of water and phosphoric acid and air. The mixture should be about 80 per cent of the salts of chloric acid and 20 per cent of one of the salts of phosphoric acid.

628,806—July 11, 1899. W. S. HORRY. *Method of producing carbid of calcium.*

Electrodes of opposite polarity are arranged in a vertical position and adjacent to each other; the charge fed around the electrodes, and an electric current caused to flow between the electrodes, thereby forming an initial pool of carbide, the charge being kept around the electrodes of such depth as to retain a considerable portion of the heat generated and thereby maintain the pool of carbide in a melted condition until it spreads laterally beyond the field of reduction; the carbide and charge being shifted vertically with respect to the electrodes to bring successive portions of the charge into the field of reduction.

629,394—July 25, 1899. I. L. ROBERTS. *Process of reducing metallic compounds and producing metallic carbids.*

The mixture of the metallic compound and carbon is supported upon an incandescent conductor or conductors, which support the charge and fuse the material, the fused metal or carbides passing the conductor. The conductors form a grate (or an incandescent pan is used for volatile metals), the chamber below being closed in.

630,612—August 8, 1899. M. LE BLANC AND H. REISENEGGER. *Process of producing chromic acid by electrolysis.*

A solution of a chromium-oxide salt in an aqueous solution of the corresponding acid—as chromium sulphate in sulphuric acid—is placed in the anode and cathode compartments of a vessel coated with lead, provided with a diaphragm, and having lead electrodes, and electrolyzed. The chromic acid produced and the residual solution are removed from the anode compartment, and the solution previously in the cathode compartment is transferred to the anode compartment. The residual solution from the anode compartment is recharged with chromium sulphate and replaced in the cathode compartment, and the electrical operation begun again.

630,690—August 8, 1899. H. L. HARTENSTEIN. *Process of manufacturing metallic carbids.*

As a modification of the process of No. 596,749, finely powdered limestone is, along with the carbonaceous matter, diffused through the molten slag.

631,253—August 15, 1899. F. A. GOOCH. *Process of reducing aluminium.*

A bath is formed by fusing together fluorides of aluminium and of an alkaline metal, as sodium; adding to the bath in suitable quantity carbon disulphide together with alumina, and electrolyzing with a current of suitably low voltage.

631,468—August 22, 1899. C. KELLNER. *Method of and apparatus for producing alkali salts.*

A solution of a suitable substance is electrolyzed in a cell having a mercury cathode forming an amalgam, the amalgam being then transferred to a second cell, where it is decomposed by means of a suitable solvent while passing therethrough the electrolyzing current and the secondary current produced by metallically connecting the electrodes of the said second cell.

631,839—August 29, 1899. H. C. WOLTERECK. *Process of manufacturing white lead or other pigments by electrolysis.*

White lead is produced by using lead anodes in the electrolysis of a solution capable of dissolving lead and containing an alkali metal carbonate—as, for example, ammonium nitrate 9 to 12 parts, ammonium bicarbonate 1 part—maintaining the electrolyte at a temperature below 25° C.; continuously withdrawing the mixed electrolyte and precipitate, and removing the white lead therefrom by filtration. The filtrate is regenerated with carbon dioxide and returned to the vat. For metallic pigments or lakes (zinc white, copper greens, etc.), a suitable anode is used and an electrolyte capable of dissolving said anode and containing a reagent suitable to produce the precipitate.

633,272—September 19, 1899. T. PARKER. *Process of manufacturing chlorates by electrolysis.*

An aqueous solution of an alkali-metal chloride is electrolyzed in a cell without a diaphragm, with a current density of about 20 amperes per square foot; the solution being covered with a layer of buoyant nonconducting material, as pumice stone or cork, to scrub the disengaged gases.

634,271—October 3, 1899. H. PLATER-SYBERG. *Process of extracting acetic acid from alkaline acetates.*

For producing the alkaline acetates, wood and mosses, rich in carbohydrates, may be boiled in a highly concentrated alkaline lye, air being injected into the mass, the temperature not going above 130° C. The process consists in first separating the acetic acid from the alkaline acetate by electrolysis cold in a trough provided with a positive electrode of iron or other equivalent metal, and a porous diaphragm, (the anode may be broken cast iron or iron shavings, and the anode compartment is lined with insulating material; the diaphragm being formed of two perforated sheet-iron plates, with the interspace packed with amianthus fiber); then in transforming the ferrous acetate into a ferric acetate by oxidizing with air; next, in acting under the influence of heat upon this ferric acetate with neutral acetate of potash; and finally in decomposing by heat the biacetate thus obtained into acetic acid and neutral acetate of potash, which serves to decompose fresh quantities of ferric acetate.

636,234—November 7, 1899. E. BAKER. *Process of and apparatus for electrolytic decomposition of saline solutions.*

A film of mercury flows continuously from a higher to a lower level beneath a column of the saline solution, in the electrolytic cell, thereby forming an amalgam, which, in its outflow, passes out of the cell and up in a substantially vertical direction until its column counterbalances the fluid head of the saline solution.

637,410—November 21, 1899. G. H. POND. *Process of and apparatus for dissociating substances by electrolysis.*

A soluble salt is packed between two vertical electrodes, and a saturated solution of the same salt is continuously fed by capillary attraction to the inner face of each electrode, and the electric current passed through the electrodes, the descending films of saturated solution, and the packed material.

641,552—January 16, 1900. M. RUTHENBURG. *Process of agglomerating comminuted ores or concentrates.*

Finely comminuted ores or concentrates are partially fused by the passage of an electric current through the mass until the contiguous corners of the particles cohere, producing a coherent body of open porous structure.

642,023—January 23, 1900. G. N. VIS. *Process of purifying brine.*

Brine is purified by passing therethrough an electric current not sufficient to decompose the calcium and magnesium salts present, but sufficient only to produce sodium hydroxide by decomposing part of the sodium chloride, allowing the sodium hydroxide to decompose the calcium and magnesium salts; and then removing the redissolved portion of calcium hydroxide by means of carbonic acid.

642,081—January 30, 1900. G. D. BURTON. *Process of unhairing animal hides or skins.*

They are electrolyzed in an unhairing solution, the current entering the solution and passing out away from the hides, and of sufficient volume to raise the hair and permit circulation through it.

642,390—January 30, 1900. F. P. VAN DENBERGH. *Process of making sulphuric acid.*

Calcium sulphate or gypsum, or other sulphur-bearing material, with or without a flux, is subjected to heat and electrolysis produced by an electric current in an electric furnace and applied directly to the material while in a molten state, and in the presence of an excess of oxygen, thereby forming sulphur oxides which are subsequently hydrated.

644,050—February 27, 1900. H. BECKMANN. *Manufacture of lead peroxid and its application to electrical storage batteries.*

The production of lead peroxide, particularly as a coating for the electrodes of storage batteries, by introducing metallic lead into a solution of sulphurous acid, or of a salt that in conjunction with an acid will generate sulphur dioxid, and adding a suitable acid, and subjecting the lead as a positive electrode to the action of an electric current.

644,510—February 27, 1900. E. F. FROST. *Process of electrical reduction.*

Chemicals or nonconducting ores are reduced by passing them into an electric arc formed between an electrode and an aqueous electrolyte, as acidulated water. For carbide of calcium the aqueous electrolyte floats on a substance that has no chemical affinity for the carbide and is not a solvent of water, as bisulphide of carbon, heavy oils, or coal tar.

644,779—March 6, 1900. J. W. RICHARDS AND C. W. ROEPPER. *Process of manufacturing metallic carbonates by electrolysis.*

An anode of the metal whose carbonate is to be formed—for example lead, in the manufacture of white lead of commerce—is used in the electrolysis of a salt of an organic acid—as acetate of sodium—either with or without an oxidizing reagent—such as sodium sulphite—whereby carbonic acid is generated at the anode, forming therewith a carbonate, while the oxygen evolved from the oxidizing reagent, if used, forms with the anode metal a hydrated oxid, intermingled with the carbonate.

645,284—March 13, 1900. E. G. ACHESON. *Method of electrically treating materials.*

The working faces of a pair of electrodes are arranged within the slope of a pile of material to be treated; fresh material is continuously supplied to the apex of the pile and the treated material delivered from the bottom

645,285—March 13, 1900. E. G. ACHESON. *Method of manufacturing graphite.*

Anthracite coal, or other noncoking coal, is heated to a high temperature by passing electricity through the coal and generating the heat electrically within the same, until it has been progressively converted into graphite. The coal is made the heating core of an electric furnace. The process is applicable to carbonaceous matter, the pieces or particles of which contain inherent impurities capable of forming carbides, but less in amount than enough to convert the whole of the respective pieces into said carbides, and naturally distributed with substantial uniformity in the piece, and which can be heated to a charring temperature without destroying the relative positions of the carbon and such associated impurities.

648,119—April 24, 1900. E. VIELHOMME. *Process of manufacturing rich ferro-chromium.*

Chromite is subjected to the heat of an electric furnace in the presence of a flux and pulverized coke, the temperature being sufficient for the reduction and the volatilization of most of the iron, producing a rich chrome iron.

648,439—May 1, 1900. A. J. ROSSI. *Process of producing alloys of iron and titanium.*

A bath is formed of a molten reducing metal, the heat of the formation of whose oxide is at a given temperature greater than that of titanic acid, as for example aluminum. Iron is added thereto and melted, and titanic acid is supported therein, a temperature being developed in the charge sufficiently high to insure the reaction between the reducing metal and the oxygen of the titanic acid, and the alloying of the titanium with the iron.

648,463—May 1, 1900. R. I. KNAUR, H. W. BUCK, AND C. B. JACOBS. *Process of abstracting silicon from silicious materials.*

Silicious material is heated to incandescence in an electric furnace and water gas is then forced therethrough, the silicon hydrid being led off as a gas. Aluminum silicate so treated leaves as a residue an aluminous product ($Al_2\ SiO_5$) of value as an abradent.

649,565—May 15, 1900. C. E. ACKER. *Process of manufacturing caustic alkali and halogen gas.*

A molten salt of an alkali metal is electrolytically decomposed in contact with a molten lead cathode, forming an alloy of lead and the alkali metal, and the molten cathode is caused to circulate in continuous flow past an anode, or series of anodes, out of the furnace compartment and into a second compartment—steam being forced into the molten body below its surface to effect the circulation—and back into the furnace compartment, where it again takes up alkali metal. In the second compartment hydrogen and molten alkali separate from the lead or alloy and are severally removed from circulation. The feed of fresh salt is melted by burning the resulting hydrogen, and heat energy is also conserved by the heat of combination of the alkali metal with the oxygen of injected steam.

650,040—May 22, 1900. E. W. ENGELS. *Fire and acid proof material and process of making same.*

A brick or slab of refractory material is covered with carborundum and then subjected to electric heat sufficient to make an intimate fusion of the coating with the material of the brick.

650,234—May 22, 1900. F. A. J. FITZGERALD. *Process of making carborundum articles.*

Carborundum is compressed in the desired form and then recrystallized by heating in an electric furnace to or about the temperature required for the formation of silicon carbide. An adhesive material, as a glue solution, may be mixed with the carborundum, and if the article is to be an electrical conductor graphite is mixed therewith.

650,536—May 29, 1900. A. HOUGH. *Process of manufacturing substances resembling mannite.*

An aqueous solution of glucose is electrolyzed in the negative compartment of a double cell having a porous partition, in conjunction with water in the positive compartment, and subsequently evaporated down to obtain the solid material, having the formula of $C_6H_{14}O_6$.

651,167—June 5, 1900. J. E. HEWES. *Manufacture of carbid of calcium.*

Horizontal and parallel electrodes, capable of being longitudinally adjusted, are used beneath a mass of the raw material, together with an armature—a block of carbon—to start the current. After the formation of product is started by means of the armature, the latter is removed and the circuit completed through the fused material, the electrodes being longitudinally adjusted as required, and the solidified product withdrawn from beneath the mass and away from the ends of the electrodes.

651,396—June 12, 1900. E. A. G. STREET. *Production of chromium oxid.*

A solution of an alkali metal chromate or bichromate is electrolyzed at a temperature of about 70° C., using a mercury cathode, resulting in the precipitation of the whole of the chromium as hydroxid.

651,718—June 12, 1900. H. LELEUX. *Method of electrically treating ores of nickel, etc.*

For the electric smelting of nickel, cobalt, silver, lead, and copper ores without preliminary roasting or fusion, a furnace is used having electrodes of a metal whose heats of combination with the nonmetallic constituents of the ore containing the metal to be liberated are higher than the heats of the said metal to be liberated. The electrodes are in contact with the ore, and the electric current brings the ore to such a temperature as to cause the suitably chosen metal of one of the electrodes to unite, by exothermic reaction, with the metals that are associated with the particular metal to be liberated. Thus, for the smelting of a nickel ore, the hearth electrode is of cast steel, water cooled below, and faced with nickel. For argentiferous galena or a complex ore of copper, nickel, or analogous metals combined with sulphur, arsenic, or antimony, the electrodes are of iron.

652,761—July 3, 1900. J. B. ENTZ. *Electrolytic production of caustic soda, etc.*

The mercury cathode of an electrolytic cell is subjected to the influence of a magnetic field to cause it to circulate and transfer the amalgam or deposited substance out of the electrolytic cell and into a depositing compartment.

652,846—July 3, 1900. J. HARGREAVES. *Process of purifying and strengthening brine for use in electrolytic cells.*

The weakened brine withdrawn from the electrolytic cell is caused to circulate, by means of a steam jet, upward through a mass of impure salt in a sealed vessel, and then back to the cell.

652,877—July 3, 1900. R. C. BAKER. *Process of obtaining hardening or toughening compounds for alloying with iron or steel.*

The boride of a metal capable of use as a hardening or toughening agent for steel and other metals (ferro-boron, nickel-boron, chromium-boron, or tungsten-boron) is obtained simultaneously with calcium carbide by subjecting a mixture of calcium borate, carbon, and a material containing such metal to heat sufficient to effect the reaction, as in an electric furnace. The boride compound is obtained in a fused mass, and may be run off, with the calcium carbide above it.

653,716—July 17, 1900. J. T. VAN GESTEL. *Process of waterproofing fabrics.*

For the purpose of setting the dye or rendering the fabric waterproof, the fabric is impregnated, in a bath, with a soluble metallic salt capable of yielding an insoluble oxide upon electrolysis, and the wet fabric is then placed between nonoxidizable electrodes and an electric current passed therethrough. In fixing a dye, the metallic salts are mingled with the dye in the goods under the influence of the electric current, thereby acting as a mordant; or a fabric already dyed may be treated as for waterproofing.

653,739—July 17, 1900. W. M. JEWELL. *Process of purifying water.*

An insoluble coagulent is continuously formed (ferrous hydrate) by electrolytically decomposing a solution of a suitable salt (sodium chloride), in which is immersed an anode composed of a substance (iron) adapted to combine with one or more of the constituents separated by the electrolytical decomposition, which coagulent as formed is introduced into the water to be purified, and the water filtered.

655,239—August 7, 1900. T. JESPERSEN. *Process of bleaching by electrolytic chlorin water.*

It consists in electrolyzing a dilute solution of hydrochloric acid, using an immersed anode and a surface cathode, bleaching in the same tank with the resulting chlorine water and thereby restoring hydrochloric acid to the solution; and again electrolyzing as before, all being simultaneous and continuous.

656,156—August 14, 1900. W. S. HORRY. *Method of producing carbid of calcium, etc.*

The zone of reduction is formed between the ends of vertically depending electrodes, the charge being maintained around and above the electrodes to a depth sufficient to oppose the upward passage of evolved gases, which escape laterally by the path of least resistance. The product mass is automatically lowered, as formed, to bring successive portions of the charge into the zone of reduction.

656,599—August 21, 1900. R. DOOLITTLE. *Process of manufacturing carbids.*

A mixture of the carbide materials is showered down a closed vertical shaft through a flame formed by gas or oil burners near the top, and then through a zone of increased temperature formed by a number of superimposed electric arcs, the gases being drawn off below the electric furnace.

656,982—August 28, 1900. E. D. KENDALL. *Electrolytically treating scrap tin.*

An aqueous solution of a nitrate of an alkali metal or nitrate of an alkaline earth metal is electrolyzed, using scrap tin plate as the anode, and the nitrate transformed into a nitrite; sodium or other nitrate is added as required, and finally the strong solution is evaporated and the nitrite salt recovered therefrom, which may be used for the preparation of fertilizers. The stannic oxide and any metallic tin is utilized for the production of sodium stannate or otherwise.

See Group XVIII for other methods and processes for the production of such bodies as are also produced electrolytically.

APPARATUS.

102,478—May 10, 1870. I. ADAMS, JR. *Improvement in the electro-deposition of nickel.*

A nickel anode combined with carbon is used to prevent the formation upon the anode of peroxide of nickel.

310,533—January 6, 1885. B. MOEBIUS. *Apparatus for the electrolytical separation and deposition of metals.*

Adjustable brushes or scrapers are provided with means for moving them along the surface of the electrodes, together with other structural details specially applicable to the electrolysis of metals.

312,803—February 24, 1885. C. S. BRADLEY. *Electrical conducting material.*

See Group XV, Rubber and Rubber Substitutes.

312,814—February 24, 1885. H. R. CASSEL. *Apparatus for treating metals by means of electrolysis.*

It includes an anode cell constructed in part of porous material and in part—as the bottom—of nonporous material, for containing material to be subjected to electrolytic action; besides features specially applicable to the electrolysis of metals.

319,945—June 9, 1895. E. H. & A. H. COWLES. *Electric smelting furnace.*

An elongated horizontal chamber has oppositely located electrodes in conductive relation to the charge but otherwise insulated from one another. The lining is of granular nonheat-conducting material of less conductivity than the charge.

335,058—January 26, 1886. A. H. COWLES. *Electric furnace and method of operating the same.*

The electrodes are introduced into the charge in proximity to each other, and caused gradually to recede—to obtain a uniform action of the electric current—until the mass of the charge is contained between them, the same remaining in contact with both electrodes.

335,059—January 26, 1886. E. H. & A. H. COWLES. *Electric furnace for metallurgic operations.*

The lining for an electric furnace consists of finely divided charcoal mixed with finely divided refractory material of low conductivity, as lime.

360,144—March 29, 1887. E. H. & A. H. COWLES. *Electric furnace.*

An incandescent electric furnace has charge-feeding mechanism automatically controlled by the electric resistance of the charge. The feed to and discharge from the zone of fusion is through tubular electrodes.

382,183—May 1, 1888. J. OMHOLT. *Apparatus for producing metals by means of electrolysis.*

A reverberatory furnace has half-retorts supported a short distance above its floor, an electrode in each half-retort, and a tube establishing communication between each half-retort and a chamber below. The bottom edges of the half-retorts being immersed in the molten halogen combinations are thereby sealed, and the light metals collecting on the upper surface of the molten mass pass into the bottom chamber in a fluid state or as a gas and are collected.

391,034—October 16, 1888. H. H. EAMES. *Device for refining metallic ores.*

Retorts have electrodes extending their entire length to electrolyze the charge when heated.

403,752—May 21, 1889. J. C. HOBBS. *Method of operating electric furnaces.*

The charge of an incandescent electric furnace is enveloped or covered with sawdust, the furnace chamber being lined therewith.

410,976—September 10, 1889. G. KERNER AND J. MARX. *Diaphragm for electrolytic apparatus.*

It consists of a liquid inclosed between two or more partitions having perforations of considerable size, too large to act osmotically by themselves. The liquid must not be in the same state as the osmotical and endosmotical liquids, and it is constantly or at intervals renewed.

428,378—May 20, 1890. E. A. COLBY. *Electric furnace for melting metals.*

The material is heated by inductively established electric currents in metal of a refractory mass. (Process No. 428,552.)

428,379—May 20, 1890. E. A. COLBY. *Electric induction device.*

A refractory conducting receptacle constituting a closed secondary circuit is heated by induced currents from a primary circuit. (Process No. 428,552.)

442,203—December 9, 1890. I. L. ROBERTS. *Separating-diaphragm for electrolytic cells.*

A nonporous diaphragm of a relatively high electrolytic resistance; preferably composed of a gelatinous substance, as a gelatinized solution of silicate of soda and water of about 18° Baumé, held by supporting walls.

442,204—December 9, 1890. I. L. ROBERTS. *Diaphragm for electrolytic cells.*

It is formed of asbestos freed from soluble constituents. Asbestos board and asbestos cloth are sewed together within a cloth case, treated with muriatic acid, rolled, kneaded, washed, and pressed.

442,332—December 9, 1890. I. L. ROBERTS. *Electrolytic apparatus.*

A nonporous diaphragm or partition is used, composed wholly or in part of a body capable of acting as an electrolyte; it permitting such decompositions and recombinations to take place as are essential to the electrolytic action. Preferably a cup, plate or sheet of earthenware is soaked in an aqueous solution of alum, then immersed in an alkali solution, such as caustic soda, until the pores are filled with a gelatinous mass.

442,333—December 9, 1890. I. L. ROBERTS. *Apparatus for use in electrolysis.*

Two or more electrolytic partitions of nonporous material (No. 442,332) are employed, forming compartments for the electrodes, with one or more bodies of electrolytic or conducting paste interposed between the partitions.

442,334; 442,396; 442,594—December 9, 1890. I. L. ROBERTS. *Electrolytic apparatus.*

In apparatus for the electrolysis of saline solutions and the manufacture of caustic alkali, encasing jackets for the anodes, or porous partitions, are used formed of anthracite coal or coke in the condition of impalpable powder, which is a barrier to the mechanical transfusion of fluid, but permits of the transference of the acid radical to the anode.

450,103—April 7, 1891. E. A. LE SUEUR. *Electrolytic apparatus.*

A vegetable parchment diaphragm is employed in an electrolytic cell, for saline solutions; placed below the positive electrode whereby it is preserved from contact with the gases formed at said electrode.

455,451—July 7, 1891. E. A. LE SUEUR. *Diaphragm for electrolytic cells.*

The diaphragm, specially adapted for the electrolysis of alkaline chlorides, consists of a layer, sheet, or film of albumen which has been dried and coagulated by heat. It may be combined with a sheet of paper or other supporting material.

464,096—December 1, 1891. L. GRABAU. *Apparatus for obtaining metals of the alkalis from molten chloride.*

A bell-shaped pole-cell is constructed with double walls, with the inclosed chamber open at the top, so that conductivity can take place through the walls thereof.

465,369—December 15, 1891. L. GRABAU. *Production of insulating coatings or linings in electrolytic apparatus.*

A bell-shaped pole-cell having double walls encompasses one of the electrodes of a fused bath, the pole-cell having means for causing a cooling agent to circulate therethrough, whereby the fused mass in contact with the pole-cell is congealed and forms a protective crust thereon.

469,428—February 23, 1892. C. N. WAITE. *Diaphragm for electrical cells.*

The diaphragm, specially adapted for the electrolysis of highly corrosive liquids, consists of a dense and compact layer, sheet, or film of a metallic albuminate. A sheet of albumen is formed, dried so as not to coagulate the albumen, and dipped in a solution of metallic or earthy salt, such as tartrate of antimony, chloride of tin, or sulphate of alumina, forming an insoluble albuminate of the metal.

473,117—April 19, 1892. P. HÉROULT. *Electrode for use in electro-metallurgical processes.*

It consists of a plurality of carbon strips secured together in a single block and a metal combined therewith and extending substantially the entire length of the electrode. The metal is adapted to lower the electrical resistance of the electrode, and it should be the same as one of the normal constituents of the useful products of the desired operation.

473,393—April 19, 1892. P. L. T. HÉROULT. *Electrode.*

It is built up of carbon blocks or slabs fitted together and secured by pins or clamps to a metal plate or plates extending the entire length of the electrode. The metal should be such as can enter into the product.

482,586—September 13, 1892. T. PARKER. *Electric furnace.*

Relates to details of auxiliary electrodes to heat the charge between fixed electrodes and start the furnace.

489,551—January 10, 1893. C. N. WAITE. *Electrical diaphragm.*

It consists of a sheet or layer of asbestos or other acid-resisting fibrous material and bichromatized gelatine. Bichromate of potash dissolved in a glue solution may be mixed with asbestos fiber and a sheet formed thereof, which is dried and exposed to sunlight, or treated in a bath of hyposulphite of soda.

494,585—April 4, 1893. W. MITCHELL. *Means for electrically heating crucibles.*

A crucible has opposite sections of electrically conducting material with an intermediate insulating strip, made, for example, by cutting a plumbago crucible on the line of its axis and interposing a strip of asbestos. It is grasped by a holder which establishes electrical connection with its opposite conducting sides.

494,586—April 4, 1893. W. MITCHELL. *Apparatus for electrically heating crucibles.*

A receptacle for crucibles is formed of conducting end sections of electrically high resistance, an interposed U-shaped insulating strip, and a filling of pulverized conducting material. An inclosed crucible may be attached to and removable with the said strip.

495,600—April 18, 1893. G. O. RENNERFELT. *Electrolytic apparatus.*

A bell-shaped cathode, having an exterior of nonconducting material, is employed with a suction pipe connected with the interior of the cathode, whereby, in the electrolysis of a fused bath, the metal set free at the cathode can be removed by suction.

503,451—August 15, 1893. W. E. CASE. *Apparatus for electrolysis of fused salts.*

A containing vessel for the electrolysis of fused salts has an inner wall of electrically nonconducting material, and an outer surrounding envelope therefor and a bottom both of electrically conducting material, with the envelope and bottom insulated from one another. The lining or inner wall and insulation is formed of fused or solidified salt.

504,282—August 29, 1893. S. SHAW. *Apparatus for melting iron.*

It relates to special details, particularly of feed mechanism for electrodes for a cupola furnace.

504,308—August 29, 1893. S. SHAW. *Apparatus for melting iron or iron ore.*

A cupola furnace has a concave base and electrodes introduced at the lower end of the vertical side walls, said furnace chamber having a central narrowed passage opening into a receiving chamber below, the latter chamber having discharge openings at different elevations, and hinged bottom doors or traps.

504,703—September 12, 1893. A. BREUER. *Electrolytic diaphragm.*

A porous diaphragm capable of resisting the action of caustic bodies, formed of a cement that will set at normal temperatures when combined with a suitable liquid in due proportions, and of a porous substance capable of resisting the reaction of an electrolyte, as comminuted pumice stone, combined with and mixed throughout the body of cement.

507,374—October 24, 1893. F. M. LYTE. *Electrode.*

A hollow carbon electrode, closed at the bottom, has a core of metal or alloy (to reduce the electrical resistance), which is fusible at or below the working temperature of the fused bath.

508,084—November 7, 1893. A. BREUER. *Diaphragm used in electrolytical processes.*

It is formed of a cement adapted to harden or set when combined with water, and of a substance or body soluble or destructible in a liquid which can be removed after the cement has set, leaving the diaphragm porous.

512,602—January 9, 1884. C. L. COFFIN. *Furnace for heating or working metals electrically.*

It relates to details of an electric forge. A pipe coil in the bed or hearth conducts hot air or gas into the arc.

513,270—January 23, 1894. A. F. W. KREINSEN. *Process of and apparatus for melting metals by means of electricity.*

Relates to details of a cap or cover for a crucible, which cover carries a carbon electrode and an electrode of the metal to be melted.

513,602—January 30, 1894. E. THOMSON. *Electric furnace.*

It consists of carbon bars or slabs, in an electric circuit, packed in powdered carbon in a chamber of nonheat-conducting material, with a receptacle for the material to be heated set in the powdered carbon.

513,661—January 30, 1894. C. T. J. VAUTIN. *Electrolytic cell.*

A mercury electrode is supported by a nonconducting reticular mesh or sieve or perforated plate.

518,065—April 10, 1894. C. HOEPFNER. *Electrolytical apparatus.*

The diaphragm is constructed of a nitrated organic substance, which may be strengthened with one or more auxiliary diaphragms. Paper, textiles, or the like may be treated with nitric acid or nitrating gases, or a coating of nitro-cellulose is applied, or paper-pulp or asbestos, etc., may be combined with nitro-cellulose and diaphragms formed thereof.

518,135—April 10, 1894. H. Y. CASTNER. *Electrolytic apparatus.*

In an electrolytic cell or apparatus where a certain portion of the substance circulates between communicating compartments, as mercury and sodium amalgam, for the relinquishment of its sodium in the reduction of a solution of sodium chloride, the cell is periodically rocked to cause the mercury to flow from one compartment to another and back again.

522,614—July 10, 1894. I. L. ROBERTS. *Electrolytic diaphragm.*

It is composed of an insoluble nonconducting pulverized substance mixed with a gelatinizable silicate. A paste formed of powdered anthracite coal and a solution of silicate of soda or potash is molded into the desired shape, temporarily supported, and gelatinized by electrolytic action.

523,026—July 17, 1894. C. N. WAITE. *Diaphragm for electrolytic cells.*

It consists of a film, sheet, or fabric of asbestos or like indestructible material with a layer of sand or like comminuted material overlying it.

523,262—July 17, 1894. G. A. CANNOT. *Apparatus for the manufacture of chlorin monoxid.*

Apparatus for the carrying out of process No. 523,263.

530,019—November 27, 1894. C. L. COFFIN. *Box of furnace for electric heating apparatus.*

Relates to structural details of a furnace box or chamber.

530,479—December 4, 1894. G. A. GOODSON. *Apparatus for casting molten material.*

The metal is kept fluid in transmission through a pipe connecting the casting pot and the mold by an electric current sent through the pipe and its metal contents.

531,143—December 18, 1894. J. W. WOODFOLK AND J. C. WHARTON. *Apparatus for electric heating, smelting, and separating.*

Relates to minor details of a furnace having a circulation of acidified water.

533,596—February 5, 1895. H. A. HOUSE. *Apparatus for refining metals by electrolysis.*

A rotary segmental cathode is partially immersed in the electrolyte, and a scraper removes the film of metal from the cathode above the solution, the segment of the cathode in engagement with the scraper being insulated.

537,009—April 9, 1895. G. D. BURTON AND E. E. ANGELL. *Method of and apparatus for electric metal-heating.*

An electric forge having electrodes adapted to receive and support a connecting bar of iron and heat it by its electric resistance.

538,271—April 30, 1895. H. G. O'NEILL. *Electrically and chemically heated crucible.*

A mixture of diatomaceous earth and carbonaceous material is used as the heating body of an incandescent electric furnace. The receptacle has a resistance wound around it as an auxiliary heater.

544,153—August 6, 1895. W. BORCHERS. *Vessel for electrolytic separation.*

A vessel (constituting the cathode) for the electrolytic treatment of metals—as the formation of lead sodium alloy in the electrolysis of fused chloride of sodium—has numerous superimposed grooves on its interior face and a bottom discharge opening, whereby the material exposed to electrolytic action flows downwardly from one groove to another.

546,328—September 17, 1895. C. HOEPFNER. *Anode for electrolytic apparatus.*

An anode, with a surface of a compound of silicium and another conductive metal in such proportions (*in minimo* 10 per cent silicium) as to be proof against the action of liquids or gases, particularly chlorine. It is made wholly or in part of ferro-silicium; if of carbon, it may be coated or plated with ferro-silicium.

546,364.—September 17, 1895. D. TOMMASI. *Apparatus for extracting, separating, and refining metals by electrolysis.*

Polarization is prevented by using a rotating cathode disk composed of a mixture of carbon and oxide of copper, partially immersed in the electrolyte. The disk is formed of removable segmental sections.

548,162—October 15, 1895. J. HARGREAVES AND T. BIRD. *Combined diaphragm and electrode.*

A permeable electrode, as wire gauze or perforated metal, has directly secured thereto a face of fibrous material and an insoluble binding agent, superposed on which there may be a layer of porous stone-like material, such as cement.

551,014—December 10, 1895. J. A. VINCENT. *Electric smelting furnace.*

The material is forced by a positive horizontal feed through a horizontal channel way and between electrodes, forming in part the walls of the channel, into a discharging pit.

552,341—December 31, 1895. J. A. VINCENT AND J. E. HEWES. *Electric smelting furnace.*

It has a removable electrode bottom to the hearth with an adjustable upper electrode and feeding devices for the material.

556,038—March 10, 1896. M. H. WILSON. *Electrolytic apparatus.*

To avoid the rapid destruction of electrodes, as by caustic soda and chlorine in the electrolysis of a saline solution, the electrode is formed of a relatively small stream or column of water which serves as a conducting medium through which the electric current enters or leaves the solution.

556,626—March 17, 1896. A. C. GIRARD AND E. A. G. STREET. *Electric furnace.*

A heating chamber has a longitudinal passage extending through it, a tubular cylinder for containing the material to be heated, with means for feeding the cylinder through said passage, an electrode projecting into the heating chamber, and connections to establish an arc between the electrode and the said cylinder.

558,357—April 14, 1896. M. R. CONLEY. *Electrical furnace.*

A melting pot or vessel made of a carbon composition electrically heated by its resistance has integral arms or opposite sides to which the electrical connections are made.

562,400—June 23, 1896. W. R. KING AND F. WYATT. *Electric furnace.*

An arc furnace with a hollow vertical upper electrode has a feed tube extending down within the said electrode.

562,403—June 23, 1896. W. R. KING AND F. WYATT. *Electric furnace.*

Appliances for carrying out the process of No. 563,402 and handling the carbide nugget.

562,404—June 23, 1896. W. R. KING. *Electric furnace.*

A plurality of upper electrodes, preferably arranged in a ring, each adjustable and all carried by a common adjustable frame, form a plurality of arcs with a common hearth electrode. There is a central feed and a deflector to throw the material into the field of the several arcs.

565,953—August 18, 1896. E. ANDREOLI. *Apparatus for indirect electrolysis.*

For the indirect electrolysis of solutions the cell has three compartments formed by two porous diaphragms; the middle section to contain the solution to be treated (e. g. sodium bisulphite), and also a series of perforated plates, and the end sections positive and negative electrodes and suitable solutions (e. g. caustic potash and sodium chloride, respectively).

567,699—September 15, 1896. J. A. VINCENT. *Electric smelting furnace.*

An upright furnace chamber open at top and bottom has a vertically movable floor, positive down feed for material, and side electrodes with automatic feed. The material is forced down between the electrodes and the smelted product feeds down with the floor.

568,177—September 22, 1896. N. TESLA. *Apparatus for producing ozone.*

Apparatus for the production of ozone by the action of high-tension electrical discharges, involving the combination with a circuit of direct currents, of a controller for making and breaking the same, a motor included in or connected with said circuit so as to increase its self-induction and driving the said controller, a condenser in a circuit around the controller, and a transformer through the primary of which the condenser discharges.

568,229—September 22, 1896. H. BLACKMAN. *Electrode.*

An anode for use in electrolytic decomposition, consisting of a dense impermeable mass of combined electro-conductive iron oxide and a flux, as, for example, the residue from pig-iron furnaces known as "black slag."

568,230—September 22, 1896. H. BLACKMAN. *Electrode for electrolytic decomposition.*

An anode consisting of a casting of ilmenite, with a small proportion of fluxing material.

568,231—September 22, 1896. H. BLACKMAN. *Electrolytic anode and apparatus.*

An anode for electrolytic decomposition, consisting of electro-conductive oxide of iron in a dense impermeable mass, as, for example, magnetite.

569,122—October 6, 1896. A. A. NAVILLE AND P. A. & C. E. GUYE. *Electrical gas-reaction apparatus.*

The apparatus for the treatment of gases comprises a series of independent insulated tubes interposed in line between two electrodes of an electric circuit, with gas conduits communicating with the inside and outside of the several tubular electrodes. It is applicable to the production of nitric acid by means of moist air circulating in an apparatus with the electrodes made of coal, and the production of acetylene gas by means of hydrogen in such an apparatus.

569,221—October 13, 1896. R. G. G. MOLDENKE. *Apparatus for melting metals.*

A regenerative or other crucible furnace has a sloping platform for the charge and an electric arc at the foot of the slope to supplement the heating. An electro-magnet deflects the arc onto the charge.

570,133—October 27, 1896. W. DE C. MAY. *Apparatus for electrolytic deposition.*

The apparatus, for the electrolytic treatment of material in a fine state of subdivision, comprises a series of superimposed pans, the bottom of each extending down into the immediately subjacent one, and each with an overflow for the electrolyte into the next pan of the series. Each pan contains a layer of the material to be treated, and the electrolyte is returned from the bottom to the top pan in continuous flow.

571,665—November 17, 1896. A. C. GIRARD AND E. A. G. STREET. *Electric furnace.*

An electric furnace has a carbon tube or casing for the material, said tube being interposed, as a common electrode, between one or more electrodes to produce arcs outside of the tube. The hearth is below the tube.

572,312—December 1, 1896. E. F. PRICE. *Electric furnace.*

It has an inclined electric hearth with means for adjusting the inclination, and a range of perpendicular adjustable electrodes, with the material fed down around them. Casings around the electrodes—there being intervening feed spaces—have flues for escaping gases.

572,472—December 1, 1896. H. Y. CASTNER. *Anode for electrolytic processes.*

A graphitized carbon electrode; produced by submitting a shaped electrode of gas-retort or like carbon to the intense heat produced by passing an electric current therethrough while it is protected from the air. The disintegration of the carbon in a bath by the combined action of oxygen, chlorine, and water is materially reduced as the carbon approaches the graphitic variety.

573,041—December 15, 1896. M. SCHINDLER. *Electric furnace.*

Relates to details of a cooled holder for a furnace electrode.

575,826—January 26, 1897. J. A. DEUTHER. *Electric furnace.*

The upper suspended electrode of an arc furnace is vibrated, and the material is fed onto the bottom electrode and within the arc path as the upper electrode swings to and fro.

575,829—January 26, 1897. J. JOYCE AND J. A. DEUTHER. *Electric furnace.*

The bottom electrode is laterally displaced, at intervals, to expose part of its surface, but not to break the arc, and the material is automatically fed onto the exposed surface of the electrode.

577,317—February 16, 1897. F. J. PATTEN. *Electric furnace.*

A plurality of incandescent carbon pencils are successively thrown into circuit in rotation—to give a diffusion of heat—by means of a liquid commutator; a rotating switch operates in an acidulated water bath.

577,370—February 16, 1897. F. J. PATTEN. *Electric furnace.*

The material is passed between electrodes, and the arc is reciprocated transverse to the path of material by a magnetic field, the current of the magnetic field or of the electrodes being alternated.

577,493—February 23, 1897. F. J. PATTEN. *Electric furnace.*

The furnace has a central vertical carbon core, and numerous lateral carbon pencils radiating from it, through the charge mixture, to the walls and to independent leads. The current is sent in succession or in groups through the pencils.

578,073—March 2, 1897. H. BLUMENBERG, JR. *Porous diaphragm.*

Asbestos, formed into the desired shape, is treated with acid to remove the metallic salts and toughen it. A binding material is then forced into the pores of the asbestos under high pressure, and it is then baked at a high temperature, which changes it from a fibrous to crystalline state.

579,324—March 23, 1897. W. S. HADAWAY, JR. *Electric furnace.*

Relates to details of a muffle electrically heated by incandescent outer packing, with a hydrocarbon gas injected therethrough, which gas is decomposed, and the hydrogen gas burnt in the outer shell of the muffle.

582,721—May 18, 1897. J. A. DEUTHER. *Electrode.*

Relates to structural details.

582,923—May 18, 1897. A. E. HUNT. *Electrolytic apparatus.*

To protect workmen attending the several pots or vessels connected in series of an electrolytic apparatus, a metal platform is provided for each pot or vessel in electrical connection therewith and maintained at the same electrical potential as the pot.

583,249—May 25, 1897. A. H. COWLES. *Electric furnace and method of operating same.*

The material is heated by internally generated heat, and a gas, or gas and air, is periodically passed therethrough in opposite directions.

583,250—May 25, 1897. A. H. COWLES. *Electric furnace.*

A furnace chamber has gas-pipe connections and valves, and bodies of broken carbon through which the gas passes on entering and leaving the furnace chamber. (See No. 583,249.)

583,513—June 1, 1897. W. SPILKER. *Electrolysis of watery salt solutions.*

A membrane, serving as a foundation, is used in the electrolysis of an alkaline cathode solution from an anode solution consisting of a mixture of the chlorides of the alkali metals and calcium holding the corresponding oxyhydrate—caustic lime—in solution, which causes a solid porous coating to be attached to the foundation membrane on the side of the anode space.

583,618—June 1, 1897. H. ELDRIDGE, G. H. WRIGHT, AND D. J. CLARK. *Vacuum electric-arc furnace.*

The furnace has a cylindrical pot cathode and a hollow cylindrical anode adjustably supported within an arcing distance; also means for sealing the chamber and other details.

583,936—June 8, 1897. E. F. PRICE. *Electric furnace.*

The furnace has an inclined hearth electrode with an adjusting screw for one end, a range of upper electrodes with a surrounding water-cooled hopper, stirrers for loosening the charge below the hopper, and other structural details.

585,040—June 22, 1897. C. G. P. DE LAVAL. *Method of melting iron by means of electricity.*

The melting chamber has a transverse bridge with pole pieces at the bottom of the pockets on each side of the bridge, and outlets for molten metal in the sides above the bottoms of the pockets. The path for the current is through the material over the bridge.

585,387—June 29, 1897. C. KELLNER. *Electrolytical diaphragm.*

It is composed of a slab of soap, which may have a reenforcing backing.

586,686—July 20, 1897. R. F. S. HEATH. *Electric furnace.*

It has a stationary upper electrode offset with respect to the axis of the furnace, and a rotary pot electrode, together with structural details.

586,687—July 20, 1897. R. F. S. HEATH. *Electric furnace.*

Means are provided for rotating vertically and laterally adjustable carbons around the axis of the furnace, the hearth constituting the other electrode.

586,822—July 20, 1897. F. J. PATTEN. *Electric furnace.*

The furnace has electrodes and passages for conveying material through the arcing space between the electrodes, such as a lower carbon-slab electrode and an upper tubular electrode; and means for rotating the arc about the axis of the upper carbon, as, for example, a magnetizable ring surrounding the arcing space with means for creating a rotating magnetic field in said ring.

586,824—July 20, 1897. F. J. PATTEN. *Electric furnace.*

A homogeneous mass of material of low and uniform conductivity is heated by passing an electric current through the mass and establishing around it a rotating magnetic field transverse to the current flow in the mass. The lines of current flow are deflected by the magnetic field and the rotation of the deflected lines of flow widens the body of heated material.

587,182—July 27, 1897. G. DE CHALMOT. *Electric furnace.*

The hearth is given a horizontal reciprocatory movement to facilitate the feeding of granular material into the arc. The carbon holder, of special construction, has separable lining plates to receive the wear of any contact arc and protect the holder.

588,267—August 17, 1897. G. DE CHALMOT. *Electric furnace.*

The furnace discharges its overflow product upon a sand-sprinkled revolving cylinder. The overflow wall, formed of the furnace product, is renewed by increasing the heat and partially fusing it down, then supplying additional material and reducing the heat until sufficient has congealed against the wall to build it up.

588,866—August 24, 1897. J. W. KENEVEL. *Means for manufacturing carbids.*

The furnace employs rotatable electrodes arranged in a horizontal plane (like a pair of rollers) with mechanism for rotating the same, and means for feeding the prepared material between the electrodes.

590,826—September 28, 1897. J. D. DARLING. *Porous diaphragm for electrolytic apparatus.*

It consists of a support having a granular filling of a vitrified oxide or oxides substantially resistant to combination or fluxing by a fused hydroxide under the conditions of electrolysis. Magnesia or other earthy oxides, as those of calcium or barium, may be fused in an electric furnace, crushed, and granulated to pass a twenty-mesh sieve.

592,802—November 2, 1897. N. MARCHAL. *Electric diaphragm.*

It consists of a plate cut from limestone, or is formed of equivalent integral natural alkaline-earth carbonate, as of a paste of pulverized limestone and burned magnesia, compressed.

595,712—December 21, 1897. J. E. HEWES. *Electric furnace.*

The furnace has an upper suspended electrode, a regulator for the same, and means for imparting thereto a longitudinally reciprocating motion whereby the furnace becomes self-stoking and the agitation prevents crystallization of the carbide.

597,476—January 18, 1898. T. L. WILLSON. *Electric furnace.*

A feed flue delivers material against the side of an upright movable carbon pencil. A removable crucible hearth having an outer flange, has a circuit-connecting clamp of special form engaging with said flange.

597,880—January 25, 1898. W. S. HORRY. *Electric furnace.*

A bottomless hopper has inclined electrodes supported on the walls of the hopper, and a rotatable receptacle (a spool-like structure) arranged below said hopper with plates removably applied to the periphery of the receptacle (spool) and forming the outer wall of the hearth.

597,945—January 25, 1898. C. S. BRADLEY. *Electric furnace.*

The furnace is carried by a wheel turning on a horizontal axis, giving a continuous downward movement of the charge relative to the electrode, by a movement of rotation. Removable rim sections form the receptacle for the charge, which is continuously fed in on one side of the periphery, and the product removed on the other.

598,318—February 1, 1898. J. E. HEWES. *Electric furnace.*

The material is laterally fed from a supply chamber into the field of the electrodes by a reciprocating rammer, the latter being controlled by fluctuations in the current.

601,367—March 29, 1898. C. L. WILSON, C. MUMA, J. W. UNGER, H. SCHNECKLOTH, A. P. BROSIUS, and J. C. KUCHEL. *Electric furnace for manufacturing calcium carbid.*

The furnace has a base electrode and an upper vertically movable electrode having a number of longitudinal flues extending therethrough with a like apertured block of insulating material superposed. The charge, in the form of sticks of compressed lime and carbon, is fed into the flues of the upper electrode, the sticks resting on the base electrode.

602,815—April 19, 1898. G. G. CLARK. *Electric furnace.*

Relates to details of construction, including a revoluble pot electrode and a scraper for feeding the material inward toward the arc.

603,058—April 26, 1898. H. ELDRIDGE, D. J. CLARK, and S. BLUM. *Electrical retort.*

Relates to structural details of an apparatus for making hydrogen from water by heat of an arc and electrolytic action.

609,745—August 23, 1898. W. G. LUXTON. *Diaphragm for electrolytic purposes.*

It is made of a composition of cement, sand, and a porous material, such as gypsum, lime, coke, etc., mixed with water and allowed to set; the diaphragm having pores through the substance of the porous material and interstices between the cement and the other constituent particles due to the contraction of the cement in drying or setting.

611,142—September 20, 1898. R. PIGNOTTE, F. LORI, S. REGNOLI, M. BESSO, AND M. PANTALEONI *Electric furnace.*

It relates to the structural details of a furnace involving, with other details, a carbon-bottom electrode having an opening closed with a lever-operated carbon plug, a suspended electrode, feeding mechanism, and a gas-heated chamber for preheating the material.

612,943—October 25, 1898. L. BRESSON. *Electric furnace.*

A crucible having axial openings for electrodes and carrying a feed hopper can be tilted to discharge its load. Inwardly projecting electrodes are coupled by levers which permit of a parallel vertical movement of their extremities and maintenance of the arc as the charge rises in the crucible.

616,906—January 3, 1899. J. A. DEUTHER. *Electric furnace.*

Relates to special details, including a fan to supply the material to the arc and telescopic wall sections.

618,391—January 31, 1899. H. BOVY. *Electric furnace.*

The furnace has an inclined floor formed of a series of carbon block electrodes with intermediate filling of carbon powder. These electrodes are made incandescent by the flow of the current through to upper electrodes and the charge.

621,908—March 28, 1899. H. H. DOW. *Porous diaphragm for electrolytic cells and method of producing same.*

The diaphragm is composed of two layers; that on the cathode side composed of a chemical substance that will consume halogens by chemical action, and the layer on the anode side composed of a different chemical substance that will not be consumed by free halogen and containing a substance with which any soluble alkali diffusing from the cathode side will readily combine chemically (e. g., iron hydrate on the anode side and calcium and magnesium hydrates on the cathode side). Two part diaphragms, in cells for the electrolytic production of chlorine, are formed wholly by the action of electrolysis on the cell contents, by electrolyzing a solution containing sodium, magnesium, and calcium chlorides, and introducing into the neighborhood of the anode a soluble iron salt, whereby the hydrates of iron, calcium, and magnesium are precipitated to form in place a coherent porous diaphragm.

625,252—May 16, 1899. H. ELDRIDGE, D. J. CLARK, AND S. BLUM. *Electric furnace.*

Relates to structural details, including a fume-collecting hood.

628,782—July 11, 1899. J. J. FAULKNER. *Electric furnace.*

It relates to structural details, including a normally stationary electrode and a series of opposing electrodes with specific means for automatically adjusting each of the latter, including spring-actuated plungers. A tilting hearth is mounted beneath the electrodes.

629,008—July 18, 1899. O. FRÖLICH. *Apparatus for distilling metals or similar substances.*

An electric crucible furnace has a tubular electrode and a condensing chamber carried by and above the same. The material surrounds the tubular electrode and condensing chamber which receives the distilled metals, the molten products being tapped off below.

630,283—August 1, 1899. W. BORCHERS. *Method of and apparatus for utilizing waste gases and heat from electric furnaces.*

The furnace, or a series of electric furnaces, are incased in a steam generator, each furnace having a dust filter for the gases generated.

630,966—August 15, 1899. L. K. BÖHM. *Carbid furnace.*

It relates to details of the furnace pot or carbide tank, which has bottom grooves in which fit ribs of a supporting plate, to facilitate the withdrawal of the pot.

636,956—November 14, 1899. F. G. CURTIS. *Process of making battery cups.*

Clay is mixed with a solution of water and hydrate of potassium and an electric current passed through the mixture, reducing the clay from a granular state to a powder paste by reason of the hydrogen being set free. It is then molded into cups and baked.

641,276—January 16, 1900. J. D. DARLING. *Porous diaphragm for cells employing fused electrolytes.*

It consists of a suitable support and a filling of Portland cement and a powdered oxide substantially resistant to combination or fluxing by the fused electrolyte, as ground-burned magnesite.

641,438—January 16, 1900. J. D. DARLING. *Electrolytic apparatus.*

In an electrolytic apparatus using a porous diaphragm with a metallic wall, a small percentage of the current—say 5 per cent—is shunted through the wall of the diaphragm, by connecting it with the positive pole, to prevent destructive electrolytic action.

641,976—January 23, 1900. R. H. LAIRD. *Down-draft electrical furnace.*

A water-jacketed furnace stack has a series of spirally arranged, downwardly inclined electrodes.

643,254—February 13, 1900. A. J. PETERSSON. *Electric furnace.*

The electrodes are at the ends of a flat hearth and covered by the reduced material so that the heat is developed by the resistance of the reduced material, and the unreduced material is reduced solely by contact therewith. The hearth chamber may be movable, and an upper chamber has flues within the charge which receive and burn the generated gases.

647,614—April 17, 1900. M. RUTHENBURG. *Electric furnace.*

A quadrilateral bosh, open at top and bottom, laterally incloses the opposed electrodes; and a crucible directly beneath the bosh has an overflow outlet at its top.

651,916—June 19, 1900. J. ZIMMERMAN AND I. S. PRENNER. *Furnace for producing calcium carbid.*

The charge, supported by a strip (stiff paper) that is projected coincident with the feed of the material, is continuously fed into the horizontal arc of an electric furnace. Compressing and feed mechanism is provided for the mixed lime and carbon and feed for the traveling flexible support.

652,611—June 26, 1900. J. HARGREAVES. *Combined diaphragm and electrode.*

A stratified diaphragm-electrode, dense as to one side and porous as to the other, is formed by covering wire cloth or perforated plate with a thin layer of clay or equivalent material adapted temporarily to perform a retentive function and ultimately to be dissolved or washed away, then applying a coating of Portland cement or like hard or dense material to one face, and covering the latter with asbestos cloth or equivalent soft or porous material.

654,463—July 24, 1900. H. LELEUX. *Electric furnace.*

Relates to details of the attachment of the vertical electrode to its hanger, the electrode being formed of cores of carbon of high conductivity surrounded by agglomerated carbon of lower conductivity.

654,467—July 24, 1900. J. MACTEAR. *Furnace for heating and treating gaseous mixtures.*

The apparatus has a chamber with a removable cover and bottom, and gas inlet and outlet flues, a catalytic substance contained in the chamber, and refractory tubes depending from the cover with electrical resistances within the tubes.

655,779—August 14, 1900. W. S. HORRY. *Control of electric furnaces.*

An electrically controlled motor actuates the movable member of the furnace, as the movable receptacle, and an electro-mechanical device under the control of the furnace circuit controls the motor to keep the amperes constant, a switch being provided for controlling the motor by hand and for cutting in and out the said electro-mechanical devices.

655,780—August 14, 1900. W. S. HORRY. *Electric furnace.*

Relates to mechanism for controlling the movable element in response to predetermined variations in the furnace circuit, and keeping the furnace current approximately constant.

656,600—August 21, 1900. R. DOOLITTLE. *Means for manufacturing carbids.*

A smelting furnace for the process of No. 656,599.

656,930—August 28, 1900. W. BORCHERS. *Electric furnace.*

The furnace has an inclined water-jacketed column for the product below the hearth, a supporting roller for the carbide core, and a chisel for breaking up the carbide.

657,736—September 11, 1900. W. S. HORRY. *Electric furnace.*

A carbide furnace having a vertically movable bottom to support the product and charge, and means for clamping and temporarily holding the column of finished product to allow for the removal of the bottom portion thereof and the running up of the furnace bottom; thus permitting a continuous downward feed and delivery.

657,911—September 18, 1900. G. D. BURTON. *Apparatus for separating metals from ores by electricity.*

The reducing chamber has a cylindrical body of electro-conductive resistance material resting on a flat electrode which forms the bottom of the chamber and from which it can be lifted to deliver the charge, the other electrode clamping the chamber under a projecting flange.

658,315—September 18, 1900. A. H. COWLES. *Electric furnace.*

The electric furnace chamber is flanked by two fuel chambers and means is provided for causing a reversing flow of gas through hot-blast stoves, the fuel chambers, and the electric furnace.

GROUP XI.—DYESTUFFS AND EXTRACTS.

NATURAL, INORGANIC.

557,325—March 31, 1896. G. D. BURTON. *Art of and apparatus for electro-dyeing.*

See Group X, Electro-chemistry.

557,324—March 31, 1896. G. D. BURTON. *Art of electric dyeing.*

See Group X, Electro-chemistry.

NATURAL, ORGANIC.

951—September 27, 1838. L. KENT. *Improvement in the mode of extracting color from dyewood.*

The ground wood is leached with steam, the liquor being drawn off into a boiler, the steam therefrom returned into the wood, and the coloring matter dried.

4,192—September 13, 1845. F. PFANNER. *Improvement in preparation of dyestuff from spent madder.*

Dyestuff or carasene is obtained from spent madder by the chemical action of water, sulphuric acid, and an alkali.

50,495—October 17, 1865. G. H. REED. *Improved preparation and manufacture of dyes and colors.*

Liquid dyes from vegetable or mineral coloring matters, so mixed and prepared with concentrated mordants as to endure heat and cold and keep without change, and to dye silk or wool at one application.

74,935—February 25, 1868. A. PARAF. *Improved process of separating coloring matter from madder and other plants.*

The coloring matter is liberated from the ligneous matter by the solution of the cellulose, as by steeping the madder root in aqueous ammonia in the presence of metallic copper, and the separation of the coloring matter from the insoluble compounds formed. The sugary matter is first removed by successive washings.

76,107—March 31, 1868. C. SEIDEL. *Improved vegetable coloring matter.*

An indelible vegetable fluid consisting of the pigment of the cashew nut in a menstrum solvent, as oil of turpentine.

81,992—September 8, 1868. C. E. & M. E. FOX. *Improved dyestuff.*

The extract of manzanita, a red coloring matter, obtained by crushing and boiling the roots.

83,182—October 20, 1868. J. LIGHTFOOT. (*Reissue: 3,647—September 28, 1869.*) *Improvement in printing certain textile fabrics and yarns.*

The indigo preparation is modified, by employing much less tin, whether as oxide or in the state of salt, in the process of dissolving the indigo; and, in connection with such modified preparation, carbonate of potash, alkaline silicates, or the chemical equivalents of them are used in simultaneously fixing indigo blue or green, or both, in juxtaposition with ordinary madder mordants.

86,047—January 19, 1869. T. WEBER. *Improved indigo dye.*

A dyeing compound obtained by dissolving the hydrated oxide of tin and common indigo in caustic lye.

86,939—February 16, 1869. A. PARAF. *Improved process of extracting the coloring matter of madder.*

The coloring matter is extracted from madder root by treatment with water at a high temperature—150° C.—and it is then precipitated from the liquid.

93,900—August 17, 1869. A. PARAF. *Improved material for dyeing and printing, obtained from madder.*

Tinctorine, the coloring matter of madder root, combined with fatty or resinous matters, and free of pectic acid or its compounds, produced according to No. 86,939.

95,039—September 21, 1869. A. PARAF. *Improved extract of madder for dyeing and printing.*

A compound extract of madder (as tinctorine, No. 93,900), with an alkaline base and a volatile acid, such as the acetate of potash or acetate of lime, which will decompose after printing and permit the alkaline base to develop the color.

97,497—December 7, 1869. J. GEE. *Improved process of dyeing black.*

The fabric is first run through a mixture of extract of logwood and sulphate of copper, and is then treated with the sizing material mixed with bichromate of potash. For fabrics which have to be sized twice, the logwood and sulphate of copper is mixed with sizing.

99,496—February 1, 1870. G. W. TALBOT. *Improvement in dyes for coloring wool.*

A dye for coloring is produced by combining extracts made from domestic barks, woods, or plants with the foreign dyes, such as fustic, madder, nutgalls, logwood, etc., producing a dye having less stringent power than the domestic extracts alone and more permanence than the foreign dyes.

109,489—November 22, 1870. S. BORDEN. *Improvement in the preparation of garancine.*

The coloring matter contained in garancine is eliminated by the combined or separate action of hard soap and chlorate of potash.

110,994—January 17, 1871. A. PARAF. *Improvement in material called "Oleizerine," for dyeing and printing.*

A new compound of the coloring matter of madder with oily matter, prepared by treating garancine with petroleum in which paraffine has been dissolved. A caustic-soda solution is added to cause the coloring matter to separate from the hydrocarbon solvent, and it is precipitated with an acid.

110,995—January 17, 1871. A. PARAF. *Improvement in processes of extracting the coloring matter of madder.*

The coloring matter of madder is extracted by means of a liquid hydrocarbon.

113,918—April 18, 1871. A. PARAF. *Improvement in products from madder.*

"Oil-izarine," produced by treating garancine with a hydrocarbon, such as kerosene, and consisting of a solution of the coloring matter of madder within insoluble matter.

117,520—August 1, 1871. F. GRAUPNER. *Improvement in compounds for dyeing.*

A combination of sulphate of copper, muriatic acid, and zinc. Added to a dye of logwood and catechu, it dyes cotton black.

120,392—October 31, 1871. A. PARAF. *Improvement in compositions of madder for dyeing.*

Alizaride, a compound of the coloring matter of madder with a neutral alkali and with ammonia.

134,694—January 7, 1873. G. MOLT. *Improvement in indigo-blue vats for coloring wool and cotton.*

Indigo is dissolved in a composition formed by mixing a solution composed of lime and soda ash, with a solution composed of muriate-of-tin crystals and soda ash.

134,876—January 14, 1873. L. G. FELLNER. *Improvement in the extract of yucca.*

The yucca root is ground, steeped in water, and pressed, and the solution evaporated to dryness in molds, or melted in forms. Yuccatin cleanses skins, hair, and wool without destroying their softness.

139,056—May 20, 1873. F. A. GATTY. *Improvement in dyeing madder colors.*

Cotton fabrics or yarns are treated with neutral soap or emulsions of fatty acids, or of oils or fats, either saponified or in their natural state, in lieu of dunging.

139,573—June 3, 1873. F. G. GRAUPNER. *Improvement in dyeing fabrics.*

Oxyduloxyd of iron, or anvil dust, is combined with muriatic acid as a base for dye. It is combined with quercitron and logwood to form a black, slate, or drab dye.

167,360—August 31, 1875. J. S. SELLON AND R. PINKNEY. *Improvement in dyeing and printing.*

A dyeing or printing compound, consisting of the salts or compounds of vanadium and animal dyeing or printing materials, such as cochineal.

169,377—November 2, 1875. W. H. SEAMAN. *Improvement in processes for testing the purity of dye in black silk thread or fabrics.*

A fixed quantity of the black silk thread or fabric is treated in a chemical liquid, of which oxalic acid is the base to ascertain the purity of the dye.

175,829—April 11, 1876. W. H. FISH. *Improvement in dyes.*

An indigo-dye aqueous solution, composed of indigo and zinc dust, together with bisulphite of soda and caustic soda.

179,939—July 18, 1876. G. MOLT. *Improvement in blue dyes.*

It is composed of indigo, 1 pound; caustic potash, 2 pounds; and water enough to dissolve; heated to boiling point, with 2¼ pounds of oxalere, 5 pounds of liquid ammonia, and 2 pounds of sal ammoniac.

210,280—November 26, 1878. E. & H. WELLS, A. E. RICHARDSON, AND W. J. VAN PATTEN. *Improvement in refining and packing catechu.*

Refined and concentrated catechu, incased in a tight integument, is made by liquefying with water and heat, introducing steam of a high temperature, skimming, straining, and settling, and drawing off, while still liquid, into boxes, preferably of paper.

220,638—October 14, 1879. G. MOLT. *Improvement in compound dyes.*

An indigo dye, consisting of indigo (XX), 50 pounds; caustic soda, 25 pounds; tin crystals, 5 pounds; and a sirup made by boiling hops, madder, bran, and molasses in water.

240,467—April 19, 1881. G. SCHWARZWALD. *Composition for printing textile fabrics.*

It consists of powdered almond shells, water, hydrochloric acid, coloring matter, gelatine, oxidized metal powder, and bichromate of potassa.

272,499—February 20, 1883. H. W. VAUGHAN. *Method of preparing dyestuffs for application to fibrous materials.*

The coloring matter, with or without a mordant, is ground with an oleaginous constituent, as paraffine oil, and a pulverulent material is then incorporated therewith, to enable the mass to be worked in a finely powdered condition.

276,061—April 17, 1883. A. M. MEINCKE. *Dyeing compound.*

It consists of corn meal, highly concentrated cudbear, indigotine, acid magenta, wool orange, and imported cudbear.

282,971—August 14, 1883. C. D. EKMAN. *Method of obtaining coloring matters.*

The raw vegetable material is boiled under pressure in a solution containing sulphurous acid and a base or alkali, as soda.

306,434—October 14, 1884. M. E. SAVIGNY. *Process of making extracts for dyeing, etc.*

Tannic woods or plants colored yellow are crushed and boiled with an oil or fatty body saponified with an alkaline solution or with a soap solution, the clear liquor being drawn off and evaporated.

306,435—October 14, 1884. M. E. SAVIGNY. *Dyeing extract.*

A soap extract from yellow-colored tannin woods or plants of a yellowish-brown color and brittle texture; the product of process No. 306,434.

308,706—December 2, 1884. M. E. SAVIGNY. *Dyeing extract.*

An acid extract produced from so-called "red-colored tannic woods and plants" by disintegration and fermentation or oxidation with acids. A soap extract is secured from the residue, or in conjunction with the fermentation or acid oxidation in one operation.

320,526—June 23, 1885. C. E. AVERY. *Process of preparing logwood extract.*

Logwood liquors, or extracts of the same, after their extraction from the wood and before they are mingled with the necessary mordants, are oxidized by the formation of hæmatein from hæmatoxylin by the action of oxidants, such as solution of bleaching powder, hypochlorous acid, chloric acid, chlorates or nitrates of the alkalis, and alkaline earths.

338,431—March 23, 1886. A. MORAND. *Art of clarifying extracts.*

An alkaline solution of caseine is mingled with the acidulous tannin or like extract in sufficient proportions to neutralize the free acid, and the precipitate separated from the clarified extract.

356,368—January 18, 1887. J. A. MATHIEU. *Manufacture of dyestuffs.*

In the manufacture and purification of lac dyes, the material is treated with turpentine or other solvent; the residuum treated with water and an alkali; neutralized with an acid; the precipitation completed by the addition of acetate of lead; and the precipitate treated with dilute sulphuric acid.

386,933—July 31, 1888. F. E. SCHMÜCKERT. *Process of preparing a solution of indigo for dyeing purposes.*

A woad-bath for dyeing with indigo is prepared by mixing guano salts with water, adding zinc dust and indigo, or other bodies having an affinity for oxygen, and then heating the mixture.

417,492—December 17, 1889. W. W. MACFARLANE. *Process of preparing logwood extracts.*

Logwood extract is treated with free chlorine, as a gas or in solution, to increase its dyeing power.

437,638—September 30, 1890. A. AINSWORTH. *Indigo solution.*

A solution for reducing indigo for dyeing purposes is prepared by saturating a solution of sodium bisulphite with metal filings, separating the liquor, adding sodium sulphide till the formation of precipitate ceases, filtering, and adding caustic soda.

443,026—December 16, 1890. F. C. WEISS. *Dye.*

The material is steeped in dilute anacardin extract, then pressed as hard as possible, then treated to a hot bath of bichromate of potassium, then washed in cold water, and then subjected to the ordinary indigo-dyeing process.

456,773—July 28, 1891. T. B. OSBORNE. *Process of extracting zein.*

The nitrogenous remainder, after the manufacture of cornstarch from Indian corn, is treated with a solvent of zein, as alcohol partially diluted with water. The solution is then evaporated to a sirupy consistency and poured into water.

491,972—February 14, 1893. P. T. AUSTEN. *Coloring matter from logwood and mode of preparing same.*

An alkaline nitrite is added to logwood extract in the presence of water, causing a reaction between the nitrite and the extract, and the product is evaporated to dryness. It is characterized by being a friable solid, soluble in cold and rapidly soluble in hot water.

492,368—February 21, 1893. P. T. AUSTEN. *Solid coloring matter from fustic and process of preparing same.*

An alkaline nitrite is added to fustic extract in the presence of water, causing a reaction between the nitrite and the extract, and the product is evaporated to dryness. It is characterized by being a friable solid, soluble in hot or cold water.

494,237—March 28, 1893. P. T. AUSTEN. *Process of curing logwood chips.*

The chips are moistened by sprinkling with an aqueous solution of nitrite of soda, or potash, or other suitable nitrite, well mixed and dried.

508,592—November 14, 1893. P. T. AUSTEN. *Obtaining friable coloring matter from dyewood extracts.*

A solid friable extract of logwood, produced by adding ammonium carbonate to a slightly warmed logwood solution, say 7 per cent, allowing the reaction to take place, and evaporating to dryness.

509,703—November 28, 1893. A. TAYLOR. *Process of making extracts from the redwood tree.*

The bark and wood of the redwood (*Sequoia sempervirens*) is comminuted, steeped in water and a caustic alkali or a carbonate of an alkali, the alkali neutralized, and the solid matters obtained.

542,403—July 9, 1895. P. T. AUSTEN. *Process of making coloring matter from logwood.*

A small proportion of borax, say 2 per cent, is dissolved in hot dilute logwood extract, which is then cooled sufficiently to cause a precipitation of coloring matter, which is then separated and dried.

558,718—April 21, 1896. H. L. BREVOORT. *Art of fixing dyes in fabrics.*

See Group X, Electro-chemistry.

610,282—September 6, 1898. W. T. SCHEELE. *Process of making coloring extracts.*

Ketones having their boiling point between 80° and 227° C., as ethylmethyl, diethyl, dipropyl, butyl, etc., are used as solvents for the extraction of the coloring principle from vegetable substances.

637,707—November 21, 1899. F. E. BUCHER. *Process of treating logwood extracts.*

Vapors of peroxide of nitrogen, preferably diluted with air, are passed through logwood liquors or extracts containing hæmatoxylin, whereby the hæmatoxylin is converted into hæmatein.

640,061—December 26, 1899. E. S. WILSON. *Dye from cottonseed oil.*

Cottonseed oil is heated with an alkaline solution, the solution separated from the oil and treated to remove the impurities, and then the coloring matter is precipitated from the solution by an acid.

ARTIFICIAL, INORGANIC.

441—October 28, 1837. H. STEPHENS. (*Reissue 3—April 21, 1838.*) *Improved manufacture of coloring matter.*

See Group VI, Ferrocyanides.

2,060—April 24, 1841. J. D. PRINCE. *Improved mode of producing a black color in the operation of dyeing.*

Arsenious acid is used in combination with sulphate of iron, as a mordant.

3,068—May 2, 1843. H. HIBBARD. *Improved mode of preparing and using compounds in dyeing, etc.*

Mordants are used in conjunction with logwood liquor:

No. 1. Sulphate of iron, muriate of soda, and hydrate of lime, 1 pound each.

No. 2. Sulphate of iron, 1 pound; sulphate of copper, muriate of soda, 8 ounces each.

No. 3. Sulphate of iron, sulphate of copper, 1 pound each; nitrate of potash, muriate of ammonia, 8 ounces each.

No. 4. Sulphate of zinc, 2 pounds; muriate of soda, 4 ounces; and sulphate of iron, sufficient to sadden.

No. 5. Sulphate of iron and of aluminium, 1 pound each.

No. 6. Bar or yellow soap, 2 pounds; litharge, 1 pound; and water, 2 quarts, boiled fifteen minutes.

9,890—July 26, 1853. F. G. VETTERCKE. *Compound to produce a liquor for coloring kali blue.*

Four pounds of prussiate of potash in 3 gallons of boiling water is prepared in a receiver, and 5 pounds of manganese and 4 pounds of common salt in a retort, to which is added a mixture of vitriol and water previously prepared, and the retort connected with the receiver and allowed to stand for six hours, when the retort is heated for six hours. The receiver is then disconnected and sealed up ready for use, the contents of the same constituting the "kali compound."

72,817—December 31, 1867. J. H. DILKS. *Improved process of making soluble bluing for use in laundries and bleaching.*

A mixture of ferrocyanide of potassium, 100 pounds, and sulphuric acid, 40 pounds, in water, is added to a solution of 10 pounds of iron in 40 pounds of nitric acid, and boiled until a violent action takes place, then washed free from acid, pressed, and dried.

73,756—January 28, 1868. J. REYNOLDS. *Preparation of dyes.*

Yellow prussiate of potash, dissolved in hot water, is treated with chlorine gas, but not more than will prevent precipitation.

87,270—February 23, 1869. A. LEYKAUF. *Improvement in the manufacture of colors.*

A violet color is produced by heating a compound of manganese with phosphoric acid and ammonia; the addition of iron gives a light blue color.

88,291—March 30, 1869. E. HARRSCH. *Improvement in the manufacture of colors and pigments.*

Colors or dyes are extracted from franklinite ores—their residues or ores containing oxide of zinc, manganese and iron—by treating with dilute sulphuric acid and then precipitating with various reagents.

88,793—April 13, 1869. J. LORY. *Improved hair dye.*

A compound of nitrate of silver, ammonia liquor, and lac-sulphur in distilled water.

95,040—September 21, 1869. A. PARAF. *Improved process of printing colors on textile materials.*

The textile material is printed with the coloring material, then a compound of an alkali and volatile acid is applied—as acetate of lime, potash, or soda—and it is then steamed to liberate the alkali.

110,277—December 20, 1870. A. PARAF. *Improvement in the manufacture of colors and their application to fabrics.*

Colors are applied to fibrous and textile articles by means of coloring matter and a coloring liberating salt of a class possessing certain characteristics, viz.: They are mineral salts; do not contain lime; alkaline or neutral, not acid; do not produce a chemical compound with the coloring matter; the acid of the salt makes an insoluble compound with the base of the mordant; and they liberate the coloring matter from the other vegetable matter.

192,491—June 26, 1877. H. D. DUPEE. *Improvement in mordanting textile fabrics.*

Coloring matters upon textile fabrics are mordanted by means of gelatine combined with chromic acid, and subjected to the action of steam.

202,822—April 23, 1878. R. HOFFMAN. *Improvement in manufacture of ultramarine colors.*

The blue or (so-called) white ultramarine, or mixtures of the same, while heated to 120° to 200° C., is exposed to the action of the vapors of acids derived from the halogen group of elements—as hydrochloric acid—and the soluble salts afterwards washed out. Blue is first converted into violet, and by continuation of the treatment into red ultramarine.

207,093—August 13, 1878. J. ZELTNER. *Improvement in manufacture of red ultramarine.*

Red ultramarine is produced by the action of nitric acid upon violet ultramarine or ultramarine hydrate.

207,836—September 10, 1878. J. ZELTNER. *Improvement in manufacture of violet ultramarine.*

Violet ultramarine, or ultramarine hydrate, is produced by the reaction upon blue or green ultramarine, or mixture thereof, of an oxidizing reagent, as chlorine, and water.

213,189—March 11, 1879. L. GRAF. *Improvement in the manufacture of prussian blue.*

A solution of leather scraps in caustic alkali is evaporated to dryness, mixed with iron filings, the mixture fused, the fused mass washed, and the lye treated with acid and persulphate of iron.

240,467—April 19, 1881. G. SCHWARZWALD. *Composition for printing textile fabrics.*

A composition for imparting a bright silk or satin like appearance to cotton goods, paper, etc., consisting of powdered almond shells, water, hydrochloric acid, coloring matter, gelatine, oxidized metal powder, and bichromate of potassa in specified proportions.

242,080—May 24, 1881. H. W. VAUGHAN. *Dyeing fibrous material.*

A dyestuff and a mordant in conjunction are mechanically incorporated with the fibrous material during the process of manufacture, by the aid of infusorial earth, or other vehicle for the same, and an oleaginous constituent, and the dyestuff and mordant are then chemically combined by heating or steaming the material; or an infusorial earth charged with a mordant is so combined with the material, and it is subsequently immersed in a dye bath to combine chemically with the mordant and make a fast dye.

ARTIFICIAL, ORGANIC.

32,965—July 30, 1861. G. E. C. DELAIRE. *Improvement in aniline colors.*

Blue and violet of aniline are produced by the reaction of aniline red upon pure aniline at a suitable temperature. A mixture of aniline red and pure aniline is boiled for several hours at 165° C. The violet coloring matter is mixed with water and hydrochloric acid and boiled, yielding the violet residue. This is successively boiled with hydrochloric acid and washed in boiling water, producing a blue precipitate.

38,589—May 19, 1863. J. LIGHTFOOT. (*Reissue: 4,746; 4,747—February 6, 1872.*) *Improvement in dyeing and printing textile fabrics and yarns with aniline black.*

The use of a salt or salts of aniline is claimed for producing or developing a black in textile fabrics. To prepare the solution 4 ounces of chlorate of potash is dissolved in a gallon of water; 8 ounces of aniline combined with 8 ounces of hydrochloric acid at 32° Twaddell is added; then 1 pint of acetic acid and 8 ounces of perchloride of copper at 88° Twaddell; and finally 4 ounces of sal ammoniac.

43 066—June 7, 1864. A. W. HOFMANN. *Improvement in preparing coloring matters for dyeing and printing.*

Coloring substances, of a violet-blue, violet, or red-violet tint, are produced by the action of the iodides and bromides of alcohol radicals on rosaniline, heated to 100° C. in a closed vessel under pressure. There may be taken 1 part of rosaniline, 2 parts of iodide of ethyl, and 2 parts of strong methylated spirit or alcohol.

49,958—September 12, 1865. A. S. L. LEONHARDT. *Improved method of preparing aniline colors for dyeing and printing.*

The blue and violet colors of commerce obtained from magenta, and insoluble in water, are rendered in a fine state of subdivision by dissolving them in alcohol or aniline or sulphuric acid and allowing the solutions, under brisk and constant agitation, to drop into cold water, or into cold water containing in solution neutral salts, caustic, or carbonated alkalies; or, when aniline is used, into cold water containing hydrochloric acid; or, when sulphuric acid is used, into cold water containing alkali in amount equivalent to the acid. The solvent is recovered.

50,335—October 10, 1865. C. CLEMM. *Improvement in the manufacture of aniline red.*

Aniline red is produced by the reaction of salts of aniline and its homologues with the arseniates of the alkalis, as by fusing at 210° C. a mixture of arseniate of soda and the sulphate of aniline, equal parts; the latter prepared by mixing sulphuric acid of 66° Baumé and water, equal parts, and stirring in two and one-half parts of aniline. The sulphate of soda of the dry mass is washed out and the residue dissolved in muriatic acid, neutralized and recrystallized.

51,404—December 5, 1865. J. HOLLIDAY. *Improvement in the manufacture of coloring matter.*

Cotton-violet dye of commerce, 1 part, is treated with 6 parts of a very weak alkali and the precipitate washed and dried. The color is purified by dissolving 1 part in 8 parts or more of methyl-alcohol and adding one-half part of acid. This may be repeated several times, rendering the color each time bluer and clearer.

53,241—March 13, 1866. P. CHEVALIER. *Improvement in the manufacture of coloring matters from aniline.*

Coloring matters, red and violet, are produced by transforming commercial aniline into a salt, as arseniate; adding a nitrite; as nitrite of potash, and heating the mixture to the temperature at which the aniline is raised to the boiling point—which should not be exceeded—until it turns blue in the presence of an acid. The mixture at the boiling point is treated with alkalinized water, which dissolves the red and leaves the violet insoluble. The red is precipitated by a neutral salt, as sodium sulphate.

54,957—May 22, 1866. G. H. REED. *Improvement in the manufacture of dyes and colors.*

Coloring matters and their mordants, one having an affinity for woolen and one for silk, and neither neutralizing the other, in quantities each suited to the quantity of the other, are boiled together in water with frequent stirring, and dissolved and concentrated until the liquid has absorbed all it will take up, when the proper quantity of glycerine and alcohol or wood naphtha is added to prevent change.

76,031—March 24, 1868. E. ZINSSMANN. *Improved compound of aniline colors.*

A soluble compound is produced by treating an aniline color (insoluble in water) with glue or equivalent material dissolved in acetic acid, glycerine, or like material.

79,942—July 14, 1868. B. BLOCH. (*Reissue: 3,103—September 1, 1868.*) *Improved aniline dye.*

A gray dye, prepared by mixing and boiling aniline oil with arsenic acid in liquid form and about 75° strength. The mixture is purified by boiling with muriatic acid, filtering, washing, drying, and then dissolving in alcohol with 20 per cent of sulphuric acid, boiling, and filtering.

82,129—September 15, 1868. J. LAMBERT, JR. *Improved aniline dye.*

Saffranine red is produced by dissolving 1 part of violet-harmaline paste in 2 parts of acetic acid, of 8° Baumé, and 100 parts of water, heating and adding 1 part of binoxide of lead, boiling, and finally neutralizing with plenty of caustic soda. The saffranine-red solution is filtered and boiled with a little carbonate of lime to remove any remaining violet.

95,465—October 5, 1869. C. GRAEBE AND C. LIEBERMANN. (*Reissue: 4,320, 4,321—April 4, 1871.*) *Improved process of preparing alizarine.*

Bibromanthrakinon, or bichloranthrakinon, is first prepared by the action of bromine or chlorine on anthrakinon (oxanthracene), and then converted into alizarine by heating in a solution of caustic potash or soda to 180° to 260° C. until the mass has a deep blue color; then dissolving in water and filtering the violet solution, from which the alizarine is precipitated by an organic or inorganic acid.

96,242—October 26, 1869. C. LAUTH. *Improved coloring material for dyeing and printing.*

Vegetable fibers are mordanted in a concentrated solution of a salt of manganese, and after desiccation the fiber is passed through an alkaline solution to eliminate the oxide of manganese. The oxide is transformed into a sesqui or binoxide, by exposure to the atmosphere, or by passing it through chloride of lime. The fibers are washed and placed in an acid solution of aniline and instantaneously dyed black. Animal fibers are mordanted with manganates and permanganates.

97,597—December 7, 1869. J. BRÖNNER AND H. GUTZKOW. (*Reissue: 4,558—September 19, 1871.*) *Improvement in preparing coloring matters from anthracene.*

The product obtained from anthracene by oxidation (oxanthracene) is nitrated. The product thus obtained is treated with a concentrated solution of caustic alkali up to 220° C., dissolved in water, and the coloring matter—alizarine—precipitated by an acid.

111,654—February 7, 1871. J. LIGHTFOOT. *Improvement in dyeing and printing textile fabrics.*

A black dye or color is produced by printing or staining with a salt of aniline mixed with certain oxidizing agents. Crystallized carbonate of soda or sesqui carbonate of ammonia is added to an aqueous solution of tartaric acid, and a solution of chlorate of potash is mixed therewith, producing chlorate of soda or ammonia and cream of tartar (a by-product). For printing, the filtrate is thickened with gum or starch, heated, and aniline and hydrochloric acid mixed therewith. Just before using the color a suitable copper salt, as sulphate of copper or sulphide of copper paste, is added. For dyeing, in lieu of the thickening, acetic acid and sugar is added and less of the copper salt.

127,426—June 4, 1872. W. H. PERKIN. *Improvement in the manufacture of coloring matters from anthracene.*

Chlorinated or brominated anthracene, 1 part, is treated with sulphuric acid, 5 parts, and the product oxidized by means of any suitable oxidizing agent, as manganese binoxide. The solution is further treated with caustic alkali.

134,076—December 17, 1872. F. LAMY, JR. *Improvement in dyeing fabrics with naphthylamine colors.*

Naphthylamine is dissolved in a mixture of nitric or hydrochloric acid and acetic acid, and treated with chloric and chromic acid. After printing the color is fixed by passing into a bath of bichromate of potash with acid, and a puce-garnet shade is developed by passing into chlorine or into ammonia; a violet shade is obtained by passing into a bath of nitrate of iron and *aqua regia*, instead of ammonia or chlorine; and a reddish violet by substituting chloride of iron and a salt of copper.

153,536—July 28, 1874. H. CARO, C. GRAEBE, AND C. LIEBERMANN. *Improvement in the preparation of coloring matters from anthracene.*

Sulphuric acid is substituted for bromine or chlorine in the process of No. 95,465.

154,153—August 18, 1874. C. RUMPFF, F. BAYER, F. WESKOTT, AND A. SILLER. *Improvement in treating anthracene and the manufacture of dyes.*

Anthracene, 1 part, is mixed with from 1 to 5 parts of powdered peroxide of manganese and heated in a retort to 200° C., whereby anthrakinon is produced by a dry and direct process.

182,234—September 12, 1876. R. SIMPSON, A. BROOKE, AND T. ROYLE. *Improvement in preparation of alizarine, etc., made from anthracene.*

Alizarine and other analogous coloring matter made from anthracene is produced in the form of a dry powder by mixing the coloring matter with a paste of hydrate of lime and water, drying, and passing through a sieve.

186,032—January 9, 1877. H. CARO. *Improvement in obtaining coloring matters suitable for dyeing and printing.*

Alizarine-orange is obtained by treating dry, powdered alizarine with nitrous fumes or by dissolving it in a solvent, such as concentrated sulphuric acid, and treating the solution with nitrous, hyponitric, or nitric acids. A coloring matter possessing the properties of purpurine is produced by subsequently heating the alizarine-orange solution to about 150° C., until the evolution of gas ceases.

186,485—January 23, 1877. L. LEIGH. *Improvement in preparing aniline dyes.*

A block or cake composed of soap, gelatine, and an aniline dye, the whole soluble in water.

188,061—March 6, 1877. F. DE LALNDE. *Improvement in process of obtaining artificial purpurine from alizarine.*

A mixture of alizarine, 10 parts, antimonic acid, 5 to 10 parts, and sulphuric acid, 66° Baumé, 80 to 100 parts, is heated to from 392° to 428° F., with constant stirring, until with dilute caustic soda it produces a currant-red color, when water is added, twenty to thirty times the volume of the mass, and it is boiled, cooled, and filtered.

188,217—March 6, 1877. J. WOLFF AND R. BETLEY. *Improvement in processes of making dyes from naphthaline.*

Dyes from naphthaline and its derivatives, in which one atom of hydrogen therein is substituted by one molecule of benzole, its homologues or their derivatives, are produced by submitting the same to an oxidizing process, and the products to a second oxidizing process, and finally to the action of an alkali.

189,538—April 10, 1877. J. WOLFF AND R. BETLEY. *Improvement in production of coloring matters from aniline.*

A dye, or series of dyes, of blue shades is produced from aniline, toluidine, or mixtures of the same, either with or without xylidine, together with nitro-benzole or nitro-toluol, or mixtures of the same, in conjunction with metallic salts, as protochloride of tin. Coloring matters are produced from aniline in conjunction with nitro-benzole by the employment of hydrochloric acid or other suitable hydrogen acids. If coloring matters are produced from arsenic acid, or other metallic oxygen acids, such arsenic acid is employed in such proportions as to saturate one-half to two-thirds of the aniline.

193,158—July 17, 1877. W. J. S. GRAWITZ. *Improvement in dyeing yarns and fabrics in aniline-black.*

The process consists in the slow concurrent progressive reaction on the fiber of aniline salts and metallic oxidizing salts or acids without exposure to the air, and with a subsequent peroxidation by means of chloric or chromic acid. A complex base, containing both an aniline and a metal, and which redissolves in acids, is obtained by precipitating certain metallic salts by means of aniline oil; or, a bath is formed containing the elements of a double salt of aniline and of a metal, as perchloride of iron and hydrochlorate of aniline; or, a bath is formed containing the elements of an aniline salt combined with the metal. All have the property of enabling the aniline to gradually oxidize with the greatest facility, producing black or shades bordering on black.

203,140—April 30, 1878. L. GRAF. *Improvement in dyestuffs or coloring matter.*

A brown dye or coloring matter prepared from leather scraps, as, for example, by digesting same with caustic soda or potash in a closed boiler under pressure, and precipitating the liquid leather with dilute acid.

204,796—June 11, 1878. H. CARO. *Improvement in the production of dyestuffs from methyl-aniline.*

"Methylene-blue:" produced from tertiary monamines, particularly from dimethyl-aniline; by, first, producing nitroso-dimethyl-aniline, by treating a cold solution of dimethyl-aniline in concentrated muriatic acid and water with pure nitrite of soda; second, reduction to amido-dimethyl-aniline, with the aid of hydrogen sulphide; third, treatment with an oxidizing agent, as perchloride of iron. The blue coloring matter is separated by saturating with sodium chloride, and adding an aqueous solution of zinc chloride. It is soluble in water and forms insoluble blue compounds with metallic tannates.

204,797—June 11, 1878. H. CARO. *Improvement in methyl-aniline violet colors.*

Coloring matter produced by converting methyl violet (comprising methyl purples, Paris violets, and Hoffman's violets) into its sulpho-acid compound (which is capable of being employed in the presence of acid or acid mordants), by drying at 110° C., and treating at that temperature, little by little, with fuming sulphuric acid under constant agitation, until a sample supersaturated with an alkali gives a clear yellowish solution without a percipitate. The thick fluid mass is dissolved in water and treated with milk of lime, filtered, and treated with a solution of soda forming a salt of soda which is evaporated to dryness. For commercial purposes, on account of deliquescence, the salt is transformed into an acid sodium salt.

204,798—June 11, 1878. H. CARO. *Improvement in ethyl-rosaniline dyestuffs.*

A dyestuff or coloring matter yielding purple or violet shades is produced by the reaction of ethyl iodide on the sulpho-acid of rosanline or fuchsine; as by heating a mixture of the soda-salt of the sulpho-acid of the fuchsine, water, alcohol, soda lye, and ethyl iodide. The iodine is recovered as subiodide of copper.

204,799—June 11, 1878. H. CARO. (*Reissue: 9,144—April 6, 1880.*) *Dye stuff or coloring matter.*

Sulpho-acid of beta-oxyazo-naphthaline, a red coloring matter: obtained from the reaction of the diazo compound of the sulpho-acid of naphthylamine and beta-naphthol: is prepared by converting naphthylamine into its diazo compound and causing equal molecules of the same and of naphthol or naphthylic alcohol to react, in an alkaline solution. Beta-oxyazo-naphthaline, so obtained, is then converted into its sulpho-acids, as by heating with fuming sulphuric acid, the excess of sulphuric acid being removed.

210,054—November 19, 1878. F. Z. ROUSSIN. *Improvement in coloring matters obtained by the reaction of the diazoic derivative of sulphanilic acid upon the amines, the amides, and the phenols.*

Coloring matters, orange, red, and yellow: produced by the reaction of the diazo derivatives of sulphanilic acid upon the amides, amines, and phenols. The azo derivative of sulphanilic acid is produced by adding dilute sulphuric acid to a mixture of an alkaline sulphanilate and an alkaline nitrite, while briskly agitating.

210,233—November 26, 1878. H. BAUM. (*Reissue: 9,986; 9,987—December 27, 1881.*) *Coloring matter or dye stuff.*

Red-scarlet coloring matter (9.986) is produced by the action of the sodium salt of bisulpho-beta-naphtholic acid, insoluble in alcohol, on the diazo derivative of xylidine.

Yellowish-red scarlet coloring matter (9.987) is produced by the action of the sodium salt of bisulpho-beta-naphtholic acid, soluble in alcohol, on the diazo derivative of xylidine.

The two isomeric bisulpho-beta-naphtholic acids are produced by mixing beta-naphthol, 1 part, with sulphuric acid of 1.848 s. g., 3 parts, and heating for twelve hours at 100° to 110° C., and the acids separated by digesting the soda salts thereof with alcohol.

211,180—January 7, 1879. A. F. POIRRIER, A. ROSENSTIEHL, AND Z. ROUSSIN. *Improvement in colors from crude naphthylamine.*

A series of coloring matters, as an intense red (adapted to replace "orseille"), is produced by the action of the sulpho-conjugated diazo derivatives of phtalamine upon the phenols and amines. By the action of heat, particularly with the concurrence of water and an alkali or an alkaline salt, new and different coloring matters are obtained.

211,525—January 21, 1879. Z. ROUSSIN AND A. F. POIRRIER. *Improvement in colors derived from nitraniline.*

New coloring matters are produced by the reaction of the diazo derivatives of nitraniline upon the amines, amides, and phenols.

211,671—January 28, 1879. Z. ROUSSIN AND A. F. POIRRIER. *Improvement in colors derived from toluidine and xylidine.*

New coloring matters are produced by the reaction of the diazo derivatives of the toluidines and xylidines upon the amines, the amides, and the phenols.

213,563—March 25, 1879. J. P. GRIESS. *Improvement in coloring matters.*

"Anisol-crimson:" produced by the action of the diazo-anisol upon an alkaline solution of disulpho-acid of beta-naphthol. A hydrochlorate of anisidine is prepared from anisidine—the amido compound of anisol—by treatment with nitrous acid combined with an alkaline solution of disulpho-acid of beta-naphthol.

213,564—March 25, 1879. J. P. GRIESS. *Improvement in coloring matters.*

A red coloring matter produced by the action of the diazo-anisol upon an alkaline solution of the monosulpho-acid of beta-naphthol (using the mono in lieu of the disulpho-acid of No. 213,563).

221,114—October 28, 1879. J. H. STEBBINS, JR. *Improvement in colors from diazo-benzole nitrate and pyrogallol.*

"Pyrogallidine:" produced by the reaction of diazo-benzole nitrate on an alkaline solution of pyrogallol. Silk is dyed a yellow brown, and wool, with a tannic-acid mordant, the same.

221,115—October 28, 1879. J. H. STEBBINS, JR. *Improvement in colors from picric acid.*

"Picridine:" produced by the reaction of an aqueous solution of diazo-benzole nitrate and picric acid dissolved in alcohol. Silk is dyed an orange yellow without mordants; wool a light yellow when mordanted with tannic acid.

221,116—October 28, 1879. J. H. STEBBINS, JR. *Improvement in coloring matters obtained from diamido-naphthaline and diazo-naphthaline nitrate.*

"Naphthaline-brown:" produced by the reaction of diamido-naphthaline on diazo-naphthaline nitrate. Silk unmordanted is dyed a brown; mordanted with acetic acid a deeper brown; with iron chloride an almost black color; and with tin chloride a fine purple.

221,117—October 28, 1879. J. H. STEBBINS, JR. *Improvement in coloring matters obtained from cresol.*

"Cresolidine:" produced by the reaction of an aqueous solution of diazo-benzole nitrate on an alkaline solution of cresol. Wool is dyed yellow, with or without mordants; silk, mordanted with muriate of tin, dyes orange.

221,118—October 28, 1879. J. H. STEBBINS, JR. *Improvement in coloring matters obtained from salicylic acid.*

"Salicylidine:" produced by the reaction of an aqueous solution of diazo-benzole nitrate on salicylic acid dissolved in alcohol. Silk, unmordanted, is dyed an orange red; mordanted with muriate of tin, it is dyed red; wool is dyed a salmon color with a tannic-acid mordant.

221,119—October 28, 1879. J. H. STEBBINS, JR. *Improvement in coloring matters obtained from naphthylamine and diazo-benzole nitrate.*

"Naphthylamidine:" produced by the reaction of an alcoholic solution of naphthylamine and an aqueous solution of diazo-benzole nitrate, with the addition of strong hydrochloric acid and gentle heat. In glacial acetic acid it dyes silk a dark brown, cotton a crimson, and wool a fine red.

221,120—October 28, 1879. J. H. STEBBINS, JR. *Improvement in coloring matters derived from toluol.*

"Toluol-orange:" produced by the action of an aqueous 1-per-cent solution of diazo-benzole nitrate on a 10-per-cent solution of toluylendiamine in strong alcohol. It dyes animal fiber with or without mordants, and for dyeing cotton it forms insoluble compounds with some metallic salts, as oleate of lead or aluminate of zinc.

222,257—December 2, 1879. O. G. DOEBNER. *Improvement in green coloring matters.*

"Malachite-green:" produced by the reaction of benzo-trichloride, 2 parts, on dimethyl-aniline, 3 parts, in the presence of metallic chlorides, such as zinc chloride, $1\frac{1}{2}$ parts.

224,927—February 24, 1880. F. KÖHLER. *Dyestuff or coloring matter.*

A bluish-red coloring matter produced by the action of the sulpho-acid of diazo-azo benzole upon an alkaline solution of a bisulpho-acid of beta-naphthol.

224,928—February 24, 1880. F. KÖHLER. *Dyestuff or coloring matter.*

A red coloring matter produced by the action of the sulpho-acid of diazo-azo benzole upon an alkaline solution of beta-naphthol.

225,108—March 2, 1880. H. CARO. *Coloring matter obtained from alpha-naphthol.*

The sulpho-acid of dinitro-alpha-naphthol: produced by the action of nitric acid upon certain alpha-naphthol-sulpho acids. Alpha-naphthol is dissolved in and heated with sulphuric acid until the mono-sulpho-acids produced in the first stage of the process are changed into those sulpho-acids which may be acted upon by nitric acid without losing their sulpho groups entirely, and then treated with nitric acid. The yellow coloring matter dyes and prints with other dyestuffs of similar acid properties.

225,908—March 23, 1880. Z. ROUSSIN. *Artificial coloring matter.*

Coloring matters, varying from yellow to red, produced by causing the diazo derivative of naphthionic acid to react upon the amines, the amides, and the phenols. They consist of the sulpho-acids or sulpho-salts of oxy-diazo pairs of aromatic radicals, one being the naphthyl derived from naphthionic acid, and the other from the amine, amide, or phenol employed.

227,470—May 11, 1880. A. BAEYER. *Manufacture of artificial indigo.*

"Artificial indigo:" produced by the action of an alkali and a deoxidizing agent, as glucose, upon ortho-nitro-phenyl-propiolic acid, its homologues and substituted compounds.

228,300—June 1, 1880. A. BAEYER. *Manufacture of artificial indigo-blue.*

It is developed in or upon fiber by impregnating yarn, fiber, or cloth with a mixture of ortho-nitro-phenyl-propiolic acid, an alkali, and a deoxidizing agent, as glucose, and then submitting the material to heat.

233,458—Oct. 19, 1880. A. BAEYER. *Manufacture of artificial indigo.*

The dibrominated compound of ortho-nitro-cinnamic acid: produced by the action of bromine on ortho-nitro-cinnamic acid, at an ordinary or an elevated temperature. It is used in the manufacture of artificial indigo.

233,459—Oct. 19, 1880. A. BAEYER, *Process for producing artificial indigo.*

Ortho-nitro-phenyl-oxyacrylic acid: produced by exposing ortho-nitro-cinnamic acid to the action of hypochlorous or hyprobromous acid, and then treating the product with alcoholic potash. It is used in the manufacture of artificial indigo.

233,460—October 19, 1880. A. BAEYER. *Process for the production of artificial indigo.*

Ortho-nitro-phenyl-propiolic acid: produced by treating the dibrominated compound of ortho-nitro-cinnamic acid with alcoholic potash and heat. It is used for the manufacture of artificial indigo.

236,465—October 19, 1880. H. BAUM. *Red coloring matter.*

Produced by subjecting the diazo compound derived from amidoazo-benzole to the action ot disulpho-beta-naphtholic acid (using the one that is practically insoluble in alcohol).

235,193—December 7, 1880. A. BAEYER. *Manufacture of artificial indigo.*

A dyestuff or coloring matter produced by the action of a reducing or deoxidizing agent, such as ferrous sulphate, upon a new derivative of ortho-nitro-phenyl-propiolic acid, resulting from treating the said acid with sulphuric acid in the cold. It is in a great part soluble in aniline at ordinary temperature, and also in an aqueous solution of sulphuric acid.

235,488—December 14, 1880. A. BAEYER. *Manufacture of dyestuff or coloring matter.*

A new product, of a dull-blue crystalline appearance: produced by repeated treatment of the artificial indigo of No. 235,193, with a cold and aqueous solution of sulphurous acid, followed by a mineral acid.

240,359—April 19, 1881. A. BAEYER AND H. CARO. *Manufacture of artificial indigo.*

A dyestuff, distinguished by the presence of free sulphur, produced by the deoxidizing action of an alkaline xanthate upon an alkaline compound of ortho-nitro-phenyl-propiolic acid.

240,360—April 19, 1881. A. BAEYER AND H. CARO. *Dyeing fabrics with artificial indigo blue.*

Blue dyes are developed in or upon textile fiber, etc., by impregnating the same with a solution of a mixture of ortho-nitro-phenyl-propiolic acid and alkali and a deoxidizing sulphur compound belonging to the class of sulphocarbonates, such as xanthates of soda, and then submitting the material to a drying or aging process.

240,361—April 19, 1881. A. BAEYER. *Manufacture of artificial indigo.*

A blue dyestuff or coloring matter obtained from the artificial indigo of No. 235,193, by repeated treatment of the same with a cold and aqueous solution of sulphurous acid, and subsequent precipitation with sodium chloride.

240,941—May 3, 1881. A. BAEYER. *Manufacture of artificial indigo.*

A blue dyestuff or coloring matter produced by exposing isatine-chloride to the action of glacial acetic acid and zinc dust, or other reducing agents.

240,942—May 3, 1881. A. BAEYER AND A. EMMERLING. *Manufacture of artificial indigo.*

A blue dyestuff or coloring matter produced by the action of a mixture of phosphorus-trichloride and acetyl-chloride with yellow phosphorus on isatine, at from 70° to 80° C.

241,738—May 17, 1881. Z. H. SKRAUP. *Manufacture of artificial chinoline.*

See Group XVIII, Fine Chemicals.

242,707—June 7, 1881. J. H. STEBBINS, JR. *Azo color.*

A dyestuff or coloring matter produced by the reaction of monosulpho-acid of beta-naphthol on a mixture of diazo-benzole and diazo-naphthaline hydrochlorates. It dyes silk or wool in an acid bath a light scarlet similar to cochineal.

242,855—June 14, 1881. N. C. ARMAND AND J. E. BERTON. *Dyeing fabrics with aniline colors.*

Aniline colors are rendered soluble in benzines and essences, by combining them with a solvent or intermediary agent, such as a composition of oil or fat, an acid (as acetic acid), ether, and alkalis.

244,757—July 26, 1881. E. LABHARDT. *Coloring matter from tetranitro-naphthol.*

"Heliochrysine," a sodium salt of tetranitro-naphthol: produced by the energetic nitrification of monobromnaphthaline; a yellow coloring matter, prominent by its brilliancy and fastness, and easy application on silk and wool.

246,221—August 23, 1881. J. SCHUNCKE. *Azo color.*

"Archil red:" produced by the action of the diazo compound of amidoazo-xylole upon an alkaline solution of beta-naphthol bisulpho-acid. It dyes wool, silk, and cotton with garnet shades similar to archil.

246,272—August 23, 1881. H. BAUM. *Azo coloring matter.*

A red coloring matter or dyestuff produced by the reaction of beta-naphthol monosulphonate of sodium and the diazo compound of amidoazo-benzole sulphonate of sodium. It is freely soluble in water and in dilute mineral acids. It dyes a fiery red on cotton mordanted with alum and in a continuous bath.

246,327—August 30, 1881. C. A. MARTIUS. *Methyl-blue color.*

A blue coloring matter produced by the reduction of methyl-orange, III, $C_{14}H_{14}N_3SO_3Na$, by the action of an excess of sulphohydrate of ammonia at from 105° to 110° C., followed by oxidation by the action of perchloride of iron. It dyes silk and wool without a mordant; vegetable fiber with a mordant.

248,153—October 11, 1881. O. FISCHER. *Process of preparing leuco base of aniline blue.*

Process consists in dissolving para-nitrobenzaldehyde in alcohol and muriatic acid, adding zinc powder and distilling off the alcohol, mixing the product with diphenylamine and methyl-diphenylamine and zinc chloride, and heating to 120° to 140° C., and finally separating the leuco base.

248,154—October 11, 1881. O. FISCHER. *Process of preparing coloring matter.*

The leuco base of rosaniline is produced by substituting chlorhydrate of aniline (or a mixture of aniline with toluidine) for diphenylamine and methyl-diphenylamine in the process of No. 248,153.

248,246—October 11, 1881. O. N. WITT. *Coloring matter.*

A violet dye, a substitute for madder violet, produced by the action of nitrosodimethylaniline on meta-phenylendiamine. It gives dark-violet shades on cotton, wool, and silk.

249,136—November 1, 1881. O. N. WITT. *Production of coloring matter.*

A dark-red dye formed by the action of nitroso-dimethylaniline on meta-toluylenediamine.

249,926—November 22, 1881. J. H. H. O. GÜRKE. *Coloring matter.*

A bluish scarlet dyestuff or coloring matter produced by the action of the disulpho-beta-naphtholic sodium salt insoluble in alcohol on the diazo derivative of para-amido-cinnamic acid methylic ether.

250,035—November 22, 1881. A. BAEYER. *Manufacture of artificial indigo.*

Indogenic acid is produced by first producing indogenic ether by treating an ether compound of ortho-nitro-phenylpropiolic acid with a reducing agent, such as ammonium sulphydrate, followed by the action of muriatic acid and a cold and dilute solution of caustic soda, and then converting the indogenic ether into indogenic acid by treatment with caustic alkalis and subsequently with muriatic acid. It is converted into artificial indigo blue by oxidation.

250,036—November 22, 1881. A. BAEYER. *Manufacture of artificial indigo.*

"Indogen" is produced by the action of heat upon indogenic acid (No. 250,035), either in a dry state or in a solvent. It is rapidly converted into artificial indigo by the access of air.

250,038—November 22, 1881. H. BAUM. *Manufacture of crimson coloring matter.*

A crimson coloring matter produced by the action of disulpho-beta-naphtholic sodium salt insoluble in alcohol, on the diazo derivative of amido-para-cresol-methylic ether.

250,201—November 29, 1881. H. CARO. *Sulphonated compound of rosaniline.*

Trisulpho acid of rosaniline, a red coloring matter: produced by the action of anhydrous sulphuric acid on fuchsine, at from 120° to 170° C., with constant agitation. It dyes wool in a boiling dye bath with mineral acids or acid mordants.

250,247—November 29, 1881. J. HOLLIDAY. *Manufacture of rosaniline colors.*

The sulpho-conjugated compound of rosaniline, capable of being used with acids or acid mordants, is produced by the action of fuming sulphuric acid on rosaniline, or its salts, preferably on anhydrous chloride of rosaniline.

251,162—December 20, 1881. H. BAUM. *Dyestuff or coloring matter.*

A yellow-orange coloring matter produced by the reaction of the disulpho-beta-naphtholic sodium salt, soluble in alcohol, upon the diazo derivative of aniline.

251,163—December 20, 1881. H. BAUM. *Dyestuff or coloring matter.*

A deep red scarlet dyestuff or coloring matter produced by the reaction of the disulpho-beta-naphtholic sodium salt, insoluble in alcohol, on the diazo compound derived from the amido-ethylxylol.

251,164—December 20, 1881. H. BAUM. *Dyestuff or coloring matter.*

A claret-red dyestuff or coloring matter, produced by the reaction of a mixture of the two isomeric disulpho-beta-naphtholic sodium salts upon the diazo derivative of naphthylamine.

251,499—December 27, 1881. A. BAEYER. *Manufacture of artificial indigo.*

Ortho-nitro-acetenyl benzene, used in the manufacture of an artificial indigo, is produced by the distillation of ortho-nitro-phenylpropiolic acid with steam.

251,500—December 27, 1881. A. BAEYER. *Manufacture of artificial indigo.*

Düsatogen, a red crystalline solid, is produced by mixing ortho-dinitro-acetenylphenyl with concentrated sulphuric acid and treating with fuming sulphuric acid, and precipitating by means of alcohol or water. It is converted into an artificial indigo blue by the action of reducing or deoxidizing agents.

251,501—December 27, 1881. A. BAEYER. *Manufacture of soluble derivatives of indigo blue.*

An alkaline salt of indigo-white sulphonic acid, convertable into indigo blue upon treatment with acid and oxidizing agents, is produced by the action upon indigo of alkaline pyrosulphates and reducing agents, such as ferrous sulphates and alkalies.

251,671—December 27, 1881. A. BAEYER. *Preparation of new material for the manufacture of artificial indigo.*

Ortho-dinitro-diacetenylphenyl, a yellow crystalline solid, m. p. 212° C., is produced by forming a copper compound of ortho-nitro-acetenyl benzene by treating an alcoholic solution of the latter with an ammoniacal solution of cuprous chloride, then treating same with prussiate of potash and caustic potash, washing and drying the precipitate, digesting with chloroform, and distilling off the solvent. It dissolves in concentrated sulphuric acid upon the addition of fuming sulphuric acid, with an intensely red color and with the production of düsatogen.

253,202—January 10, 1882. O. FISCHER. *Rosaniline-red coloring matter.*

A rosaniline red obtained from paranitrobenzaldehyde and a salt of commercial aniline oil. Nitroleuco bases are first formed from the said materials in the presence of dehydrating agents, and the rosaniline red is produced either direct from the bases or after transformation into leucoaniline.

252,203—January 10, 1882. O. FISCHER. *Preparation of rosaniline-blue coloring matter.*

A blue coloring matter produced by first forming nitroleuco bases from para-nitro benzaldehyde and diphenylamine in the presence of dehydrating agents, and then forming the aniline blue direct therefrom or after transforming them into amidoleuco bases.

252,273—June 10, 1882. J. H. STEBBINS, JR. *Purple dyestuff or coloring matter.*

A dark-violet coloring matter produced by the action of an acid solution of the soda salt of beta-naphthol-monosulpho acid upon nitroso-dimethyl-aniline hydrochlorate, at from 110° to 121° C. It dyes wool mordanted with an iron or alum mordant a dark purple color.

252,274—January 10, 1882. J. H. STEBBINS, JR. *Manufacture of blue coloring matter.*

A coloring matter or dyestuff produced by the action of an alkaline solution of the soda salt of alpha-naphthol-monosulpho acid on para-amido dimethyl-aniline hydrochlorate. It dyes wool with a chrome mordant an indigo color; with an alum mordant and tannin added to the dye bath it dyes wool a dark blue-green.

252,317—January 17, 1882. T. HOLLIDAY. *Producing azo colors upon vegetable fiber.*

Process consists in subjecting the fiber to the action of oil followed by an alkali, to oxidize the oil on the fiber; subsequently to the action of a naphthol or phenolic body, and then the azo color is produced upon the fiber by treating with a diazo compound, whereby the color is fastened upon the fiber in conjunction with the oil.

252,782—January 24, 1882. A. LIEBMANN. *Manufacture of the higher homologues of phenol, naphthol, and resorcin.*

See Group XVIII, Fine Chemicals.

253,443—February 7, 1882. J. H. STEBBINS, JR. *Coloring matter or dyestuff.*

A blue dyestuff produced by the action of chloride of lime upon an alkaline mixture of dimethyl-para-phenylendiamine hydrochloride and orthocresol. It dyes wool with alum or chrome mordants at about 150° F. a prussian blue.

253,444—February 7, 1882. J. H. STEBBINS, JR. *Coloring matter or dyestuff.*

A blue dyestuff produced by the action of dimethyl-para-phenylendiamine hydrochloride upon an alkaline solution of orthocresol in presence of an oxidizing agent; the coloring matter is developed with acetic acid. It dyes wool with alum or chrome mordants at about 150° F. an indigo extract blue color.

253,445—February 7, 1882. J. H. STEBBINS, JR. *Coloring matter or dyestuff.*

A blue dyestuff produced by the action of para-amido-dimethyl-aniline hydrochloride upon an alkaline solution of phenol in the presence of chloride of lime. It dyes wool mordanted with alum or chrome mordants at about 180° F. a deep indigo blue.

253,598—February 14, 1882. F. GRAESSLER. *Manufacture of yellow coloring matters.*

The sulpho-acid of amidoazo-benzole; obtained by producing the amidoazo-benzole and then transforming it into the sulpho-acid compound thereof; or by transforming a sulpho-acid compound of aniline—a sulphanilic acid—into the amidoazo-benzole sulpho-acid; or by commencing with a sulpho-acid compound of aniline and transforming this into the corresponding amidoazo-sulpho acid. They afford fast coloring matters.

253,721—February 14, 1882. H. KOECHLIN. *Manufacture of colors or dyestuffs.*

Violet coloring matters produced by the action of nitroso derivatives of the tertiary amines on tannin, or on principles analogous to tannin, as by heating a solution of nitroso-dimethyl-aniline and gallic acid.

254,064—February 21, 1882. J. H. STEBBINS, JR. *Dyestuff or coloring matter.*

A blue dyestuff produced by the action of diethyl-para-phenylendiamine chloride upon an alkaline solution of the soda salt of alphanaphthol mono-sulpho-acid in presence of an oxidizing agent. Wool is dyed at 150° F. in a neutral bath without mordants or acids; also with alum or chrome mordants.

254,065—February 21, 1882. J. H. STEBBINS, JR. *Dyestuff or coloring matter.*

A blue dyestuff produced by the action of diethyl-para-phenylendiamine chloride upon an alkaline solution of alpha-naphthol in the presence of an oxidizing agent. The color on wool is developed by an oxidizing agent, as bichromate of potash, into a bright indigo blue.

254,098—February 21, 1882. W. PICKHARDT. *Manufacture of chinoline.*

See Group XVIII, Fine Chemicals.

254,550—March 7, 1882. T. & R. HOLLIDAY. *Process of dyeing colors or textile fabrics.*

Azo colors are produced direct in or upon cotton or other textile fibers by impregnating the same with a solution of naphthol or naphthols and with a solution of a diazo-azo compound.

255,349—March 21, 1882. J. H. STEBBINS, JR. *Dyeing blue colors upon textile fabrics.*

A blue color is developed within or upon textile fiber, etc., by the reaction in or upon the fiber of nitroso-diethyl-aniline chloride and the soda salt of alpha-naphthol in the presence of an oxidizing agent.

255,350—March 21, 1882. J. H. STEBBINS, JR. *Manufacture of blue coloring matter.*

A blue dyestuff produced by the action of diethyl-para-phenylendiamine chloride upon an alkaline solution of phenol in the presence of an oxidizing agent. It dyes wool with or without alum or chrome mordants at 150° F. a deep blue.

256,330—April 11, 1882. E. D. KENDALL. *Process of treating certain derivatives of coal-tar colors.*

See Group X, Electro-chemistry.

256,375—April 11, 1882. C. RUMPFF. *Dyestuff or coloring matter.*

The product resulting from the reaction of diazo-azo-tolnol-monosulphonic acid with the sodium salt of the alpha-monosulphonic acid of beta-naphthol.

256,376—April 11, 1882. C. RUMPFF. *Manufacture of dyestuff or coloring matter.*

The product resulting from the reaction of diazo-alpha-naphthaline-monosulphonic acid with a solution of the sodium salt of the alpha-monosulphonic acid of beta-naphthol.

256,377—April 11, 1882. C. RUMPFF. *Manufacture of dyestuff or coloring matter.*

Product resulting from the reaction of diazo-beta-naphthaline-monosulphonic acid with the sodium salt of the alpha-monosulphonic acid of beta-naphthol.

256,378—April 11, 1882. C. RUMPFF. *Manufacture of dyestuff or coloring matter.*

Product resulting from the reaction of diazoazo-xylol-monosulphonic acid with the sodium salt of the alpha-monosulphonic acid of beta-naphthol.

256,379—April 11, 1882. C. RUMPFF. *Manufacture of dyestuff or coloring matter.*

A yellow dyestuff resulting from the reaction of the nitro-alpha-monosulphonic acid with carbonate of potash.

256,380—April 11, 1882. C. RUMPFF. *Manufacture of dyestuff or coloring matter.*

A scarlet dyestuff resulting from the reaction of diazoazo-benzole with alpha-monosulphonic acid of beta-naphthol.

256,381—April 11, 1882. C. RUMPFF. *Manufacture of a new coloring-producing acid.*

The alpha-monosulphonic acid of beta-naphthol is produced by treating beta-naphthol, 100 kilograms, with commercial sulphuric acid (66 per cent), 200 kilograms, the temperature not exceeding 50° to 60° C. Also the soda salt of the same, a new product. It gives coloring matters, with diazo compounds, fast against soap and light.

256,400—April 11, 1882. J. H. STEBBINS, JR. *Production of naphthyl-sulphate soda salt.*

The soda salt of naphthyl-sulphate: produced by treating beta-naphthol with sulphuric acid at not to exceed 20° C. It is separated out by the action of hot alcohol.

256,401—April 11, 1882. J. H. STEBBINS, JR. *Dyestuff or coloring matter.*

The dyestuff or coloring matter produced by the action of diazoazo-benzole-monosulpho-acid upon the soda salt of naphthyl-sulphate. It dyes wool, in a bath acidulated with sulphuric acid, a pure scarlet red.

256,596—April 18, 1882. P. REID AND J. EASTWOOD. *Ink for dyeing purposes.*

It is composed essentially of pyroxyline, a coloring agent, camphor, and a suitable menstruum, such as alcohol, wood-naphtha, etc.

256,599—April 18, 1882. C. H. RUDOLPH. *Production of coloring matter.*

A yellow coloring matter obtained from a mixture of acetanilide and hydrochlorate of aniline by heating the same with chloride of zinc or other dehydrating agent. The methylated, ethylated, etc., derivatives are obtained by the action of chloride, bromide, or iodide of methyl, ethyl, etc., on the same or on the base contained therein.

257,242—May 2, 1882. C. RUMPFF. *Manufacture of brown dyestuff.*

A brown coloring matter formed by the reaction of nitrous acid upon the salts of the alpha-naphthylamine-sulphonic acid in neutral or very slightly acid solution. Distinguished by immense dyeing power.

257,243—May 2, 1882. C. RUMPFF. *Manufacture of brown dyestuff.*

A brown coloring matter formed by the reaction of nitrous acid upon the salts of the beta-naphthylamine-sulphonic acid in neutral or very slightly acid solution. Distinguished by immense dyeing power.

257,498—May 9, 1882. H. KOECHLIN. *Manufacture of coloring matter.*

The leuco bases and leuco products or reduction products of the bodies obtained by the action of nitroso derivatives upon tannin, or on principles analogous to tannin, the same being obtained by the reaction of said bodies, or directly as by the heating of a solution of gallate of soda and chlorhydrate of nitro-sodi-methylaniline.

257,717—May 9, 1882. E. JACOBSEN. *Manufacture of red coloring matter.*

The process of manufacturing a red or violet coloring matter consists in heating a mixture of equal parts of chinoline or pyridine and benzotrichloride, and subsequently treating with water and an alkali. It dyes cotton mordanted with tannin. It shows an intense yellow fluorescence visible on wool and silk.

257,812—May 9, 1882. A. BAEYER AND V. B. DREWSEN. *Preparation of material for manufacture of artificial indigo.*

The process of producing ortho-nitro-cinnamylformic acid consists in treating ortho-nitro-benzoldehyde with pyroracemic (pyruvic) acid in the presence of hydrochloric acid.

257,813—May 9, 1882. A. BAEYER AND V. B. DREWSEN. *Preparation of material used in the manufacture of artificial indigo.*

Ortho-nitro-cinnamylformic acid—product of No. 257,812—a yellowish-white crystalline solid, characterized by the facility with which its alkaline solutions containing an excess of the base are decomposed with production of artificial indigo.

257,814—May 9, 1882. A. BAEYER AND V. B. DREWSEN. *Manufacture of artificial indigo.*

The process consists in treating ortho-nitro-benzaldehyde with acetone in the presence of a diluted solution of an alkali, such as caustic soda.

257,815—May 9, 1882. A. BAEYER AND V. B. DREWSEN. *Artificial indigo.*

The product of No. 257,814: distinguished from vegetable and from the artificial indigo of No. 227,470 by its pure blue color and absence of any coloring matter soluble in alcohol with a red or purple color.

258,530—May 23, 1882. H. BRUNCK. *Manufacture of anthracene blue.*

"Anthracene blue:" produced from alizarine orange—No. 186,032—by heating same with glycerine and sulphuric acid at not to exceed 110° C., and subsequently treating the product with bisulphite of soda. It is not decomposed in aqueous solution by acetic or tartaric acid, or the lime, magnesian, or chromic salts of these organic acids.

258,531—May 23, 1882. H. BRUNCK. *The production of blue colors upon textile fabrics.*

The fiber or fabric is impregnated with an aqueous solution of the anthracene blue—No. 258,530—and then exposed to heat of from 70° to 100° C. The material may first be impregnated with a solution of acetic acid or tartaric acid, or of the lime, magnesian, or chromic salts of said acids.

259,260—June 6, 1882. A. BAEYER. *Process of manufacture of indigo blue.*

An ether compound of ortho-nitro-phenylpropiolic acid is first produced, such as its ethylic ether; then the same is converted into indogenic ether, which is converted into indogenic acid by treatment with caustic alkalis, followed by muriatic acid, and the product finally exposed to an oxidizing action.

259,261—June 6, 1882. A. BAEYER. *Process of manufacture of indigo blue.*

Process the same as No. 259,260, except the indogenic acid is transformed into indogen by the action of heat, and the indogen is then exposed to an oxidizing action.

259,629—June 13, 1882. A. BAEYER. *Manufacture of artificial indigo.*

Produced by starting from toluene, successively through benzyl chloride, benzyl cyanide, phenylacetic acid, oxindol, nitroso-oxindol, amido-oxindol, artificial isatine, and isatine-chloride to artificial indigo. It contains "indirubin," and colors alcohol purple on boiling; on combustion it leaves an ash containing zinc.

260,242—June 27, 1882. C. RUMPFF. *Manufacture of coloring matter from naphthylamine.*

A brown dyestuff or coloring matter produced by the action of diazoazo-benzol-sulphonate of soda upon naphthylamine in an acid solution. It dyes wool and silk a dark reddish brown in an acidulated bath, fast to soap and light.

261,175—July 18, 1882. C. RUMPFF. *Manufacture of coloring matter from naphthylamine.*

A brown dyestuff or coloring matter produced by the action of diazo-naphthalene-sulphonate of soda upon naphthylamine in an acid solution. It dyes silk and wool in an acidulated bath.

261,518—July 18, 1882. H. KOECHLIN AND O. N. WITT. *Manufacture of blue and violet coloring matters.*

Produced by the reaction upon a phenol of a nitroso amine or phenol or a chloroquinonimide in the presence of a reducing agent, or a paramido body in the presence of an oxidant.

261,600—July 25, 1882. J. H. H. O. GÜRKE. *Production of soluble alizarine-blue color.*

A dark yellow coloring matter produced by the reaction of sulphite of ammonia upon commercial "alizarine blue" ($C_{17}H_9NO_4$) at from 30° to 40° C.

261,766—July 25, 1882. C. RUMPFF. *Manufacture of brown dyestuff.*

Produced by adding to a solution of amidoazoxylolsulphonate of soda, first, muriatic acid, then a solution of sodium nitrite, and then naphthylamine in acid solution. It dyes wool and silk a dark reddish brown in an acidulated bath.

261,767—July 25, 1882. C. RUMPFF. *Manufacture of brown dyestuff.*

Produced by adding to a solution of amidoazotoluolsulphonate of soda, first, muriatic acid, then a solution of sodium nitrite, and then an acid solution of naphthylamine. It dyes wool and silk a dark reddish brown in an acidulated bath.

262,620—August 15, 1882. C. RUMPFF. *Manufacture of dyestuff.*

A brown dyestuff or coloring matter produced by combining diazoazobenzolsulphonic acid with a solution of naphthylaminsulphonate of soda. It dyes wool and silk a dark reddish brown in an acidulated bath.

262,680—August 15, 1882. F. MANN. *Manufacture of rosaniline color.*

A red dyestuff or coloring matter produced by treating rosaniline or a suitable salt thereof with carbyl sulphate or ethionic acid. For practical purposes an acid alkali salt of the dyestuff is prepared.

262,695—August 15, 1882. C. RUDOLPH. *Manufacture of artificial indigo.*

Produced from benzaldehyde by first converting the same into monobenzylidenacetone, then converting the latter into its orthonitro substitution derivative, separating this orthonitro product from isomers by crystallization, filtration, and distillation, and finally digesting in a weak alkaline lye.

263,341—August 29, 1882. H. KEOCHLIN AND O. N. WITT. *Manufacture of blue coloring matters called "indophenols."*

Soluble indophenols: produced by the reaction between nitrous derivatives of amines or chloroquinominides, as nitroso-dimethylaniline, and phenols, as alpha-naphthol, by heating, without the presence of alkali or a reducing agent. The indophenol is obtained in the shape of leuco compound, and rendered soluble in alkaline lyes by excess of the phenol, and in water by the addition of alkali. Insoluble indophenols may be treated with phenols or their alkaline derivatives, in the formation of the former or when already formed.

263,420—August 29, 1882. R. MELDOLA. *Manufacture of blue coloring matters.*

Produced by the reduction of the diazo colors formed from the various amidonaphthaline-sulphonic acids in conjunction with dimethylaniline and other tertiary monamines by means of a sulphide, with or without the addition of zinc dust, the products being oxidized by means of ferric chloride or other suitable oxidant. It dyes wool and silk from a neutral or ammoniacal bath, and cotton with or without a mordant, according to the shades required.

263,964—September 5, 1882. H. ROSE. *Manufacture of dyestuff from alizarine-blue.*

Produced by mixing an alkaline salt of alizarine blue, as the natrium salt in paste, with an alkaline bisulphite and a mordant, whereby the salt of the alizarine blue dissolves quite easily.

263,965—September 5, 1882. H. ROSE. *Manufacture of alizarine-blue color.*

A brownish-red coloring compound produced by first combining alizarine blue, $C_{14}H_9NO_4$, with alkalis, and then treating the alkaline salt thus obtained with the bisulphites of the alkalis.

266,912—October 31, 1882. J. H. STEBBINS, JR. *Coloring matter or dyestuff.*

A green dyestuff produced by the action of benzoyl chloride upon methyldiphenylamine in the presence of zinc chloride, at about 100° C.

268,113—November 28, 1882. C. MARTIUS. (*Reissue: 10,353—July 10, 1883.*) *Process of producing a basic coloring matter from xylidine.*

Process of producing crystallized cumidine, a base for the manufacture of azo colors: consists in treating hydrochlorate of xylidine with methyl alcohol in a digester to 280° C., converting the crude hydrochlorate of cumidine into a nitrate, separating the nitrate from the mother liquors, washing it, and subsequently converting it into the base and subjecting it to fractional distillation between 225° and 245° C. and crystallization.

268,505—December 5, 1882. C. F. L. LIMPACH. *Manufacture of coloring matter.*

A bluish-red coloring matter produced by the action of the sulphonic acid of amidoazo-benzole upon an alkaline solution of betanaphthol trisulphonic acid.

268,506—December 5, 1882. C. F. L. LIMPACH. *Manufacture of coloring matter.*

A red coloring matter produced by the reaction, with sodium salt, of the betanaphthol trisulphonic acid upon the diazo compound derived from alpha-naphthylamine sulphonic acid.

268,507—December 5, 1882. C. F. L. LIMPACH. *Manufacture of coloring matter.*

A bluish-red coloring matter produced by the action of the diazo compound of the amidoazo-benzole upon an alkaline solution of betanaphthol trisulphonic acid.

268,543—December 5, 1882. C. RUDOLPH. *Production of methylquinoline.*

Produced by treating ortho-nitro-benzylidenacetone with reducing agents, as tin chloride and muriatic acid, and purifying by distillation in a current of steam. It boils at 240° C. and is used for the production of azo coloring matters.

269,359—December 19, 1882. O. WALLACH. *Manufacture of coloring matter.*

A brown coloring matter produced by combining diazotized aniline and resorcin, dissolving the product in caustic soda, and then combining again with diazo-sulphanilic acid. It dyes wool and silk in reddish-brown shades.

270,311—January 9, 1883. E. HEPP. *Manufacture of blue dyestuff or coloring matter.*

Produced from nitroso derivatives of tertiary aromatic monamines such as dimethylaniline, by dissolving same in concentrated sulphuric acid and then subjecting to the action of a reducing agent, as a metallic sulphide.

271,636—February 6, 1883. T. HOLLIDAY. *Production of azo colors on cotton fabrics.*

They are produced direct by the action of a neutralized bath (e. g., neutralized by carbonate of lime) of the diazo compounds upon fiber previously treated with the naphthols or phenols.

274,081—March 13, 1883. H. BRUNCK. *Manufacture of anthracene-blue.*

In the manufacture of anthracene blue, No. 258,530, the time is shortened by the use of a solvent. Alizarine blue is exposed to the action of a solution of bisulphite of soda or other alkali, an alkaline earth, or a metal, such as zinc, chromium, or iron, in the presence of a suitable solvent, such as alcohol, acetic acid, or acetic ether.

275,774—April 10, 1883. H. KOECHLIN AND O. N. WITT. *Treatment of indophenols.*

"Leuco-indophenol" is produced from indophenol by the reaction of alkaline or acid reducing agents upon the latter. The indophenol is ground to a paste and maintained alkaline or acid during the reaction, according to the reducing agent used.

276,796—May 1, 1883. O. FISCHER. *Preparation of oxyhydro-methyl chinoline.*

See Group XVIII, Fine Chemicals.

276,888—May 1, 1883. C. RUDOLPH. *Manufacture of cinnamic acid.*

See Group I, Acids, Other Organic.

276,889—May 1, 1883. C. RUDOLPH. *Material for the manufacture of metamethyl indigo.*

Ortho-nitro-meta-methyl-benzaldehyde is produced by dissolving toluylaldehyde in concentrated sulphuric acid, thereafter slowly adding a cold mixture of nitric and concentrated sulphuric acids, pouring into ice water to separate the nitro-aldehyde in the form of an oil, which is consecutively washed in water and a dilute carbonate of soda solution.

276,890—May 1, 1883. C. RUDOLPH. *Manufacture of metamethyl indigo.*

Produced by dissolving ortho-nitro-meta-methyl-benzaldehyde in a double quantity of acetone or ethylaldehyde, and adding a sodium lye. As contrasted with natural indigo the methyl indigo is easily soluble in alcohol.

277,182—May 8, 1883. J. WOLFF. *Production of coloring matters from diazoamido compounds.*

A scarlet coloring matter produced by the reaction of a solution of diazoxylolamido-benzol sulphonate of ammonia with a solution of sodium betanaphthol disulphonate.

277,864—May 15, 1883. H. ENDEMANN. *Production of sulpho-acid compound of betanaphthol.*

A new compound produced by treating betanaphthol with fuming sulphuric acid at 115° to 125° C. for two hours, when the temperature is reduced to 100° to 110° C. and more fuming sulphuric acid is added from time to time. It is used in the manufacture of coloring matters.

278,926—June 5, 1883. E. FISCHER. *Production of paranitrobenzylidene chloride.*

Process consists of treating paranitrotoluol with a current of chlorine gas at a high temperature, rising from 130° to 160° C., and washing the resulting mass successively with water, a solution of sodium carbonate, and finally with water, and crystallizing from alcohol. It is used in the manufacture of coloring matters.

280,317—June 26, 1883. L. LIMPACH. *Manufacture of coloring matter.*

A betanaphthol trisulpho acid compound which produces brilliant colors when treated with diazo compounds, produced by reacting upon betanaphthol with sulphuric anhydride (or single oleum) at 160° C. for five to ten minutes, and neutralizing the acid solution, when the reaction is complete, with caustic soda or a salt thereof, so as to form a salt of the said trisulpho acid.

282,835—August 7, 1883. A. BERNTHSEN. *Manufacture of materials suitable for dyestuffs.*

Thiodiphenylamine, a yellowish-white crystalline solid, is produced by heating a mixture of diphenylamine and sulphur at from 250° to 300° C.

282,836—August 7, 1883. A. BERNTHSEN. *Manufacture of coloring matter.*

A purple dyestuff or coloring matter obtained from thiodiphenylamine (No. 282,835) by converting the same into a nitro compound, then acting thereon with reducing agents, as tin and hydrochloric acid, and oxidizing the product. It dyes cotton previously mordanted with tannin, and becomes fixed on the fiber without the aid of a mordant.

283,265—August 14, 1883. N. McCALLUM. *Composition to be used as a paint or dye.*

"Echurine," a yellow dye, consists of nitric acid, picric acid, and flavine, boiled and evaporated to dryness.

283,766—August 28, 1883. E. FISCHER. *Manufacture of the nitro-leuco base of rosaniline.*

Produced by the reaction of para-nitro-benzylidene chloride dissolved in a medium, such as ligroine, benzine, or alcohol, on aniline, at the temperature of a water bath, followed by distillation of the solvent, extraction of the residue with water, and precipitation of the base by an alkali. It varies in color from yellow to red and melts under boiling water to a wax-like mass.

285,335—September 18, 1883. J. WOLFF. *Manufacture of cardinal-red coloring matter.*

Produced by the reaction of a solution of diazo-naphthalene-amido-benzole sulphonate of ammonia and a cold solution of one equivalent of betanaphthol disulphonate of sodium in 10 to 12 parts of its own weight of water. It is distinguished by containing besides the diazo compound of naphthalene, the amido-benzole sulphonate compound with the beta-naphthol sulphonate.

286,526—October 9, 1883. A. BERNTHSEN. *Sulphureted derivative of diphenylamine as a basis for the production of coloring matters.*

Thiodiphenylamine produced by heating diphenylamine with sulphur at from 250° to 300° C. The product is purified by distillation.

286,527—October 9, 1883. A. BERNTHSEN. *Process of obtaining coloring matter or dyestuff from thiodiphenylamine.*

Thiodiphenylamine is treated with nitric acid, the nitro compound obtained is reduced, and the resulting colorless compound oxidized. It is a purple coloring matter, dyeing cotton which has been mordanted with tannin, and it becomes fixed on animal fiber without the aid of a mordant.

289,543—December 4, 1883. I. LEVINSTEIN. *Manufacture of yellow coloring matter.*

Coloring matter produced by the action of nitric acid upon the mono and disulpho acids of nitroso-alpha-naphthol, or a mixture of the same.

289,613—December 4, 1883. O. BREDT. *Manufacture of red coloring matter.*

Produced by diazotizing naphthylamine sulphonic acid, and then treating it with naphthol. The alpha form of naphthylamine sulphonic acid yields bluish-red and the beta form, yellowish-red shades.

290,585—December 18, 1883. E. JACOBSEN. *Production of yellow coloring matter.*

Produced by heating chinaldine with phthalic anhydride and zinc chloride to from 190° to 210° C. The melt is boiled out with muriatic acid. As obtained, it is soluble only in spirit. It is made soluble in water by heating with sulphuric acid, monochlorhydrine, or fuming sulphuric acid.

290,856—December 25, 1883. H. CARO AND A. KERN. *Manufacture of dyestuff.*

The process for manufacturing crystallized methyl-violet by the reaction of oxychloride of carbon (phosgene) upon a mixture of dimethylaniline and anhydrous chloride of aluminium and then separating the coloring matter.

290,891—December 25, 1883. A. KERN. *Manufacture of dyestuff or coloring matter.*

Crystallized methyl-violet, the product of process No. 290,892. It is marked by its uniformity of composition. It dyes textile fiber a bluish-purple shade similar to "methyl-violet 5B."

290,892—December 25, 1883. A. KERN. *Manufacture of purple dyestuff.*

Process consists in converting dimethyl-aniline into tetra-methyl-diamido-benzophenone; treating the same with reducing or hydrogenizing agents; combining tetra-methyl-diamido-benzhydroll, the hydrogenized product, with dimethyl-aniline; submitting the new product to an oxidizing process; and finally crystallizing the dyestuff from its solution in suitable solvents.

290,893—December 25, 1883. A. KERN. *Manufacture of dyestuff or coloring matter.*

"Ethyl-purple 6B:" produced by converting diethylaniline into tetraethyl-diamido-benzophenone, treating the same with reducing or hydrogenizing agents, combining the hydrogenized product with diethylaniline, and then oxidizing, and separating out the dyestuff or coloring matter.

295,825—March 25, 1884. Z. H. SKRAUP. *Manufacture of parachinisol.*

See Group XVIII, Fine Chemicals, Nitro-substitution compounds.

297,413—April 22, 1884. A. KERN. *Manufacture of ethyl-blue coloring matter.*

"Victoria blue BB:" produced by the condensation of alpha-phenyl-naphthyl-amine with tetra-ethyl-diamido-benzophenone, in the presence of phosphorus oxychloride.

297,414—April 22, 1884. A. KERN. *Methyl-blue coloring matter.*

"Victoria blue B:" produced by the condensation of alpha-phenyl-naphthyl-amine with tetra-methyl-diamido-benzophenone, in the presence of phosphorus oxychloride.

297,415—April 22, 1884. A. KERN. *Methyl-blue coloring matter.*

"Benzyl-violet B:" produced by the condensation of tetra-methyl-diamido-benzophenone with dibenzyl-aniline, in the presence of phosphorus oxychloride.

297,416—April 22, 1884. A. KERN. *Ethyl-blue coloring matter.*

"Benzyl-violet BB:" produced by the condensation of tetra-ethyl-diamido-benzophenone with dibenzyl-aniline, in the presence of phosphorus oxychloride.

297,844—April 29, 1884. A. F. POIRRIER AND D. A. ROSENSTIEHL. *Sulpho-conjugated violets of Paris.*

A new product having the free acid neutralized, readily soluble, and with the coloring matter unaltered; produced by treating the crude coloring matter with potash, soda, ammonia, zinc, magnesia, or other suitable base, to transform the excess of acid into soluble sulphate.

297,852—April 29, 1884. Z. ROUSSIN AND D. A. ROSENSTIEHL. *Manufacture of yellow and orange coloring matters.*

Azo coloring matters, varying from yellow to orange and even red, having the radical of carbonic acid substituted for that of sulphuric acid, are produced by substituting the amido-carboxylated acids, such as amidobenzoic acid, for the corresponding sulpho acids in the manufacture, in the state of free acid. They are insoluble iu water, but their alkaline salts are sufficiently soluble.

298,998—May 20, 1884. P. MONNET. *Obtaining brown dyes from the aromatic diamines.*

Process consists in saturating the material in a bath composed of chlorhydrate of paraphenylene diamine, or paratoluylene diamine, sulphuric acid and water, then wringing, and then treating the material to an oxidizing bath to develop the color.

300,874—June 24, 1884. F. KRÜGER, G. TOBIAS, AND E. KEGEL. *Production of coloring matters from dinitro-phenol.*

Dinitro-phenol-sulpho acid and its salts are produced by nitrating phenol-sulpho acid, or mono-nitro-phenol-sulpho acid, or their salts. The commercial product is the dinitro-phenol-sulphonate of potash, a red product, ground, mixed with spirit of ammonia, and evaporated to dryness.

301,802—July 8, 1884. H. CARO AND A. KERN. *Manufacture of yellow coloring matter.*

"Auramine:" produced by fusing a mixture of tetra-methyl-diamido-benzophenone, ammonia hydrochlorate, and zinc chloride, and washing out and crystallizing the product. When dissolved in alcohol and treated first with sodium amalgam, and then with acetic acid and heat, it is decomposed into tetra-methyl-diamido-benzhydrol and ammonia.

302,170—July 15, 1884. J. H. STEBBINS, JR. *Manufacture of brown coloring matter.*

"Phenanthrol brown:" produced by the action of diazoazobenzole-parasulpho-acid upon beta-phenanthrol in alkaline solution. When treated with reducing agents, as tin and hydrochloric acid, it splits up into beta-amido-phenanthrene, aniline, and sulphanilic acid.

302,790—July 29, 1884. A. SPIEGEL. *Azo coloring matter.*

Produced from ortho-amido-dichlorphenol by diazotizing and then combining with a molecular quantity of beta-naphthol, producing the azo coloring matter dichlorphenol-azo-beta-naphthol, which is then treated with spirits of wine along with a concentrated solution of the bisulphite of an alkali and heat. It is distinguished by solubility in water with a yellow color, and when an alkali is added to the solution, or when boiled with a nitrite, the bisulphite compound is decomposed and a bluish-violet paste is precipitated.

302,791—July 29, 1884. A. SPIEGEL. *Fastening azo colors on yarn or textile fabrics.*

Azo colors are developed in or upon textile fiber, etc., by impregnating the fiber with the bisulphite compounds of azo coloring matters formed from diazo compounds, combined with aromatic hydroxylated bodies or phenols, together with salts of alumina, iron, or chromium, and then exposing to heat, preferably steam, or to an alkaline agent, or a hot solution of a nitrite.

303,385—August 12, 1884. A. SPIEGEL. *Azo coloring matter.*

The bisulphite compound of dichlorphenol-azo-ethyl-beta-naphthol (soluble in water): produced by treating the scarlet azo coloring matter dichlorphenol-azo-ethyl-beta-naphthol (insoluble in water) with a concentrated solution of the bisulphite of an alkali along with spirits of wine.

306,546—October 14, 1884. A. SPIEGEL. *Manufacture of bisulphite compounds of azo coloring matters.*

Azo coloring matters soluble in spirit—i. e., not sulphonic acids—are converted into compounds soluble in water by combining such azo coloring matters, in the presence of a solvent, with the bisulphite of an alkali.

306,969—October 21, 1884. A. SPIEGEL. *Preparation of pheneto-sulpho-diazo-beta-naphthol with bisulphite compound.*

A coloring matter soluble in water is produced from phenetol-sulphon-diazo-beta-naphthol—insoluble in water—by treating same with a concentrated solution of the bisulphite of an alkali, along with spirits of wine.

307,401—October 28, 1884. C. LOWE. *Coloring matter derived from aurin.*

Process of manufacturing "roso-phenoline," a basic red coloring matter, consists in heating aurin with a mixture of ammonia and an organic acid either in aqueous, ethylic, phenylic, or other alcoholic solution, at from 212° to 400° F.

308,748—December 2, 1884. H. CARO AND A. KERN. *Manufacture of purple-blue coloring matter.*

"Victoria blue 4 R:" produced by the condensation of tetramethyl-diamido-benzophenone with methyl-phenyl-alpha-naphthylamine, in the presence of phosphorus oxychloride.

308,912—December 9, 1884. F. MACHENHAUER. *Manufacture of rosaniline derivatives.*

Yellow coloring matters produced from "azuline," of commerce—a blue coloring matter—and the sulphonic acids thereof, by treating the same with nitric or nitrous acids or their salts.

309,882—December 30, 1884. Z. ROUSSIN AND D. A. ROSENSTIEHL. *Manufacture of bromated azo coloring matters.*

Yellow and orange brominized azo coloring matters are produced by introducing bromine directly into the coloring matter after the latter has been formed. They are more readily fixed on vegetable fiber than substances not bromated.

310,128—December 30, 1884. E. ERLENMEYER. *Production of rosaniline coloring matters.*

Process of manufacturing coloring matters of the rosaniline series of different composition by the oxidation of various combinations or mixtures of methylated amines or anilines or rosanilines with primary, secondary, or tertiary aromatic amines in such a way that the methyls of the former compounds are applied under the influence of oxidizing media—a methan carbon—in order to combine therewith always three aromatic molecules of the latter compounds.

310,155—December 30, 1884. L. VIGNON. *Sulpho-alpha-naphthol coloring compound.*

Produced by the reaction of a sodium sulpho-alpha-naphthol rendered slightly alkaline by sodium carbonate or ammonia hydrate upon diazo-benzole.

313,118—March 3, 1885. J. H. STEBBINS, JR. *Red coloring matter.*

Benzole-azo-sulphonate of soda-azo-diethylaniline: produced by treating a solution of amidoazo-benzole-sulphonate of soda with sodium nitrite, and then adding the diazo compound to a solution of diethylaniline in methyl alcohol. It is split by reducing agents into para-phenylendiamine, sulphanillic acid, and para-amido-diethylaniline. It dyes a brownish red.

314,938—March 31, 1885. M. HOFFMANN. *Coloring matter from beta-naphthol.*

A red coloring matter, producing on wool and silk a blue shade: produced by mixing the diazo compound of the difficultly soluble alpha-naphthylamine sulphonic acid with an alkaline solution of beta-naphthol gamma disulphonic acid.

314,939—March 31, 1885. M. HOFFMANN. *Red coloring matter from gamma disulphonic acid of beta-naphthol.*

Produced by the action of the diazo compound of amidoazobenzole upon an alkaline solution of gamma disulphonic acid of beta-naphthol. It dyes wool, silk, and mordanted cotton a brilliant scarlet.

315,932—April 14, 1885. R. GNEHM. *Production of chlorinated derivatives of benzaldehyde.*

Benzaldehyde is treated with iodine and pentachloride of antimony under heat, and the chlorinated substitution products of benzaldehyde are then separated by known methods. They are employed in the manufacture of coloring matters.

316,036—April 21, 1885. O. HOFFMANN. *Coloring matter derived from naphthol.*

Naphthol-green: produced from the reaction of nitroso-naphtho-sulphonic acids or their salts upon iron or its salts, or by the reaction of nitrous acid upon naphthol-sulphonic acids treated with iron or its salts.

316,471—April 28, 1885. C. LOWE. *Manufacture of derivatives of aurin.*

"Roso-phenoline," the product of process No. 307,401.

318,484—May 26, 1885. C. LOWE. *Manufacture of the derivatives of aurin.*

Roso-phenoline sulphonic acid, a conjugated acid red coloring matter: produced by heating aurin at a low temperature with sulphuric acid and heating the product, after removing excess of acid, with ammonia in aqueous, ethylic, phenylic, or other alcoholic solution. It combines with alkali to form solid or pasty salts, insoluble in benzole but soluble in alcohol or water.

319,646—June 9, 1885. L. VIGNON. *Process of obtaining coloring matter from amidoazo-benzole and homologues.*

A solution of chlorhydrate of amidoazo-benzole, hydrochloric acid and water, is heated to from 140° to 176° F., and a solution of sodium sulphide is then added until the reduction is complete, when the liquid is filtered and oxidized.

322,368—July 14, 1885. R. GNEHM. *Production of chlorophthalic acid.*

Tetrachlorophthalic acid (or its anhydride): produced by the action of chlorine upon a mixture of anhydrous phthalic acid and antimony pentachloride, heated to about 200° C.

322,940—July 28, 1885. T. KEMPF. *Manufacture of iodoform bromoform, and chloroform.*

See Group X, Electro-chemistry.

323,514—August 4, 1885. W. MAJERT. *Manufacture of methylene-blue by electrolysis.*

See Group X, Electro-chemistry.

324,615—August 18, 1885. L. VIGNON. *Manufacture of coloring matter from alpha-naphthol and dinitro-naphthol.*

The process of producing a yellow coloring matter consists in treating alpha-naphthol with sulphuric acid at 66° Baumé; cooling and diluting with ice; adding nitric acid at 40° Baumé; maintaining the temperature under 30° C.; then heating to near 40° C.; cooling to 12° or 15° C.; and finally filtering, redissolving the precipitate, and precipitating with carbonate of potash in solution.

324,630—August 18, 1885. H. ZIEGLER. *Coloring matter from phenylhydrazine.*

A yellow dyestuff or coloring matter produced by the action of bioxytartaric acid (carboxytartronic acid) upon the sulpho-acid of phenylhydrazine. It is soluble in water; almost insoluble in strong alcohol and glacial acetic acid.

325,827—September 8, 1885. F. FISCHER. *Manufacture of violet dyestuffs.*

Process consists in treating diethyl-aniline by perchlormethyl-mercaptan.

325,828—September 8, 1885. F. FISCHER. *Violet methyl dyestuff.*

Product of process No. 325,827.

327,953—October 6, 1885. A. KERN AND C. L. MÜLLER. *Production of blue dyestuffs.*

Trimethyl-triphenyl rosaniline is produced by the reaction of oxychloride of carbon (phosgene) upon methyl-diphenylamine, followed by digestion of the warm mass with zinc chloride and carbon oxychloride, separation of the base from residual matters, and purification.

329,125—October 27, 1885. A. T. BÖHME. *Process of making coloring matter.*

Consists in boiling glucosides derived from quercitrin, horse-chestnut, Brazilian wood, or the like, in water mixed with nitric or hydrochloric acid to precipitate the resin, removing the braziline, or the like, treating with potassium permanganate, filtering, lixiviating the precipitate, and treating with acid, cooling and neutralizing.

329,632—November 3, 1885. C. DUISBERG. *Coloring matter obtained from tetrazo-ditolyl.*

Produced by the action of tetrazo-ditolyl upon the alpha-naphthylamine sulpho-acids. It dyes unmordanted cotton alizarine-red.

329,633—November 3, 1885. C. DUISBERG. *Coloring matter obtained from tetrazo-ditolyl.*

Produced by the action of tetrazo-ditolyl upon the beta-naphthylamine sulpho-acids. It is isomeric to No. 329,632, dyeing an alizarine red, although a little yellower.

329,634—November 3, 1885. E. ELSAESSER. *Red dyestuff or coloring matter.*

Obtained by the reaction of the diazo derivative of the monosulpho acid of beta-naphthylamine, and the monosulpho-acids of alpha-naphthol derived from naphthionic acid and sulpho-naphthyladamic acid.

329,636—November 3, 1885. F. FISCHER. *Production of new violet dyestuffs.*

Process consists in treating dimethyl-aniline with perchlor-methylmercaptan, which is the product of the reaction of chlorine upon carbon bisulphide. Its muriate forms bronze-like needle crystals.

329,637—November 3, 1885. F. FISCHER. *Violet coloring matter.*

Product of process No. 329,636.

329,638—November 3, 1885. E. FRANK. *Yellow coloring matter.*

Product of process No. 329,639. Unmordanted cotton is dyed a sulphur yellow in a boiling soap bath.

329,639, November 3, 1885. E. FRANK. *Production of new yellow coloring matter.*

Process consists in azotizing benzidine sulphate by means of sodium nitrite, forming tetrazo-diphenyl, and treating it with oxibenzoic acids—salicylic acid—and finally separating and purifying the product.

330,275—November 10, 1885. M. E. WALDSTEIN AND A. MÜLLER. *Composition of matter to be used in dyeing.*

A composition containing a sulpho compound of the fatty acids, such as sulphoricinoleic acid or sulpholeic acid, aniline or its homologues, and a neutralizing alkali.

331,059—November 24, 1885. M. HOFFMANN. *Manufacture of beta-naphthol sulphonic acid.*

The gamma disulphonic acid of beta-naphthol is produced by first sulphonating the alpha-monosulphonic acid of beta-naphthol or beta-naphtol itself, and finally purifying the acid. Coloring matters are formed by combination with aromatic diazo compounds.

331,964—December 8, 1885. H. HASSENCAMP. *Manufacture of benzylated methyl violet.*

The product of No. 331,965, a benzylated methyl violet which has been sulphonated and oxidated. It is principally used for dyeing wool when sulphuric acid is used as a mordant.

331,965—December 8, 1885. H. HASSENCAMP. *Manufacture of benzylated acid violet.*

Process consists in reducing the methyl violet of commerce to its leuco base, benzylating the leuco base, transforming into its leuco-sulpho acid, and finally obtaining the sulpho-acid of the dyestuff by oxidation.

332,350—December 15, 1885. E. OSTERMEYER AND M. DITTMAR. *Producing chloriodine double combinations from pyridine and chinoline bases.*

The process of producing double combinations of chloriodine with pyridine, chinoline, tetrahydrochinoline or chinoline methylate, from which coloring matters may be obtained: consists in treating these bases with chloroid-hydrochloric acid.

332,528—December 15, 1885. M. HOFFMANN. *Dyestuff made from diazo-naphthaline.*

Produced by the reaction of diazo-naphthaline with the gamma-disulphonic acid of beta-naphthol in alkaline solution. It dyes wool, silk, and other materials a bluish-red shade, and is characterized by its great tendency to crystallize.

332,829—December 22, 1885. H. PRINZ. *Manufacture of beta-naphthylamine sulpho-acid.*

The beta-naphthylamine sulpho-acid obtained by treating the beta-naphthol monosulpho-acid described by Schäfer with ammonia at from 180° to 200° C., by which a reaction exchange of the hydroxyl group with the amido group takes place. It is difficultly soluble in water and forms almost insoluble salts of highly crystallizing properties.

332,830—December 22, 1885. H. PRINZ. *Red coloring matter from beta naphthylamine sulpho-acid.*

Produced by combining beta-naphthol disulpho acid with the diazo combinations of beta-naphthylamine sulpho-acid (No. 332,829). It dissolves in concentrated sulphuric acid with a cherry-red color, and when treated with tin and muriatic acid, it forms beta-naphthylamine sulpho-acid and the disulpho-acids of amido beta-naphthol.

333,034—December 22, 1885. H. VOLLBRECHT AND C. MENCSHING. *Manufacture of color-producing acids.*

A new naphtholdisulphonic acid, produced by converting into the diazo compound the naphthylamine sulphonic acid whose sodium salt is not easily soluble in water, and then treating the diazo compound with sulphuric acid. When treated with nitric acid it forms a yellow dyestuff, and it forms dyestuffs with diazo compounds.

333,035—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Coloring matter derived from alpha naphthol disulphonic acid.*

Produced by the reaction of diazo-xylol with the soda salt of alpha-naphthol-disulphonic acid (No. 333,034).

333,036—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Nitro-naphtholsulphonic acid.*

A yellow dyestuff, naphtholmononitromonosulphonic acid: produced by the reaction of a nitro compound of alphanaphtholdisulphonic acid (No. 333,034) with carbonate of potash.

333,037—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Manufacture of dyestuff from naphthol.*

Produced by the reaction of diazoazobenzol with a solution of the sodium salt of alphanaphthol disulphonic acid (No. 333,034).

333,038—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Manufacture of dyestuff from naphthol.*

Produced by the reaction of diazotoluol with a solution of the sodium salt of alphanaphtholdisulphonic acid (No. 333,034).

333,039—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Coloring matter derived from diazobenzol and alphanaphtholdisulphonic acid.*

Produced by the reaction of diazobenzol with a solution of the sodium salt of alpha-naphthol-disulphonic acid (No. 333,034).

333,040—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Alpha-naphtholsulphonic acid.*

Produced by converting into the diazo compound the naphthylaminesulphonic acid whose sodium salt is easily soluble in water, and treating the same in boiling water with a small quantity of sulphuric acid. It produces, with diazobenzol, a bright scarlet dye.

333,041—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Coloring matter derived from diazobenzol and alphanaphthol.*

A bright scarlet dye: produced from the reaction of diazobenzol with a solution of the sodium salt of the new naphthol-monosulphonic acid (No. 333,040).

333,042—December 22, 1885. H. VOLLBRECHT AND C. MENSCHING. *Coloring matter derived from alphanaphthol and diazotoluol.*

Produced by the reaction of diazotolnol-sulphonic acid with the sodium salt of the new naphtholmonosulphonic acid (No. 333,040). It dyes scarlet with a bluish shade.

333,649—January 5, 1886. C. LOWE. *Manufacture of derivatives of aurin.*

The process of manufacturing "rosophenolinesulphonic acid," a conjugated acid red coloring matter, consists in heating aurin, 1 part, with sulphuric acid, 5 parts at from 38° to 100° C., separating the excess of sulphuric acid, and heating the product with an aqueous or alcoholic solution of ammonia.

333,861—January 5, 1886. A. KERN. *Manufacture of soluble methyl-blue from rosaniline.*

"Methyl-blue S:" produced by the sulphonization of trimethyl triphenyl rosaniline, which results from the action of carbon oxychloride (phosgene) upon methyl diphenylamine.

334,140—January 12, 1886. J. A. VAN WINKLE. *Compound for softening and dyeing broom corn.*

It consists of water, alum, saltpeter, cider vinegar, and diamond dye (green).

334,257—January 12, 1886. C. A. MARTIUS. *Manufacture of archil-red azo colors.*

Process consists in the combination of beta-naphthylamine—monosulpho acid (No. 332,829), with para-diazonitro—benzole.

341,991—May 18, 1886. F. BENDER. *Production of yellow azo coloring matter.*

Produced by the action of diazotized metanitroaniline or its sulpho-acids upon phenylene diamine. It is hardly soluble in cold water, somewhat more so in hot water, but soluble in alcohol, sulphuric and nitric acid.

342,207—May 18, 1886. A. MÜLLER-JACOBS. *Coloring compound.*

A coloring composition, insoluble in water or alcohol and soluble in benzine and similar solvents, formed by compounding the resinate of a metal or alkaline earth and coloring matter or dye soluble in water or alcohol. The resinate is formed by dissolving and mixing at boiling heat colophony or other resins with caustic alkali, and saturating same with sulphate of zinc, aluminum, or other salt of a metal or alkaline earth, and washing out the precipitate, which has the property of uniting with any coloring matter soluble in water or alcohol.

342,432—May 25, 1886. C. DUISBERG. *Blue coloring matter from nitrophenetol.*

Produced by azotizing the diamido-diphenol-diethylester (ether) (diphenetidin) obtained from nitro-phenol-aethylester (ether) (nitrophenetol) by alkaline reduction, and the transformation of the formed hydrazo-diphenol-diaethylester (ether) by means of acids with sodium nitrite, forming the tetrazo-diphenol-diaethylester (ether) and heating it in an organic acid solution with beta naphthylamine-monosulpho acid.

343,793—June 15, 1886. O. BIELSCHOWSKI. *Dyeing cotton fiber.*

Cotton or other textile fibers or fabrics are dyed by steeping in a solution of alpha-naphthylamine, and then slowly adding to said solution an oxidizing aqueous solution of potassium bichromate and sulphuric acid to develop the color on the fiber. Printing is done first with a paste of alpha-naphthylamine, and then with a mucilaginous solution of potassium bichromate.

344,075—June 22, 1886. F. BENDER. *Production of yellow coloring matter.*

Produced by combining diazotized nitro-amido-benzoic acid with metaphenylen-diamine, converting the same into a sodium salt and crystallizing.

344,971—July 6, 1886. C. A. MARTIUS. *Producing mixed azo colors.*

Process consists in combining one molecule of a salt of tetrazo-diphenyl or tetrazo-ditolyl with one molecule of an aromatic amido compound, and combining the product with one molecule of a different aromatic amido compound, or of a phenol compound.

345,901—July 20, 1886. M. HOFFMAN AND A. WEINBERG (*Reissue: 11,598—April 27, 1897*). *Naphthol-black color compound.*

Produced by diazotizing sodium naphthylamine disulphonate, then treating with alpha-naphthylamine chlorhydrate, and converting the product into the diazo-azo compound, which latter is allowed to act upon an alkaline solution of sodium beta-naphthol-alpha-disulphonate (salt R). It produces on the fiber in an acidulated bath dark-blue shades.

346,022—July 20, 1886. H. BULL AND C. L. MÜLLER. *Sulphonated purple dyestuff from benzyldiphenylamine.*

Produced by the sulphonization of the basic derivative resulting from the condensation of tetramethyldiamidobenzophenone with benzyldiphenylamine.

348,483—August 31, 1886. H. VON PERGER. *Production of phenyl-methyl oxy quincine.*

See Group XXIII, Fine Chemicals, Esters.

348,613—September 7, 1886. R. BOHN. *Manufacture of yellow coloring-matter or dyestuff from gallic acid.*

"Galloflavine," produced by the oxidizing action of atmospheric air, or oxygen, upon alkaline solutions of gallic acid, at not exceeding 10° C. It combines with metallic oxides, forming yellow lakes or pigment colors from a greenish to an orange yellow.

348,816—September 7, 1886. H. M. BAKER. *Resorcin blue compound.*

Produced by making a solution of resorcin in a solution of caustic ammonia, adding cuprous ammonio-carbonate or other ammoniacal copper salt, agitating the mixture by a copper plate dipping or moving therein, immersing metallic zinc to precipitate the copper, treating with dilute sulphuric acid, boiling, and filtering. It combines with bases to form lakes, and has the formula $C_{18}H_{12}N_2O_6$.

350,229—October 5, 1886. F. BENDER. *Yellow coloring matter.*

Produced by treating the soda salt of a paranitro toluol sulpho acid with caustic soda lye, reducing the red product of condensation into a hardly soluble amido-sulpho acid, diazotizing the latter, and combining the diazo product with a mixture of phenol and its carbon acids, or only with the one or the other component of said mixture in an alkaline solution. It is fixed on unmordanted cotton with a brilliant yellow shade.

350,230—October 5, 1886. F. BENDER. *Red coloring matter.*

Produced by treating the soda salt of paranitrotoluol mono-sulpho acid by caustic soda lye, reducing the red product of condensation into a hardly soluble amido-sulpho acid, diazotizing the latter, and combining the diazo product with a mixture of hydrochloric salt of beta-naphthylamine and a sodium salt of beta-naphthylamine sulpho acid, or only with the one or the other component of said mixture. It is fixable on cotton without a mordant, giving a purple-like color.

350,468—October 5, 1886. R. SCHMITT AND C. KOLBE. *Manufacture of napthol-carbonic alkaline salts.*

See Group XVIII, Fine Chemicals, Esters.

351,056—October 19, 1886. F. KRÜGER. *Production of betanaphthol-disulpho acids.*

Process consists in introducing betanaphthol, 1 part, into concentrated sulphuric acid, 4 parts, heated to 125° to 135° C., with temperature maintained at 125° to 145° C. during four to five hours, when the thus obtained beta-naphthol-disulpho acid is separated by treating its acid or neutral soda or lime salts in aqueous solution with common salt.

352,361—November 9, 1886. C. SCHRAUBE. *Production of acetine-blue colors.*

Produced by mixing induline with or dissolving it in acetine.

353,264—November 23, 1886. C. L. MÜLLER. *Manufacture of sulphonated purple dyestuffs from basic rosaniline.*

Produced from the basic rosaniline derivative resulting from the condensation of tetraethyl-diamido-benzophenone with methyl-diphenylamine, by sulphonization of the same.

353,265—November 23, 1886. C. L. MÜLLER. *Manufacture of sulphonated purple dyestuffs from basic rosaniline.*

Produced from the basic rosaniline derivative resulting from the condensation of tetraethyl-diamido-benzophenone with benzyl-diphenyl-amine, by sulphonization of the same.

353,266—November 23, 1886. C. L. MÜLLER. *Manufacture of sulphonated purple dyestuffs from basic rosaniline.*

Produced from the basic rosaniline derivative resulting from the condensation of diethyl-amido-benzoic acid with methyl-diphenyl-amine, by sulphonization of the same.

354,714—December 21, 1886. C. LOHMANN. *Process of dyeing wool azodiphenyl-blue.*

Wool and other animal fibrous materials are boiled in an aqueous solution of azodiphenyl blue, extract of logwood, blue vitriol, green vitriol, an alkali bisulphate, and oxalic acid.

354,746—December 21, 1886. L. SCHAD. *Production of coloring matter.*

A bluish black coloring matter produced by the combination of the disulpho-acid of diazo-azo-benzol with para-tolyl-beta-naphthylamine.

355,935—January 11, 1887. T. HOLLIDAY. *Naphthol-dyed fabric.*

The product of process No. 355,933, being the combination of cotton or other fiber with oxide or soap of lead and alpha or beta naphthol, or coloring matter formed with them.

356,672—January 25, 1887. H. VOLLBRECHT AND C. MENSCHING. *Red coloring matter from alpha diazo beta-naphthylamine sulphonic acid.*

"Brilliant red:" produced from the reaction of beta-naphthol with alpha diazonaphthylaline monosulphonic acid.

357,273—February 8, 1887. C. DUISBERG. *Blue coloring matter from tetrazodiphenyl.*

Produced by the action of tetrazo-diphenol-dimethylester (ether) upon the alpha naphthol alpha monosulpho acid. It dyes cotton not mordanted in a boiling bath containing alkali, and develops with phosphate of soda or carbonate of potash into a deep blue, fast to mineral acids.

357,274—February 8, 1887. C. DUISBERG. *Red coloring matter for dyeing by the action of tetrazo dyes with beta-naphthylamine sulpho acid.*

Produced by azotizing the diamido-diphenol-dimethylester (ether) (dianisidin) obtained by alkaline reduction of the nitro-phenol-methylester (ether) (nitroanisol) and transforming the formed hydrazo-diphenol-dimethylester (ether) (hydrazoanisol) by means of acids, with sodium nitrite, forming the tetrazo-diphenol-dimethylester (ether) and heating it in an organic acid solution with beta-naphthylamine-monosulpho acid. The aqueous solution dyes dark blue by the action of strong acids. It dyes unmordanted cotton a bluish red in an alkaline bath containing phosphate of soda or carbonate of potash.

358,865—March 8, 1887. C. A. MARTIUS. *Production of mixed azo coloring matter.*

Mixed azo colors are formed by combining the intermediate product formed first by one molecule of tetrazodiphenyl, or tetrazoditolyl, or tetrazodixylyl and one molecule of an amine, amido-sulpho-acid, amido-carbo-acid, phenol, phenol-sulpho-acid, or phenol-carbo-acid. The reaction of salts of tetrazodiphenyl or tetrazoditolyl upon amines, phenols, sulpho-acids, or carbo-acids at first causes one molecule of the tetrazo compound to combine with one molecule of the amine, phenol, sulpho-acid or carbo-acid. The first product containing still one free diazo group is able to be combined again with the same or another amine, phenol, sulpho-acid or carbo-acid, forming a new azo color.

359,576—March 15, 1887. A. RÖMER. *Manufacture of red coloring matter.*

Produced by first converting alpha-naphthalene-diamine (a reduction compound of alpha-dinitro-naphthalene, fusing at 216° C.) into its tetrazo compound, and afterwards combining one molecule of the tetrazo compound with two molecules of naphthionic acid. It dyes unmordanted vegetable fiber a full and bright red.

360,553—April 5, 1887. F. BENDER. *Production of disulpho-acid of diamido-stilbene.*

Produced by treating the soda salt of para-nitro-toluol-sulpho acid with caustic lye, and reducing the red product of condensation with zinc dust in alkaline solution or with protochloride of tin in an acid solution. It is a yellowish powder, hardly soluble in water or spirit, but dissolves easily in alkaline fluids.

360,792—April 5, 1887. F. BENDER AND G. SCHULTZ. *Obtaining diazo colors by means of diamido-stilbene and amido-fluorene.*

The process for producing azo colors, which dye cotton direct from a soap bath, by combining one molecule of the tetrazo compounds of stilbene or fluorene (obtained from diamido-stilbene or diamido-fluorene) with two equal or different molecules of an amine or a phenol, or of a sulphonic or carbonic acid of an amine or a phenol.

361,404—April 19, 1887. P. FRIEDLAENDER. *Combination of tetrazodiphenyl chloride with resorcin.*

The red azo dyestuff produced by subjecting an alkaline solution of resorcin to the action of tetrazo-diphenyl-chloride or tetrazo-ditolyl-chloride. It is fixable without mordants.

362,560—May 10, 1887. A. WEINBERG AND H. SEIBERT. *Production of a new napthylamine-monosulphonic acid.*

A color-producing acid which is a derivative of the new naphthol-monosulphonic acid, obtained by heating sodium alpha-naphthalene-disulphonate with caustic soda to about 200° C. until dioxynaphthalene is formed, when it is treated with an ammonium salt.

362,592—May 10, 1887. E. ULLRICH. *Trimethylethylthionin-blue coloring matter.*

Produced by joint oxidation of para-amido-dimethyl-aniline and ethyl-methyl-aniline in presence of a hyposulphite. It is fixed on fiber by tannin and emetic tartar.

362,813—May 10, 1887. F. BAYER. *Yellow-red dyestuff from tetrazo-diphenyl.*

A yellowish-red coloring matter produced by the action of the tetrazo compound of benzidine upon beta-naphthylamine deltamonosulphonic acid. It dyes unmordanted cotton in an alkaline bath, and is distinguished by being easily soluble in hot water.

362,835—May 10, 1887. T. HOLLIDAY. *Process of dyeing.*

Wool or other animal fiber is dyed by impregnating it with metallic mordants and then immersing in a bath containing one or more nitroso compounds of naphthols. The product is also claimed.

363,502—May 24, 1887. F. BAYER. *Manufacture of dyestuffs and coloring matter.*

A bluish-red coloring matter produced by the action of the tetrazo compound of toluidine on beta-naphthylamine deltamonosulphonic acid. It dyes cotton a bluish red in a boiling alkaline or soap bath; color not altered by acetic acid.

364,320—June 7, 1887. E. ULLRICH. *Nitrosophenyl-blue dyestuff.*

Prepared by the action of paranitroso-phenyltolylamine upon phenols or oxycarbonic acids. The paranitroso-phenyltolylamine is prepared from phenyltolyl-nitrosoamine by treatment with alcoholic hydrochloric acid. It is fixed on the fiber by chrome or iron mordants under addition of acetate of lime. It dyes a greenish-blue shade.

365,409—June 28, 1887. J. ROHNER. *Production of new coloring matter.*

Brown, reddish-brown, and brownish-violet coloring matters: produced by the action of metaphenylenediamine and metatoluylenediamine upon amidoazobenzole or amidoazo-toluol, or amidoazo-xylol, or amidoazo-anisol. They dye directly unmordanted cotton.

365,666—June 28, 1887. P. BÖTTIGER. *Manufacture of new red dyestuffs or coloring matters.*

Process consists in combining the salts of tetrazodiphenyl with alpha or beta-naphthylamines, and then treating the thus-formed dyestuffs with concentrated sulphuric acid, anhydrous sulphuric acid, or mono chlorhydrine, whereby the mono or disulpho acids of said dyestuffs, or the salts of said acids, are obtained.

365,667—June 28, 1887. P. BÖTTIGER. *Combination of the salts of tetrazo-diphenyl and the naphthylamines.*

A red dyestuff or coloring matter which results from the sulphonated combination of the salts of tetrazo-diphenyl and the naphthylamines.

366,078—July 5, 1887. C. DUISBERG. *Manufacture of dyestuffs or coloring matters.*

A blue azo coloring matter produced by the action of tetrazo-ditolyl upon the monosulpho-acid of the alpha-naphthol which is obtained by sulphonizing alpha-naphthol, or by the decomposition of the alpha-diazo-naphthylamine sulpho-acid (diazotized naphthionic acid) by boiling.

366,356—July 12, 1887. E. ULLRICH. *Blue coloring matter formed by the action of paranitroso-diphenylamines on phenols or oxycarbonic acids.*

A blue coloring matter or dyestuff produced by the action of paranitroso-diphenylamine on phenols or oxycarbonic acid. In dyeing and in printing it is fixed on the fiber by chrome or iron mordants, with the addition of acetate of lime.

366,357—July 12, 1887. E. ULLRICH. *Blue coloring matter formed from paranitroso-methyldiphenylamine on phenols or oxycarbonic acids.*

A blue coloring matter or dyestuff prepared by the action of paranitroso-methyldiphenylamine on phenols or oxycarbonic acid. In dyeing and in printing it is fixed on fiber by chrome or iron mordants, with the addition of acetate of lime.

366,639—July 12, 1887. E. ULLRICH. *Production of dimethyldiethylthionin-blue.*

Produced by joint oxidation of paramido-dimethylaniline and diethylaniline in presence of a hyposulphite, or of paramido-diethylaniline and dimethylaniline in presence of hyposulphite. The coloring matter is fixed on the fiber by means of tannin and emetic tartar.

366,640—July 12, 1887. E. ULLRICH. *Production of diethylmethylthionin-blue.*

Produced by joint oxidation of paramido-diethylaniline and monomethylaniline in presence of a hyposulphite.

368,054—August 9, 1887. R. BOHN. *Manufacture of soluble naphthazarin.*

"Soluble naphthazarin" (dioxynaphthaquinone): produced by digesting a mixture of naphthazarin in a solution of sodium bisulphite in a closed vessel at from 50° to 70° C. for about eight days. It is soluble in water and characterized by extreme stability in the presence of acids.

368,716—August 23, 1887. E. GREPPIN. *Process for the production of blue coloring matter.*

Blue coloring matters of unsymmetrical structure, produced by the oxidation of a mixture of paramido-dimethylaniline or the derivatives of diethylaniline, dimethylaniline, dimethyl-orthotoluidine, methylethyl-orthotoluidine, and paraphenylendiamine or paratolnylendiamine (paradiamidotoluol) in the presence of hydrogen sulphide in acid solution.

369,764—September 13, 1887. J. ANNAHEIM. *Manufacture of blue coloring matter.*

Products for the manufacture of coloring matters are produced by treating a mixture of bioxynaphthalene and aniline, or one of the homologues of the latter, with a condensing agent, and freeing the product of condensation. Coloring matters are obtained by treating such products of condensation directly with nitroso combinations of the tertiary aromatic amines, or by reducing the nitroso combinations and oxidizing the resulting diamine and the product of condensation.

374,259—December 6, 1887. A. LIEBMANN. *Monosulpho-acid of alpha-naphthol.*

Produced by mixing alpha-naphthol, 1 part, with 4 parts of concentrated sulphuric acid, 170° to 185° C., and heating for about an hour at 130° C. The mixture of sulpho-acids is converted into their barium salts, treated with gaseous hydrochloric acid, and the barium salt crystallized out. The new sulpho-acid does not, on nitration, lose its sulpho group; but yields, with nitric acid, dinitro-sulpho-alpha-naphthol. It forms dyestuffs with diazo compounds.

375,848—January 3, 1888. A. WEINBERG AND H. SEIBERT. *Manufacture of dyestuffs.*

A coloring matter produced by the action of tetrazo-ditolyl upon the naphthylamine sulphonic acid of No. 362,560. It dyes unmordanted cotton a bluish red similar to saffranine.

375,930—January 3, 1888. P. FRIEDLAENDER AND B. PRIEBS. *Production of orange azo dyestuffs.*

Produced by adding a solution of metatoluylenediamine sulpho-acid to a solution of tetrazo-ditolylchloride prepared from tolidine sulphate, and afterwards adding a solution of salicylic acid. It has a striking affinity for raw cotton fiber, dyeing without a mordant.

376,392—January 10, 1888. A. MYLINS. *Production of a new red azo color.*

Process consists in mixing nitro-aniline with water acidulated with sulphuric acid; diazotizing by adding sodium nitrate; mixing therewith, with agitation, alpha naphthylamine disulphonate of sodium; filtering, and saturating with sodium carbonate, and drying.

377,349—January 31, 1888. M. CERESOLE. *Production of new red coloring matter.*

Tetramethyl-rhodamine: produced by the condensation of one molecule of phthalic anhydride or its halogen substitution products, with two molecules of dimethyl-meta-amidophenol or of its alkyl derivatives; dyes in pure tints from pink to crimson.

377,350—January 31, 1888. M. CERESOLE. *Production of new red coloring matter.*

Tetraethyl-rhodamine: produced by the condensation of one molecule of phthalic anhydride, or of its halogen substitution products, with two molecules of diethyl-meta-amidophenol, or of its alkyl derivatives. It dyes in pure tints from pink to crimson.

379,150—March 6, 1888. R. BOHN. *Dyeing animal textile fabrics with naphthazarin.*

Chrome lakes of naphthazarin are produced within or upon textile fibers by exposing said fibers to the action of chromium mordants and naphthazarin in dyeing. The shades vary from a black to a delicate gray or slate color.

380,067—March 27, 1888. A. WEINBERG. *Production of new diamido compounds and of azo colors produced therefrom.*

Process consists in combining the ethers of the tetrazo-oxy-diphenyl and of the tetrazo-oxy-phenyl-tolyl with two equal or different molecules of an amine or of a phenol, or of a sulphonic or carbonic acid of an amine or of a phenol.

380,098—March 27, 1888. T. DIEHL. *Coloring matter from the sulpho-acids of ethyl or diphenylamine combined with tetrazo-diphenyl or tetrazoditolyl.*

Substantive cotton coloring matters, produced by the action of one molecule of tetrazo salt upon two molecules of the sulpho-acids of monoethylaniline or diphenylamine. They may be subsequently combined with phenols, salicylic acids, phenol-sulpho-acids, the sulpho-acids of alpha and beta naphthol, or of alpha and beta naphthylamine.

380,402—April 3, 1888. L. PAUL. *Production of disulpho and dicarbo acids of the diamidoazo-benzidines.*

It consists in the processes for producing mono and diamidoazo-benzidines, transformation of them into tetrazo compounds, and their combination with amines and phenols, or the sulpho-acids of these bodies, and in the colors produced therefrom. Coloring matters are produced by the combination of (a) tetrazo-diphenyl, tetrazo-ditolyl, tetrazo-dixylyl; (b) tetrazo-diphenyl-dicarbon acid and its ethers; (c) tetrazo compounds of the ethers of diamido-diphenol; (d) tetrazo-fluorene, tetrazo-stilbene, or the sulpho-acids of these bodies, with two molecules of aniline, toluidine, xylidine, and cumidine, or their sulpho acids.

380,403—April 3, 1888. L. PAUL. *Production of disulpho and dicarbo acids of the diamidoazo-benzidines.*

It consists in tetrazotizing benzidine, tolidine, and diamido-dixylyl, and the combination of the thus obtained tetrazo compounds with one or two molecules of meta or para amido-benzol sulpho-acid, or ortho, meta, or para amido-benzoic acid, or the sulpho-acids of ortho or para toluidine or xylidine in alcoholic solution, and the products thereof.

380,927—April 10, 1888. A. F. POIRRIER AND D. A. ROSENSTIEHL. *Production of azo colors.*

Produced by reducing in an alkaline medium nitro-aromatic amines, particularly metanitraniline, the isomeric nitro-toluidines fusible at 107° C. and 78° C., and nitro-xylidine fusible at 123° C. and combining the polyazo derivatives of these reduction products with the phenols, the oxyphenols, the naphthols, the oxynaphthols, the primary, secondary, and tertiary amines, the diamines, and also the alkyl, sulpho, and carboxyl derivatives of all these bodies.

380,928—April 10, 1888. A. F. POIRRIER AND Z. ROUSSIN. *Production of diazoic coloring matters.*

Produced by the reaction of the nitrodiazo benzols, toluols, xylols, etc., with the isomers and homologues of alpha-naphthylamine sulpho, especially the naphthionic acid of Witt.

381,045—April 10, 1888. O. N. WITT. *Manufacture of purple-black azo dyestuff.*

Produced by transforming assymmetrical binitro-aniline (m. p. 180° C.) into its diazo derivative, and treating same with sodium beta-naphthylamine monosulphate (Brönner's modification) and sodic acetate.

381,046—April 10, 1888. O. N. WITT. *Purple azo dyestuff.*

Produced by transforming assymmetrical binitro-aniline (m. p. 180° C.) into its diazo derivative, and treating same with sodium beta-naphthylamine disulphonate, such as may be obtained by heating beta-naphthol disulphonate acid (R) with caustic ammonia under pressure, and sodic acetate.

381,132—April 17, 1888. E. HASSENKAMP. *Production of blue-red azo dyestuff by the action of tetrazo-ditolyl salts on beta-naphthylamine monosulpho acid.*

Produced by the action of tetrazo-ditolyl salts of the alkylated derivatives of beta-naphthylamine monosulpho-acid. It dyes unmordanted cotton bluish red, fast to diluted acids.

381,471—April 17, 1888. E. HASSENKAMP. *Process of producing blue-red coloring matter.*

It consists in combining salts of the tetrazo compound of paradiamines or their sulphonic or carbonic acids with the alky-naphthylamine sulphonic acids.

382,832—May 15, 1888. C. RUDOLPH. *Production of yellow coloring matter.*

"Benzoflavine:" produced from benzaldehyde and toluylen or phenyl-diamine by first condensing benzaldehyde with the said diamines, heating the tetra-amines thus formed with bodies capable of separating ammonia, and then oxidizing the products (the hydro-phenylacridines).

384,315—July 12, 1888. M. HERZBERG. *Manufacture of dyestuffs.*

Brown dyestuffs are produced by combining the salts of diazo compounds of aniline, toluidine, xylidine, cumidine, and the nitro-derivatives of the same, amidoazo-benzol, amidoazo-toluol, amidoazo-xylol, alpha and beta naphthylamine, or their sulpho and carbo acids, and tetrazo compounds of benzidine, benzidine-sulpho, toluidine, diamido-stilbene, or their sulpho or carbo acids, with Bismarck brown (triamidoazo-benzol or triamidoazo-toluol). Insoluble colors are rendered soluble by sulphonation.

384,316—June 12, 1888, M. HERZBERG. *Manufacture of dyestuffs.*

A brown coloring matter, produced by the action of diazo compound of naphthylamine sulpho-acid on Bismarck brown (triamidoazo-benzol or triamidoazo-toluol).

384,342—June 12, 1888. R. G. WILLIAMS. *New coloring matter obtained by the action of tetrazo-diamido benzole on phenols.*

Produced by the action of tetrazo-diamido benzole (hydrochlorate) or its homologues on resorcin, the phenols, benzoic, the oxybenzoic acids, and alpha-naphthol, or their substitution products, on aniline and its homologues, beta-naphthol and the naphthylamines, or their substitution products, and on the sulpho-acids of the above amines, amides, and phenols, or their substitution products.

384,480—June 12, 1888. E. ULLRICH. *Production of blue coloring matter.*

Process of producing methylene-blue by subjecting a solution containing paramido-dimethylaniline, hydrochlorate of dimethylaniline, and sodium hyposulphite to the action of an oxidizing agent, as bichromate, with heat.

386,192—July 17, 1888. S. FOREL. *Obtaining oxyazoic coloring matter from tetrazo diphenyl and ditolyl.*

Produced by the action of tetrazo-ditolyl on phenol, or of tetrazo-diphenyl and tetrazo-ditolyl on phenol and orthocresylol in alkaline solution. It yields a bright yellow on vegetable fiber in an alkali or soap bath.

386,709—July 24, 1888. W. KELBE. *Production of coloring substances by the reaction of aromatic hydrazin sulphonic acids on retenchinon.*

A red coloring matter, characterized by great fastness: produced by the condensation of an aromatic hydrazin sulphonic acid with retenchinon.

387,097—July 31, 1888. P. MONNET. *Dyeing colors by the simultaneous oxidation of diamines and monamines.*

Colors or tints—as blacks, more or less brown or blue—are produced directly upon the materials by the oxidation of a mixture of a salt of a simple diamine—as the chlorohydrate of paraphenylene-diamine—and the salt of a simple monamine, as the chlorohydrate of aniline.

388,185—August 21, 1888. C. DUISBERG. *Blue azo coloring matter.*

Produced by the action of tetrazo-diphenol-diethyl ether upon the alpha-naphthyl alpha-monosulpho acid, which is obtained by sulphonizing alpha-naphthol or by the decomposition of the alpha-diazonaphthylamine sulpho-acid by boiling. It dyes unmordanted cotton in a boiling alkaline bath a fast deep blue, more red than the homologous product of No. 357,273.

389,127—September 4, 1888. H. WOLFF. *Production of new azo colors.*

Produced by diazotizing nitrodiamidotriphenyl-methane or its sulpho-conjugations, and combining with an aromatic amido or diamido compound, phenols, or their sulpho-conjugations.

390,842—October 9, 1888. B. F. CRESSON. *Dyeing aniline black.*

An aniline-black coloring solution is formed by dissolving and mixing in water, chlorate of potash, sal ammoniac, sulphate of copper, nitrate of iron and tragacanth gum, and forming another liquor of aniline oil, muriatic acid, tartaric acid and water, and then mixing the liquors.

392,723—November 13, 1888. E. ELSAESSER. *Blue coloring matter obtained from paraphenylen-diamine, etc.*

Derived from paraphenylene-diamine and hydrochlorate of amidoazo-benzole or its equivalents (hydrochlorate of phenyl-amidoazo-benzole, amidoazo-benzole-monosulpho-acid, or phenyl-amidoazo-benzol-monosulpho acid). It is soluble in cold and hot water.

394,425—December 11, 1888. R. G. WILLIAMS. *Action of salts of tetrazo-ditolyl or diphenyl on dihydroxides of toluene or their sulpho-acids.*

Red coloring matters, dyeing unmordanted cotton in an alkaline bath: formed by the action of a salt of tetrazo-diphenyl or tetrazo-ditolyl, or the sulpho-acids of a salt of tetrazo-diphenyl or tetrazo-ditolyl on the dihydroxides of toluene, or the sulpho-acids of the same.

394,841—December 18, 1888. C. DUISBERG. *Manufacturing of coloring matters.*

A yellow coloring matter produced by the action of tetrazo compound of benzidine, tolidine or diamidodiphenolether upon cresol carbonic acid.

395,080—December 25, 1888. C. RUDOLPH. *Coloring matter.*

An amidobenzoflavine dyestuff produced from amidoditolylphenylmethan, by transforming the nitrotetraamidoditolylphenylmethan into pentaamidoditolylphenylmethan, then into hydrotriamidodimethylphenylacridine, and finally into the amidobenzoflavine. Cotton mordanted with tannic acid is dyed a greenish yellow.

395,115—December 25, 1888. F. BENDER. *Production of coloring matter.*

A fast yellow coloring matter obtained from paranitrotoluol-sulpho-acid by treating the unstable yellow dyestuff of No. 350,229 with chlorinating, brominating, nitrating, or alkylating agents. When treated with soda-lye it is not changed in color to red.

395,300—December 25, 1888. A. WEINBERG. *Blue coloring matter from nitroso derivatives upon phenylene-diamines.*

A class of blue coloring matters produced by the action of paranitroso derivatives of secondary and tertiary amines upon diphenylmetaphenylendiamine, ditolylmetaphenylendiamine, or dixylylmetaphenylendiamine.

395,474—January 1, 1889. F. BAYER. *Manufacture of dyestuffs or coloring matters.*

Process of producing red azo colors consists in combining betanaphthylaminedeltasulpho acid with the group of tetrazo compounds of paradiamines, such as tetrazodiphenyl, tetrazoditolyl, tetrazodiphenylether, tetrazostilben, or their sulphonic acids.

395,634—January 1, 1889. C. RUDOLPH AND B. PRIEBS. *Orange azo dyestuff.*

Produced from tolidin by diazotation and subsequent heating with cresotin acid and toluylendiaminesulpho-acid. It easily dissolves in hot water, and the solution in concentrated sulphuric acid is violet red.

396,293—July 15, 1889. C. RUDOLPH. *Tetrazo dyestuff.*

Blue-black tetrazo dyestuff produced from the sulpho-acids of the amido cresols by their combination with naphthylamine, the diazotation of the compound thus formed, and its combination with naphtholdisulpho acid.

396,294—January 15, 1889. C. RUDOLPH AND B. PRIEBS. *Yellow coloring matter.*

Produced by the action of tetrazodiphenyl or ditolyl chloride upon one molecule of beta cresotinic acid and the subsequent treatment of the intermediate body with salicylate of soda.

396,417—January 22, 1889. S. M. NEVILLE. *Dye.*

A coloring composition, insoluble in water and alcohol and soluble in benzine, turpentine, and similar solvents: consisting, essentially, of common soap dissolved in water, coloring matter—as aniline colors such as will dissolve in liquid soap—and sulphate of zinc.

396,527—January 22, 1889. F. BENDER. *Production of coloring matter.*

Produced by the action of caustic alkalis upon paranitrotoluol sulpho acid in presence of water, alcohol, or glycerine with an oxidable substance, of mineral or organic nature. It dyes unmordanted cotton in fast shades, depending upon the nature of the oxidable agent employed.

396,574—January 22, 1889. A. KERN. *Formation of purple coloring matter.*

A purple coloring matter, $C_{16}H_{14}N_2O_5HCl$, obtained from the methylic ether of gallic acid and hydrochloric nitroso-dimethylaniline.

396,692—January 22, 1889. G. GRÜN. *Printing of induline dyestuffs.*

Process consists in mixing the induline paste with the formylethers of glycerine (obtained by heating oxalic acid with glycerine to 110° C. until the development of carbonic acid begins).

398,990—March 5, 1889, J. WALTER. *Process of making a yellow dye.*

Sulphuric acid is added to an aqueous solution of sodium salt of thiopara-toluidine sulphonic acid, the precipitate cooled with ice, a solution of sodium nitrate gradually added, the diazo solution poured into an alkaline solution of salicylic acid containing enough caustic soda to saturate the acids, and the mixture boiled and the color precipitated with salt.

401,024—April 9, 1889. E. FRANK. *Yellow dye.*

Produced by the action of tetrazo-ditolyl upon salicylic acid. It dyes cotton a more reddish yellow than the homologous product (No. 329,638) of benzidine.

401,483—April 16, 1889. T. DIEHL. *Crimson dye.*

Process consists in first combining one molecule of beta-phenylnaphthylamine monosulpho acid with one molecule of a tetrazo salt. The obtained product is afterwards subjected to the action of phenols, amines, or other sulpho or carbon acids. Unmordanted cotton is dyed direct.

401,633—April 16, 1889. R. BOHN. *Alizarine-blue green.*

Produced by the successive action of sulphuric anhydride and of alkalis or mineral acids upon alizarine blue.

401,634—April 16, 1889. R. BOHN. *Carbazol-yellow.*

Produced by the combination of one molecule of tetrazo-carbazol with two molecules of salicylic acid. It dyes cotton without mordants, and dyes animal fiber in a neutral or acidified bath.

401,635—April 16, 1889. R. BOHN. *Alizarine-green sulpho-acid.*

Produced by the action of moderately-strong fuming sulphuric acid at 130° to 135° C. upon alizarine green. It corresponds in chemical constitution and behavior to a true and staple sulphonated derivative of alizarine green. It dyes chrome-mordanted wool green shades.

402,436—April 30, 1889. R. GNEHM. *Red carbon color.*

Obtained from succinic acid and diethylmetaamidophenol. It dyes wool, silk, and mordanted cotton a brilliant red with yellow fluorescence.

402,980—May 7, 1889. J. SCHMID. *Azo dye.*

Azo bodies produced by the combination of alphadiazonaphthaline with metaamidophenol or its dialkylized derivatives. They possess the same properties as the azo bodies obtained from metaamidophenol.

404,097—May 28, 1889. A. LIEBMANN. *Production of yellow coloring matter.*

Produced by treating a diazo compound of primuline (polychromineate) with an alkaline solution of beta-naphthol, producing an insoluble compound, which is rendered soluble by treating with bisulphite of soda.

404,193—May 28, 1889. J. HAHN. *Process of dissolving aniline colors.*

Aniline is directly united with vegetable oil by dissolving aniline in hot water, adding part of the solution to oil, boiling the mixture, adding the remainder to the boiling oil, and stirring the mixture until the water has evaporated.

404,309—May 28, 1889. J. SCHMID. *Blue azo dye.*

Obtained by subjecting the dialkylized azonaphthalene-metaamido-phenol to the action of a reducing agent and subsequent treatment with an oxidizing agent.

404,331—May 28, 1889. R. GREVILLE-WILLIAMS. *Compound orcine dye.*

Produced by combining one molecule of tetrazo-diphenyl or tetrazo-ditolyl or their sulpho-acids with first one molecule of naphthylamine, or its known sulpho-acids; and then combining this intermediate product with one molecule of orcine or sulpho-acids of the same. The colors are faster against light than No. 394,425.

405,938—June 25, 1889. M. ANDRESSEN. *Naphthol-disulphonic acid.*

A new alpha-naphthol-disulphonic acid obtained by first forming naphthalene-disulphonic acid by treating naphthalene with sulphuric acid and monochlehydrin, or with fuming sulphuric acid, then treating with nitric acid, reducing the alpha-nitro-naphthalene-disulphonic acid to alpha-amido-naphthalene-disulphonic acid, and separating and converting into the corresponding alpha-naphthol-disulphonic acid. It acts upon the diazo compounds of diphenyl, ditolyl, stilbene, etc.

406,669—July 9, 1889. T. SANDMEYER. *Red color.*

Red to violet colors produced by boiling ortho-toluidine with caustic soda and gradually adding nitro-benzene, reducing with zinc powder, treating with concentrated muriatic acid, boiling, diluting, and filtering, when Glauber's salt is added to precipitate the sulphate, and the paste is mixed with muriatic acid, cooled and diazotized, and the product is treated with a solution of soda and naphthionate of sodium, heated, and the color precipitated.

406,670—July 9, 1889. T. SANDMEYER. *Yellow color.*

Produced by boiling ortho-toluidine with caustic soda and gradually adding nitro-benzene, reducing with powdered zinc, treating with muriatic acid, boiling, diluting, and filtering, when Glauber's salt is added, the product is diazotized, poured into a solution of caustic soda, soda, and salicylic acid, heated, and the color precipitated. It dyes unmordanted cotton.

406,952—July 16, 1889. W. PFITZINGER. *Thioparatoluidine.*

A new thioparatoluidine: produced by melting paratoluidine and sulphur to 180° to 220° C. and then to 25C° C., and purifying the product. It is infusible at 220° C., nearly insoluble in boiling alcohol and concentrated hydrocholoric acid, and combines with fuming sulphuric acid to form a new sulphonic acid, the soda salt of which dyes unmordanted cotton yellow in an alkaline bath.

407,906—July 30, 1889. B. R. SEIFERT. *Process of making paraoxybenzoic acid.*

See Group I, Acids, Other Organic.

409,384—August 20, 1889. C. S. BEDFORD. *Compound dye.*

A coloring matter consisting of the active principle of fustic dyewood with a diazo compound, produced by treating an aqueous extract of fustic dyewood with a slightly acid solution of a salt of diazo-benzene, diazo-toluene, diazo-xylene or diazo-naphthalene, adding the requisite quantity of alkali, and separating the coloring matter.

409,822—August 27, 1889. J. BRACEWELL. *Aniline black.*

Formed of ferrocyanide of soda, chlorate of potash, and aniline salts prepared so as to be free of hydrochloric acid; that is to say, with the ferrocyanide in amount sufficient to take up the aniline and the chlorate in quantity not less than 35 per cent of that of the aniline, and thereby prevent the formation of chlorate of aniline in injurious quantity in the color.

410,057—August 27, 1889. R. GREVILLE-WILLIAMS. *Process of making orcine dye.*

It consists in combining one molecule of any alkalized orcine—as the mono, di, or tri methyl, ethyl, amyl, or acetyl orcines—or one molecule of a sulpho-acid of an alkalized orcine with the intermediate product formed by combining one molecule of tetrazo-diphenyl, or one molecule of any of the other tetrazo compounds of dixylyl, stilbene, fluorine of naphthalene or their sulpho acids, with one molecule of one of the sulpho-acids of naphthylamine. They dye unmordanted cotton in an alkaline or soap bath.

410,058—August 27, 1889. R. GREVILLE-WILLIAMS. *Process of making orcine dyes.*

It consists in combining one molecule of a compound formed by combining orcine with sodium chloride, with the intermediate product formed by combining one molecule of a tetrazo compound of diphenyl, ditolyl, dixylyl, stilbene, fluorene, or naphthalene or their sulpho acids, with one molecule of one of the sulpho-acids of naphthylamine.

410,295—September 3, 1889. R. SCHMITT. *Process of making beta-naphthol carbon acid.*

Beta-naphthol carbon acid of a m. p. 216° C. is produced by the reaction of carbonic acid upon the alkaline salts of the beta-naphthol under pressure and at 200° to 250° C.

410,733—September 10, 1889. R. GEIGY. *Process of making a violet dye.*

Twenty kilos of gallamide is heated with 30 kilos of the chlorhydrate of nitroso-dimethylaniline in a solution of acetic acid.

410,739—September 10, 1889. T. SANDMEYER. *Process of making aurin derivatives.*

Salicylic acid, 2 parts, dissolved in concentrated sulphuric acid, 15 parts, and methyl alcohol, 4 parts, is heated to 70° C., after which $1\frac{1}{4}$ parts of sodium nitrate is added, and then poured into water by which the product is precipitated. It is then washed, saturated with an alkali, and dried. It dissolves in caustic soda with brown, and in ammonia with red color. Oxides of metals form lakes; chromine lake of a red violet tint.

411,149—September 17, 1889. D. E. HUGUENIN. *Blue dye.*

A compound dye consisting of indigo and indophenol.

412,148—October 1, 1889. R. GREVILLE-WILLIAMS. *Process of making dyes.*

It consists in combining one molecule of a tetrazo compound (tetrazo diphenyl and its homologues, tetrazo-naphthalene, tetrazo-stilbene, tetrazo-fluorene, tetrazo-diphenol ether, tetrazo-azo-benzole and its homologues, tetrazo-oxydiphenyl, and the alkylized compounds or the sulpho or carbo acids of the same) with two molecules of an alkylized acid of the orchilla lichens or halogen or sulpho compounds of the same. They dye unmordanted cotton in an alkaline or soap bath.

412,149—October 1, 1889. R. GREVILLE-WILLIAMS. *Process of making dyes.*

Mixed coloring matters produced by first combining one molecule of a tetrazo compound (No. 412,148) with one molecule of one of the amines or phenols (the sulpho-acids of the naphthylamines, the naphthols, monoethylaniline, diphenylmine, salicylic acid), and then combining this intermediate product with one molecule of an alkylized acid of the orchilla lichen or halogen or sulpho compound of the same.

412,440—October 8, 1889. A. WEINBERG. *Azo coloring matter.*

Produced by the action of diazo derivatives of compounds obtained from naphthylamine and diazo-sulphonic acids upon alpha or beta naphthylamine. It gives dark-blue shades in an acidulated bath, and differs from naphthol-black—No. 345,901—by the presence of the amide group, and by its greater intensity and resistance to washing and milling.

412,613—October 8, 1889. A. HERRMANN. (*Reissue: 11,077—May 20, 1890.*) *Coloring matter.*

A blue-green coloring matter, the sulphonic acid of metaoxytetralkyldiamidotriphenyl carbinol, produced by dissolving meta-amido-tetralkyldiamidotriphenyl methane in a mineral acid, diazotizing by a nitrous acid or a nitrite, decomposing by boiling with water, precipitating with soda or sulphate, and boiling the resulting oxy leuco base with water until it becomes neutral, sulphonating by heating with concentrated or fuming sulphonic acid, and oxidizing with peroxide of lead or similar agent. It is characterized by great resistance to the action of alkalis.

412,614—October 8, 1889. A. HERRMANN. (*Reissue: 11,078—May 20, 1890.*) *Coloring matter.*

A blue-green coloring matter, the sulphonic acid of meta-amidotetralkyldiamidotriphenyl carbinol, produced by dissolving meta-amidotetralkyldiamidotriphenyl methane in fuming sulphuric acid, heating until a sample gives a clear solution with cold ammonia, converting the product into the calcium or sodium salt, oxidizing the leuco sulphonic compound thus obtained with peroxide of lead or manganese and dilute sulphuric acid, filtering and evaporating to dryness.

412,615—October 8, 1889. A. HERRMANN. *Coloring matter.*

A fast green-blue coloring matter obtained from the etherized compounds of metaoxytetralkyldiamidotriphenyl methane or metamethyoxy or metaethyoxy tetralkyldiamidotriphenyl carbinol.

412,978—October 15, 1889. J. ROSENHEK. *Production of yellow dyestuffs.*

"Thioflavine T," obtained by introducing alcohol radicals into the primary thionated bases from paratoluidine and xylidine, and which as chlorhydrate is soluble in water, alcohol, and diluted acid. It dyes mordanted cotton a bright yellow.

412,979—October 15, 1889. J. ROSENHEK. *Production of yellow coloring matter.*

Obtained by sulphonating thio bases from paratoluidine and xylidine.

413,048—October 15, 1889. R. GNEHM AND J. SCHMID. *Violet coloring matter.*

Monophenylmeta-amidophenolphthaleine, produced by melting two molecules of metaoxydiphenylamine with one molecule of phthalic-acid anhydride in the presence of a condensing agent, as zinc chloride, at 160° to 170° C.

413,049—October 15, 1889. R. GNEHM AND J. SCHMID. *Blue coloring matter.*

Phenylmeta-amidophenoldichlorphthaleine, produced by the reaction of dichlorophthalic acid on metaoxydiphenylamine in the presence of a condensing agent, as zinc chloride, at 170° to 200° C.

413,050—October 15, 1889. R. GNEHM AND J. SCHMID. *Gray coloring matter.*

Phenylmeta-amidophenoltetrachlorphthaleine, a dark green powder, produced by the reaction of tetrachlorophthalic acid on metaoxydiphenylamine in the presence of a condensing agent, as zinc chloride, at 180° to 210° C.

413,562—October 22, 1889. A. SARAUW. *Production of azo coloring matter.*

The process consists in reacting with a salt of the nitroso derivatives of the tertiary amines, more especially nitroso-dimethyl-aniline, upon a bioxynaphthaline whose boiling point is above 186° C., in the presence of heat and a suitable solvent. The coloring matter ranges from violet-blue to blue.

413,724—October 29, 1889. H. D. KENDALL. *Brown dye.*

A fast-brown coloring matter produced by treating diritroso-resorcin (Alsace green) or its homologues with a hydrosulphite.

415,088—November 12, 1889. R. BOHN. *Trioxybenzophenone.*

Produced by the condensation of equal molecules of pyrogallol and benzoic acid. It combines with metallic mordants; gives fast yellow shades with alumina, and brown shades with iron and chrome mordants. M. p. 137° to 138° C.

415,257—November 19, 1889. M. ULRICH. *Process of making dioxynaphthalene monosulpho-acid.*

The process consists in melting the beta-naphthol alpha disulpho acid (the so-called "R" salt) or the beta-naphthol beta or gamma disulpho acid (the so-called "G" acid) with caustic alkali at above 200° C.

415,258—November 19, 1889. M. ULRICH. *Azo-blue color.*

Produced by the action of tetrazo-diphenol ether upon the dioxynaphthalene monosulpho acid gained by melting beta-naphthol beta or gamma disulpho acid with caustic alkali.

415,359—November 19, 1889. E. ELSAESSER. *Process of making paratoluidine sulpho-acid.*

The process of producing yellow dyestuffs from paratoluidine consists in extracting the soluble parts of crude dithioparatoluidine with alcohol, filtering and converting the residuum into a sulpho-acid by agitating it with fuming sulphuric acid containing sulphuric anhydride.

416,055—November 26, 1889. G. DÄNLIKER AND H. A. BERNTHSEN. *Manufacture of toluidine blue.*

Produced by converting dimethylaniline into nitroso, then into paramido-dimethylaniline, submitting this diamine, in mixture with sodium hyposulphite, to an oxidizing agent to transform it into paramido-dimethylaniline-thiosulphonic acid, then producing by addition of orthotoluidine and an oxidizing agent a green indamine ($C_{15}H_{17}N_3S_2O_3$) and finally converting this into toluidone blue by heating it with zinc chloride in the presence of an oxidizing agent. It is a redder tint than methylene blue.

416,145—November 26, 1889. R. GREVILLE-WILLIAMS. (*Reissue: 11,178—July 21, 1891.*) *Process of making azo dyes.*

Produced by combining one molecule of a tetrazo compound (tetrazo-diphenyl and its homologues, tetrazo-naphthalene, tetrazo-stilbene, tetrazo-fluorine, tetrazo-diphenolether, tetrazo-benzole and its homologues, tetrazo-oxy-diphenyl as well as the alkylized compounds, or the carbo or sulpho acids of the same) with one molecule of naphthalene-azo-naphthylamine or its sulpho compounds, and afterwards acting on the intermediate body thus formed with one molecule of one of the naphthylamines or sulpho-acids of the same. The process may be reversed.

417,207—December 10, 1889. R. GREVILLE-WILLIAMS. (*Reissue: 11,179—July 21, 1891.*) *Process of making azo dyes.*

Red substantive azo coloring matters produced by combining one molecule of a tetrazo body (No. 416,145) with one molecule of an amine (the amines and phenols are, first, aniline and its homologues, the naphthylamines, diphenylamine and its homologues; second, the alkylized products of these amines; third, sulpho-acids of one and two; fourth, carbolic acid and its homologues; fifth, resorcin and its homologues; and sixth, sulpho-acids of four and five), then combining a molecule of an azotized amine with the thus produced intermediate product, and afterwards reacting on the resulting secondary intermediate with one molecule of one of the amines or phenols.

417,294—December 17, 1889. M. ULRICH. *Azo dye.*

Produced by the action of tetrazo-diphenol ether upon the dioxynaphthalene monosulpho-acid obtained by melting "alpha-naphthol alpha-disulpho-acid S" with caustic alkali. It dyes unmordanted cotton in a boiling soap bath a clear greenish blue.

417,295—December 17, 1889. M. ULRICH. *Azo dye.*

Produced by the action of tetrazo-diphenyl salts from benzidine upon the dioxynaphthalene monosulpho-acid obtained by melting "alpha-naphthol alpha-disulpho acid S" with caustic alkali. It dyes unmordanted cotton in a soap bath a fast reddish blue.

417,296—December 17, 1889. M. ULRICH. *Azo dye.*

Produced by the action of orthotetrazoditolyl salts upon the dioxynapthalene mono-sulpho-acid obtained by melting "alpha-naphthol alpha-disulpho-acid S" with caustic alkali. It dyes unmordanted cotton in an alkaline bath a fast, clear blue.

418,153—December 31, 1889. F. BAYER. *Process of fixing azo dyes.*

Goods of animal or vegetable fibers which have been dyed or printed in the usual way with the substantive cotton coloring matters, are boiled with a solution of a metallic salt, and the metals fixed by the coloring matters in the form of a fixed lac.

418,657—December 31, 1889. G. SCHULTZ. *Production of orange and red dyestuffs.*

The process consists in heating certain amido compounds, such as cumidine or xylidine, with sulphur, treating the sulphide as formed with sulphuric acid, converting the sulphonic so formed into the corresponding diazo compound, and combining it with a phenol, naphthol, orcin, resorcin, amido compound, or naphthylamine, or their carbonic or sulphonic acids.

418,916—January 7, 1890. B. HOMOLKA. *Blue dye.*

A blue-violet coloring matter formed from aniline, hydrochlorides of aniline, and amido-azo-benzole, of the formula $C_{24}H_{18}N_4$, and capable of forming stable acetate. The hydrochloride, $C_{24}H_{18}N_4HCl$, is easily soluble in hot water.

420,164—January 28, 1890. J. MÖHLER. *Blue dye.*

Produced from the hydrochloride of nitroso-dimethylaniline and the crystallized condensation product from tannin with aniline. It is rendered soluble in water by treatment with bisulphite of soda and alcohol.

420,311—January 28, 1890. A. F. POIRRIER. *Nitroso dye.*

Brown to gray coloring matters: produced by heating in a suitable medium, as water, a salt of a nitroso derivative of secondary or tertiary amines, as nitroso-dimethylaniline hydrochlorate, and precipitating the coloring matter by a mineral salt.

420,372—January 28, 1890. O. N. WITT. *Blue dye.*

Produced by the combination of beta-naphthylamine beta-naphthionic acid (Broenner's) with one molecule of beta-naphthohydroquinone; distinguished by producing colored lakes with metallic mordants similar to alizarine and allied coloring matters.

420,373—January 28, 1890. O. N. WITT. *Ammonium salt of beta-naphthohydroquinone-beta-sulphonic acid.*

Produced by submitting amido-beta-naphthol-beta-sulphionic acid to the successive action of oxidizing and reducing agents.

420,374—January 28, 1890. O. N. WITT. *Dark-blue dye.*

Produced by the combination of one molecule of Dahl's alphanaphthylamine-disulphonic acid with one molecule of beta-naphthohydroquinone-beta-sulphonic acid. It dyes wool dark blue with a chrome mordant and bluish-purple shades with alumina mordants.

421,049—February 11, 1890. E. D. KENDALL. *Sulphonating rosaniline.*

Process consists in mingling dry bisulphate of soda, or of potash and rosaniline, and heating the same dry until the desired degree of sulphonation is obtained. Any sulphate wholly or in part composed of a higher sulphate than bisulphate is included.

421,640—February 18, 1890. A. WEINBERG. *Blue azo dye.*

Process consists in first combining diazo compounds with the oxyethers of alpha-naphthylamine or their sulpho-acids, forming the sulpho-acids of compounds of the general formula $R_1{-}N{=}NC_{10}H_5(OR)NH_2$ (where R_1NH_2 stands for the aromatic amido compound, R for the alkyl group), and afterwards diazotizing these basic compounds and reacting with the diazo-azo derivatives upon amines or phenols.

422,018—February 25, 1890. A. HERRMANN. (*Reissue: 11,116—October 14, 1890.*) *Blue-green dye.*

Metaoxytetralkyldiamidotriphenylmethan of unsymmetric constitution is derived from metaoxytetralkyldiamidotriphenylmethan, two different tertiary aromatic bases being condensed with metanitrobenzaldehyde. It is converted into the sulphonic acid by treatment with fuming sulphuric acid and the acid oxidated to coloring matter.

423,341—March 11, 1890. A. F. POIRRIER. *Green dye.*

Produced by condensing with tetramethyldiamidobenzhydrol, in a hydrochloric or sulphuric medium, paratoluidine, alpha-metaxylidine, pseudocumidine, amidotrimethylbenzol, or mesidine, and subjecting the leuco bases thus formed to oxidation, or oxidation in conjunction with the formation of hydroxyl, methyl, ethyl, benzyl, and sulpho-conjugated benzyl derivatives of said leuco compounds.

423,550—March 18, 1890. C. DUISBERG. *Process of making blue dyes.*

The tetrazo compound of benzidine disulphono-disulpho-acid is combined with alpha or beta naphthylamine, or their alkyl derivatives. It dyes cotton in an unmordanted bath and wool in a neutral bath.

423,569—March 18, 1890. P. OTT. *Azo dye.*

Process consists in obtaining substantive dyestuffs from intermediate products not dyestuffs by combining the tetrazo compounds of diamidoditoluylene oxide with one molecule of an amine, or a phenol or their sulpho or carbo or sulpho-carbo acids, and combining the product of the reaction with another molecule of an amine, or a phenol or their sulpho or carbo or sulpho-carbo acids.

424,019—March 25, 1890. R. NIETZKI. *Brown carbon dye.*

A yellowish-brown coloring matter of the formula $CnH_2n\text{-}8(NO_2)N_2CnH_2n\text{-}9$ (OH) (COOH), produced by condensing a nitrodiazo body with an ortho-oxy-carbonic acid; characterized by great fastness on chrome and nickel mordants.

425,504—April 15, 1890. R. GNEHM. *Red dye.*

Produced by the action of succinic acid upon dimethyl-meta-amidophenol, heated together with chloride of zinc up to 190° C., the temperature not to exceed 210°. It dyes a brilliant red with yellow fluorescence on wool, silk, and mordanted cotton.

425,525—April 25, 1890. J. SCHMID. *Orthonitroparadiamido-diphenyl.*

Produced by nitrating a sulphuric acid solution of benzidine sulphate and separating the nitro product. It is available for the production of a series of new coloring matters.

425,885—April 15, 1890. M. KAHN. *Process of making azo dyes.*

Process of producing violet to blue-black azo dyes for wool consists in combining the diazo compounds of the sulpho-acids of aniline or its specified equivalents with alpha-naphthylamine, again diazotizing the amidoazo compounds thus obtained and combining therewith phenyl alpha-naphthylamine or a homologue thereof.

426,345—April 22, 1890. A. WEINBERG. *Red dye.*

Produced by combining benzidine with beta-naphthol gamma disulpho-acid (No. 331,059), the reaction taking place only between one equivalent of the tetrazo compound and one equivalent of the sulpho acid. It dyes unmordanted cotton a fiery red and wool and silk in an acidulated bath bright scarlet shades.

427,564—May 13, 1890. R. GNEHM AND J. SCHMID. *Carbonic-acid compound of meta-amidophenol.*

Obtained by treating meta-amidophenol in presence of alkalis or alkaline earths with carbonic acid at a high temperature; and used for the production of coloring matters.

427,565—May 13, 1890. R. GNEHM AND J. SCHMID. *Carbonic-acid compound of dimethyl meta-amidophenol.*

Obtained by treating dimethyl meta-amidophenolate of soda with compressed dry carbonic anhydride at 120° to 140° C. It crystallizes in colorless needles, m. p. 145° C., under decomposition, and is used for the production of coloring matters.

428,530—May 20, 1890. C. SCHRAUBE. *Rosinduline monosulpho-acid.*

A red crystaline powder, $C_{28}H_{18}N_3SO_3H$, obtained by sulphonation of rosinduline. It is purified by suspending in water, neutralizing with cold dilute caustic alkali, boiling and adding additional caustic alkali, and converting the precipitate by a mineral acid into the pure monosulpho acid.

428,629—May 27, 1890. W. PFITZINGER. *Substantive yellow dye.*

Process consists in combining the diazo compounds of the thio derivatives, or the sulpho-acids of the thio derivatives, of paratoluidine, metaxylidine, and pseudo cumidine with the thio derivatives of paratoluidine, metaxylidine, and pseudo cumidine, or their sulpho-acids.

429,350—June 3, 1890. G. KOERNER. *Red dye.*

Produced by the combination of two molecules of napthionic acid with one molecule of the tetrazo derivative obtained by the action of nitrous acid on orthometa-toluidine. It dyes unmordanted cotton a bright red.

430,533—June 17, 1890. C. L. MÜLLER. *Process of preparing disazo dyes.*

Certain amidoazo compounds are coupled by twos by means of intermediaries, such as phosgene, and thio phosgene, or carbon bisulphide, in the presence of alkalis and alcohol; the said amidoazo bodies being paramido-benzene-azo bodies of the formula $NH_2.C_6H_4:N:N.R$, in which the second element (the residue of which is denoted by R) is a phenol, phenol-carboxylic acid, or phenol-sulphonic acid, or an amido-sulphonic acid of the aromatic series, capable of combining with diazo compounds and forming azo bodies.

430,534—June 17, 1890. C. L. MÜLLER. *Red to brown dye.*

A pink to orange-brown substantive dyestuff, a diazo derivative of symmetrical diamido-diphenyl-urea, obtained by coupling together two molecules of paramido-benzene azo-naphthionic acid by the aid of one molecule of phosgene.

430,535—June 17, 1890. C. L. MÜLLER. *Yellow dye.*

A yellow substantive dyestuff, a diazo derivative of symmetrical diamido-diphenylurea, obtained by coupling together two molecules of paramido-benzene salicylic acid by the aid of phosgene.

430,975—June 24, 1890. C. SCHRAUBE. *Red dye.*

Disulpho-acid of rosinduline, of the formula $C_{28}H_{17}N_3(SO_3H)_2$, produced by the action of fuming sulphuric acid or similar body, as monochlorhydrine sulphuric acid, on rosinduline, or upon its monosulpho acid. It dyes animal fiber in an acid bath a crimson tint.

431,297—July 1, 1890. J. WALTER. *Azo color.*

The process consists in adding sodium nitrite to a heated aqueous solution of aniline and muriatic acid, pouring the resulting solution into an alkaline solution of salicylic acid, precipitating with acid, and filtering, dissolving the dried product in sulphuric acid, and then slowly adding a mixture of nitric acid and sulphuric acid, pouring into water, and filtering; producing yellow to brown colors.

431,404—July 1, 1890. C. SCHRAUBE. *Rosinduline sulpho-acid.*

Produced by increasing the action of fuming sulphuric acid, or similar body, upon the disulpho-acid of rosinduline, No. 430,975, or upon the mono-sulpho acid, or on rosinduline itself. It dyes animal fiber in the acid bath a bright red color.

431,541—July 1, 1890. T. REISSIG. *Blue dye.*

Produced by the condensation of alpha-naphthylamine with the mononitroso compound of diethyl-meta-amidophone.

432,989—July 29, 1890. C. DUISBERG. *Blue dye.*

Produced by the action of the tetrazo compound of the benzidine sulphone disulpho-acid—which is manufactured by the sulphuration of benzidine sulphate with fuming sulphuric acid—upon phenyl-beta-naphthylamine. It dyes unmordanted cotton in an alkaline bath, and wool and silk in a neutral bath, indigo blue.

434,493—August 19, 1890. A. WEINBERG. *Blue dye.*

A disulphonated tertiary dibenzyl derivative of thionine, produced from the methyl and ethyl benzyl-paraphenylene-diamine-sulphonic acids. It dyes animal fiber in an acid bath a greenish blue.

437,989—October 7, 1890. A. HERRMANN. *Greenish-blue dye.*

The sulphonic acid of methylated and ethylated meta-amidotetralkyldiamidotriphenyl carbinol, easily soluble in water. The methylated and ethylated leuco bases corresponding to the sulphonated color are obtained by treatment of meta-amidotetralkyldiamidotriphenyl methane with methyl or ethyl halogens.

438,053—October 7, 1890. H. BOEDEKER. *Violet dye.*

Produced by the action of sulphuric acid upon ortho or para ditolyl-meta-amido-phenolphthaloine (ditolylrhodamine), which is obtained by the action of fluoresceine-chloride upon ortho or para toluidine.

438,438—October 14, 1890. R. LAUCH AND C. KREKELER. *Manufacture of dye-stuffs.*

Produced by the combination of the diazo compound of amidosalicylic acid with alpha-naphthylamine, again diazotizing the amidoazo compound obtained and recombining the diazo compound obtained with alpha-naphthol-sulpho-acid. It prints cotton violet and dyes wool blue black in a neutral or weak acid bath, dyeing a blue black with chromium mordants.

440,281—November 11, 1890. C. RIS. *Yellow dye.*

Produced by treating the diazo compound of polychromine (sulpho-acid of thioparatoluidine, also called "primuline") with ammonia. It dyes cotton without a mordant and can be diazotized.

440,288—November 11, 1890. J. WALTER. *Brown dye.*

Produced by combination of metadiamines with two diazo compounds, of which one is diazotized polychromine (the sulpho-acid of thioparatoluidine), and the other, one of the diazo compounds of naphthylamine or amidoazobenzole or amidoazo-toluol sulpho-acid.

440,359—November 11, 1890. C. A. MAYER. *Blue dye.*

Derived from nitroso-dimethylaniline and gallonaphthylamide. Violet coloring matters are produced by the action of nitroso derivatives of the tertiary amines on the products of condensation of tannin or catechine with the primary amines. Further products are obtained by reduction with alkaline bisulphites.

440,536—November 11, 1890. R. BOHN. *Blue dye.*

Produced by the action of nitroso derivatives of tertiary aromatic bases on a symmetrical dihydroxybenzoic acid C_6H_3COOOH. OH. OH. (1.3.5) which is obtained by melting metadisulpho-benzoic acid with an excess of caustic potash. Its alcoholic solution is most characteristic, being reddish-violet and marked by a striking reddish fluorescence.

440,639—November 18, 1890. R. LAUCH AND M. KAHN. *Blue-black azo dye.*

Violet to blue-black dyestuffs produced by combining a tetrazo compound (those of benzidene, toluidine, diamido-diphenol ether, diamido-stilbene, naphthylene-diamine, their sulphones and their sulphonic acids, with the exception of benzidine and toluidine disulphonic acids) with one or two molecules of alpha-naphthylamine (except the benzidine and toluidine disulphonic acids, which combine with two molecules of alpha-naphthylamine), diazotizing the resulting mono and diamido tetrazo compounds, and combining the new tetrazo compounds with naphthols (dioxynaphthalines) and their sulphonic acids.

440,953—November 18, 1890. W. MAJERT. *Blue dye.*

A new dioxynaphthaline, m. p. between 248° and 252° C., prepared by melting alpha-naphthyldisulpho-acid or alpha-naphthaline alpha-sulpho-acid with caustic soda or potash, dissolving the molten mass in water, and separating the dioxynaphthaline by means of acid. Mono or bisulpho acids of dioxynaphthaline are obtained by treating the same with concentrated sulphuric acid, fuming sulphuric acid, or sulphuric chlorhydrin. A blue coloring matter is obtained by treating a tetrazo compound, as tetrazo-diphenyl chloride, in the presence of sodium carbonate with the said dioxy-naphthaline, or its mono or bisulpho acids.

441,945—December 2, 1890. C. DREYFUS. *Red dye.*

Produced by combining diazotized dehydro-thio-paratoluidine sulphonic acid with beta-naphthol and then converting the combination into an ammonia salt.

442,369—December 9, 1890. L. GANS. *Blue-black dye.*

Produced by the action of amidonaphtholmonosulphonic acid upon tetrazo-diphenyl or homologous compounds.

442,680—December 16, 1890. M. HOFFMANN AND A. WEINBERG. *Blue dye.*

Produced by the action of the secondary bases of the series of fat bodies, as dimethylamine, diethylamine, upon the coloring matters belonging to the class of the oxazines (dimethyle or diethyle amidonaphtophenoxazine chloride) forming new bases which are oxidized into greenish-blue coloring matters.

443,402—December 23, 1890. M. V. NENCKI. *Gallacetophenone.*

See Group XVIII, Fine Chemicals, Ketones.

443,408—December 23, 1890. C. SCHRAUBE. *Yellow-red dye.*

Produced by treating rosinduline sulpho-acid (No. 431,404) with dilute sulphuric acid at from 175° to 180° C. The acid is dilnted so as to boil at the desired temperature.

444,229—January 6, 1891. R. M. DONOVAN. *Compound for coloring broom corn.*

Consists of green aniline, hurnt alum, water, and sulphuric acid.

444,538—January 13, 1891. J. MOHLER AND C. A. MAYER. *Blue dye.*

Produced by sulpho-conjugating the new products resulting from the action of the primary aromatic amines, at from 100° to 200° C., on the dyes obtained by the action of the nitroso derivatives of the tertiary aromatic amines on the condensation products of aniline and its homologues.

444,679—January 13, 1891. M. ULRICH. *Dioxynaphthaline-mono-sulphonic acid.*

The dioxynaphthaline-mono-sulphonic acid S, obtained by melting alpha-naphthol-alpha-disulphonic acid S (No. 333,034) with caustic alkali. The acid or its salts gives, with diazobenzene, an azo dyestuff similar in shade to acid magenta, and with ortho-tetrazo-ditolyl or tetrazo-diphenyl ethers, direct dyeing coloring matters of bright blue shades.

445,684—February 3, 1891. F. BENDER. *Pink dye.*

Produced by treating dimethyl or diethyl meta-amido-phenol with formaldehyde in order to produce tetramethyl or tetraethyl diamidodioxydiphenylmethane, treating the latter with dehydrating agents to produce tetramethyl or tetraethyl diamidodiphenylmethane oxide, and oxidizing the latter.

446,009—February 10, 1891. W. PFITZINGER. *Yellow dye.*

Prodnced by treating the diazo compound of thioparatoluidine sulpho-acid with the sulpho-acid of the same thio derivative of the paratoluidine.

446,892—February 24, 1891. R. E. SCHMIDT. *Alizarine derivative.*

"Alizarine cyanine" (pentaoxyanthraquinone) is produced by oxidizing alizarine bordeaux (tetraoxyanthraquinone) in sulphuric acid solution with oxidizing agents, such as manganese or arsenic acid, boiling, filtering, and washing, dissolving the precipitate in hot diluted alkali, filtering and precipitating with acid.

446,893—February 24, 1891. R. E. SCHMIDT. *Alizarine derivative.*

"Alazarine bordeaux" (tetraoxyanthraquinone), is produced by oxidizing alizarine with large quantities of fuming sulphuric acid of a high precentage of anhydride at a low temperature. It crystallizes from glacial acetic acid or nitro-benzole in garnet-red needles which do not melt at 280° C.; composition $C_{14}H_8O_6$.

447,189—February 24, 1891. P. JULIUS. *Red dye.*

A substantive red dyestuff, the sodium salt of diamido-diphenylene ketoxime diazo-naphthionic acid, produced from a new ketoxime base resulting from the action of hydroxylamine or hydroxylamine sulpho-acids upon the diamidodiphenylene ketone.

447,302—March 3, 1891. C. DUISBERG. *Violet dye.*

A direct-dyeing coloring matter derived from the action of one molecule of tertrazodiphenyldialkyl ether, first, on one molecule of alpha-naphthylamine mono-sulpho acid, and then, on one molecule of alpha-naphthol monosulpho acid.

447,303—March 3, 1891. C. DUISBERG. *Orange dye.*

A substantive reddish-orange coloring matter of the formula $C_{29}H_{19}N_6SO_6Na_2$, produced by combining one molecule of tetrazo-diphenyl with one molecule of salicylic acid, and combining the intermediate product with one molecule of naphthylamine monosulpho-acid.

449,520—March 31, 1891. M. CERESOLE. *Benzo-rhodamine.*

A red dyestnff resulting from the condensation of one molecule of benzotrichloride with two moleculesof alkylized meta-amidophenol. It dyes in general similarly to the tetramethyl and ethyl rhodamines.

449,551—March 31, 1891. E. MENTHA. *Dihydroxynaphthalene.*

"2.3-dihydroxynaphthalene," m. p. 160° to 161° C., yielding an intensely blue coloration with ferric chloride solution, may be produced by melting dihydroxynapthalene monosulpho acid R with twice its weight of a caustic alkali at 300° to 320° C., or by treating the said monosulpho acid with a dilute mineral acid. It is readily soluble in hot water, alcohol, ether, and fusel oil, slightly soluble in cold water, benzene, and petroleum ether.

449,629—March 31, 1891. J. SCHMID. *Black dye.*

Derived from monoalkylized derivatives of beta-naphthylamine and a diazo compound of the formnla $C_{10}H_5\ (SO_3Na)_2\ (a){=}N{-}N{-}C_{10}H_6\ N{=}NCl\ (a)$. It dyes wool and silk a brilliant black which in light shades presents a bluish gray.

450,037—April 7, 1891. H. REISENEGGER. *Black dye.*

A quinoline compound, soluble in soda lye with violet-red color, produced from amidoflavopurpurine or amidoanthrapurpurine by treatment with glycerine, sulphuric acid, and an oxydizing agent.

451,502—May 5, 1891. J. MOHLER AND C. A. MAYER. *Blue dye.*

A sulpho acid derived from tannin, aniline, and nitroso-dimethylaniline: produced by combining the coloring matter of No. 420,164 with ordinary sulphuric acid (containing 90 to 95 per cent of monohydrated acid, bnt no anhydrons sulphuric acid) at 80° C. It combines with alkalis, forming salts readily soluble in warm or cold water.

452,197—May 12, 1891. J. SCHMID. *Orange-yellow dye.*

Produced by combining a diazo compound of salicylic acid, or its homologues, with resorcin. The tints obtained on chrome mordants are orange yellow, on iron mordants brown.

452,210—May 12, 1891. R. BOHN. *Process of dyeing with gallacetophenone.*

Gallacetophenone imparts fast colors to animal and vegetable fiber when combined with metallic oxides or mordants within or upon the fibrous material.

453,477—June 2, 1891. A. HERRMANN. *Blue-green dye.*

The sulphonic acid of meta-chlortetralkyldiamidotriphenylcarbinol, produced by converting metadiazotetralkyldiamidotriphenylmethanchloride into the corresponding metachlor leuco base by treatment with copper or cuprous chloride, sulphonation of the chlor leuco base, and oxidation of the leuco-sulphonic acid thus obtained by means of peroxide of lead.

454,535—June 23, 1891. A. COBENZL. *Gray dye.*

Produced by the action of nitroso-diethylaniline hydrochlorate upon the beta-naphtholsulphonic acid of Schäffer. Suited for printing and dyeing woolen fabrics in blue-gray shades.

454,645—June 23, 1891. L. GANS. *Amido-naphthol-monosulphonic acid.*

Gamma-amido-naphthol-monosulphonic acid, produced by subjecting the beta-naphthylamine-gamma-disnlphonic acid to the action of a caustic alkali at 210° C. Azo coloring matters are produced by combining the diazo derivatives of aromatic monamines or diamines with the amido-naphthol-monasulphonic acid.

454,840—June 30, 1891. O. BORGMANN. *Orange dye.*

Produced by alkalizing the orange-yellow dyestuffs obtained by the combination of a tetrazodiphenyl or tetrazoditolyl with beta-naphthylamine disulpho-acid R and phenol, by treating the same with a halogen alkyl. It withstands the action of alkalis.

455,442—July 7, 1891. J. SCHMID. *Betadelta-amidonaphthol.*

Obtained by melting the sodium salt of beta-naphthylamine-delta-monosulpho acid with caustic alkalis at from 260° to 300° C. It is soluble in water, more so in benzene, easily soluble in ether and alcohol, m. p. 200° C.; nsed for the production of coloring matters.

455,952—July 14, 1891. C. RIS. *Brown dyestuff.*

Produced by condensation of paranitro-toluol sulpho-acid with paraphenylendiamine or paratoluylendiamine in a solution of caustic alkalis; soluble in water and alcohol.

456,081—July 14, 1891. M. CERESOLE. *Red dyestuff.*

A dye base, symmetrical diethyl-rhodamine: produced by the condensation of one molecule of phthalic anhydride with two molecules of monoethylmeta-amidophenol.

456,627—July 28, 1891. C. A. MARTIUS. *Process of making azo dyes.*

An alpha-naphthol disulphonic acid is, first, formed by treating naphthalene disulphonic acid with nitric acid, reducing the alpha-nitro naphthalene disulphonic acids so formed to alpha-amido naphthalene disulphonic acid and converting it into the corresponding compound alpha-naphthol disulphonic acid; and, second, the disulphonic acid so formed is added to a diazo derivative of an amido compound, such as xylidine, cumidine, alpha-naphthylamine, etc. It forms red, brown, violet, or bluish-violet coloring matters.

456,628—July 28, 1891. C. A. MARTIUS. *Process of making azo dyes.*

An alpha-naphthol disulphonic acid, formed as in No. 456,627, is added to a solution of a tetrazo derivative of an amido compound, such as diamido-stilbene, benzidine, etc., in proportions to form a compound of one molecule of the tetrazo compound combined with one of the alpha-naphthol disulphonic acid; then to this compound there is added a portion of naphthol or naphthol-sulphonic acid, and finally the dyestuff is precipitated from the solution. It forms violet or bluish-violet coloring matters.

456,897—July 28, 1891. C. A. MARTIUS. *Azo dye.*

Process consists in adding to the alpha-naphthol disulphonic acid formed as per No. 456,627, a tetrazo derivative of diphenitidine in proportions to form a compound of one molecule of tetrazo-diphenitidine with one of the alpha-naphthol disulphonic acid, then adding to this compound another portion of the alpha-naphthol disulphonic acid, and finally precipitating the dyestuff. There are formed red, brown, violet, blue, and bluish-black coloring matters.

458,281, August 25, 1891. B. HOMOLKA. *Induline dye.*

A blue coloring matter of the induline series, a zinc chloride double salt, produced by heating a mixture of solnble indulines together with paraphenylenediamine and hydrochlorate of paraphenyldiamine to 150° to 180° C., and after filtering precipitating with common salt and zinc chloride.

458,283—August 25, 1891. H. KUŽEL. (*Reissue: 11,231—April 5, 1892.*) *Azo dye.*

A brown powder adapted for dyeing wool in greatly differing shades, ranging from blnish red to deep black, depending upon the use of acids and metallic mordants, derived from a new dioxynaphthalene disnlphonic acid (the subject of a companion application) and diazo bodies.

458,284—August 25, 1891. H. KUŽEL. *Azo dye.*

Produced by the action of diazo bodies upon naphthol trisulphonic acid-monamide (which is formed by adding a solution of caustic ammonia to the naphthosulphon disulphonic acid obtained from napthalene trisulphonic acid, prepared by sulphonation of napthalene, by nitration and reduction, by treatment of the novel naphthylamine trisulphonic acid with nitrous acid, and subsequent boiling with acidulated water). It dyes wool a pronounced bluish-red shade.

458,285—August 25, 1891. H. KUŽEL. *Amido-naphthol monosulphonic acid.*

Produced by melting the salts of beta-naphthylamine disulphonic acid with caustic alkalis. A crystalline powder of difficult solubility in water and alcohol. Combined with diazo or tetrazo compounds it furnishes, in alkaline or acetic solution, azo coloring matters.

458,286—August 25, 1891. H. KUŽEL. *Amido-oxynaphthaline disulphonic acid.*

Produced by heating alpha-naphthylamine trisulphonic acid with caustic alkalis, and crystallizing in long pearly needles. It is easily converted by nitrons acid into a diazo compound of light yellow color, and combines with diazo and tetrazo compounds, in alkaline or acetic solutions, to form azo coloring matters.

462,414—November 3, 1891. C. RUDOLPH. *Brown dye.*

A brown basic dyestuff derived from paradiazoacetanilid chloride, meta-phenylene-diamine, and concentrated muriatic acid; easily soluble in water; especially suited for dyeing jute and leather.

462,415—November 3, 1891. C. RUDOLPH. *Blue-black azo dye.*

Produced by combining tetrazo diphenyl or ditolyl chloride with one molecule of amido-oxy-alpha-naphthalene disulpho-acid and with one molecule of alpha or beta naphthalene. It is soluble in water with a red-violet color and dissolves in concentrated sulphuric acid with a blue color.

462,824—November 10, 1891. G. SCHULTZ. *Blue azo dye.*

Blue direct-dyeing dyestuffs, produced by combining one molecule of a tetrazo salt, toluidine, or anisidine, with one molecule of alpha-naphthylamine, again diazotizing the compound, and combining the product with two molecules of an alpha-naphthol disulpho acid.

463,898—November 24, 1891. A. HERRMANN. *Blue dye.*

Produced by oxidizing the sulphonic acids of metaoxy, meta-amido, or alkylized meta-amido tetralkyl-diamidotriphenyl carbinols with salts of iron or chromic acid.

464,135—December 1, 1891. M. HOFFMANN. *Blue dye.*

Produced by mixing solutions of amidonaphthol-disulpho-acid H (formed by heating diamido-naphthalene-alpha-disulpho-acid with diluted mineral acids) and of the tetrazo derivatives of paradiamines and sufficient alkali to keep the solution alkaline. Its blue aqueous solution is not changed by addition of carbonate of soda, and it dyes unmordanted cotton.

464,538—December 8, 1891. A. WEINBERG. *Violet dye.*

Tetralkyl disulphobenzyldiamidotriphenylcarbinol: produced by mixing solutions of the substituted diamidodiphenylmethanes with solutions of aromatic monamines and oxidizing substances, to give simultaneous oxidation.

464,566—December 8, 1891. M. HOFFMANN. *Violet dye.*

"Naphthalene-violet:" produced by the action of tetrazonaphthalene betadisulphonic acid upon alpha-naphthylamine having the constitution $C_{10}H_4(SO_3Na)_2=[N=N-C_{10}H_6NH_2(a)]_2$. It is transformed by nitrous acid into a tetrazo compound which reacts upon phenols or amines, forming fast colors.

464,775—December 8, 1891. R. LAUCH AND C. KREKELER. *Blue-green azo dye.*

Produced by combining one molecular proportion of the diazo compound of amidonaphthalene azo-salicylic acid with one molecular proportion of dihydroxynaphthalene monosulphonic acid in the presence of sodium acetate.

465,116—December 15, 1891. C. RUDOLPH. *Brown azo dye.*

Produced by first combining diazotized toluylenediamine sulpho-acid 1:2:4:6 ($CH_3:NH_2:SO_3H:NH_2$) and two molecules of metaphenylenediamine, and then treating this intermediate compound with diazotized alpha or beta naphthylamine sulpho-acid.

466,202—December 29, 1891. M. ULRICH. *Black azo dye.*

Produced by combining the diazo compound of sulphanilic acid with alphanaphthylamine, further diazotizing the amidoazo product thus obtained, and causing the diazo derivative to act upon the sodium salt of the dihydroxynaphthalene monosulphonic acid S of No. 444,679. It dyes unmordanted wool fast bluish black to black, and forms lakes with chromium salts.

466,826—January 12, 1892. E. HEPP. *Blue-red dye.*

Trisulpho-acid of "phenyl-rosinduline," $C_{28}H_{16}N_3(SO_3H)_3$, obtained by treating phenyl-rosinduline with fuming sulphuric acid.

466,841—January 12, 1892. M. ULRICH. *Red azo dye.*

Produced by combining molecular proportions of toluidine sulpho-acid after diazotation, and of the dihydroxynaphthalene monosulphonic acid of No. 444,679. It dyes wool in acid baths bluish-red shades.

466,852—January 12, 1892. E. HEPP. *Disulpho-acid of phenyl-rosinduline.*

Beta-disulpho-acid of phenyl-rosinduline, $C_{28}H_{17}N_3(SO_3N_2)$, obtained by treating phenyl-rosinduline with concentrated sulphuric acid at 170° C. Its potassium and sodium salts dye wool red-bluish shades.

467,162—January 19, 1892: C. DUISBERG. *Tetrazo dye.*

Produced by combining with one molecular proportion of dianisidine after its diazotation one molecular proportion of beta-naphthol disulpho-acid R, and then one molecular proportion of alpha-naphthol alpha-monosulpho acid (Neville-Winther). It dyes unmordanted cotton in greenish-blue shades.

468,049—February 2, 1892. C. RUDOLPH. *Azo dye.*

Produced by treating tetrazodiphenyl or ditolyl with one molecule of amidooxyalphanaphthalenedisulpho acid and with one molecule of metaoxydiphenylamine or metaoxytolylphenylamine. It dyes unmordanted cotton blackish violet.

468,142—February 2, 1892. M. ULRICH. *Blue-red azo dye.*

Produced by acting with the diazo compound of paramido-benzol-sulphonic acid on the dihydrooxynaphthalene-mono-sulpho-acid of No. 444,679. It dyes unmordanted wool in sulphuric acid baths clear red shades; wool mordanted with chromium salts, dull violet.

468,539—February 9, 1892. O. BORGMANN. *Red dye.*

Produced by combining a diazo compound of tolidine with betanaphthylamine disulpho acid R, adding to the resulting intermediate body naphthionate of soda, allowing the mixture to stand until the reaction is complete, neutralizing with an alkali, and salting out the dyestuff.

469,329—February 23, 1892. A. WEINBERG. *Blue dye.*

Produced by forming the hydrochlorate of paranitrosomonomethyltoluidine, from the nitrosomine of monomethyl (or ethyl) orthotoluidine, then reducing with zinc dust, neutralizing, adding sodium thiosulphate and potassium bichromate, treating with monomethylorthotoluidine hydrochlorate, and oxidizing.

471,638—March 29, 1892. B. HOMOLKA. *Process of making rosaniline dyes.*

Diamidodiphenylmethan bodies are treated with oxidizing agents in the presence of hydrochlorates of aromatic amines.

471,659—March 29, 1892. E. VONGERICHTEN. *Process of making diamidodiphenylmethan bases.*

Hydrochlorates of aromatic amines are caused to act upon the anhydroformaldehyde compounds of aromatic amines.

472,121—April 5, 1892. M. HOFFMANN. (*Reissue*: *11,267—September 6, 1892.*) *Manufacture of yellow dyes.*

A derivative of the diamido beta-naphthalene disulpho-acid, which is prepared by double nitration and reduction of the naphthalene beta-disulpho-acid, F No. 464,566, and obtained from the said diamido acid by combining its tetrazo derivative with phenol or cresol, and treating the product with alkylated halogens.

473,453—April 26, 1892. M. EPTING. *Red dye.*

Produced by sulphonization of triamido-triortho-tolyl carbinol, in the form of its sodium salt; a green mass having metallic luster, of easy solubility in water, but insoluble in absolute alcohol.

473,467—April 26, 1892. H. KUZEL. *Process of making naphthosulfondisulphonic acid.*

Produced by nitrating a specified naphthalintrisulphonic acid (German patent No. 38,281), reducing the nitro compound, converting the naphthylaminetrisulphonic acid thus formed into the diazo compound, and boiling with acidulated water until the development of nitrogen ceases. The neutral disodium salt crystallizes in colorless needles.

475,616—May 24, 1892. R. SENGER. *Induline dye.*

Trioleate of induline, an intensely black liquid of the consistency of castor oil at ordinary temperature: produced by mixing one molecule of induline with three molecules of oleic acid (or stearic or palmitic acid) and heating to 100° to 120° C. It is insoluble in water, but easily soluble in alcohol and in benzene.

476,335—June 7, 1892. M. ULRICH. (*Reissue*: *11,308—February 21, 1893.*) *Violet azo dye.*

Produced by combining the diazo compound of paramido-phenol with the sodium salt of dihydroxynaphthalene monosulpho-acid S of No. 444,679; soluble in water. It dyes wool in acid baths a clear violet.

476,336—June 7, 1892. M. ULRICH. *Black-azo dye.*

A coloring matter, dyeing unmordanted wool a greenish-black: produced by combining diazotized beta-naphthylamine monosulpho-acid with alpha-naphthylamine, diazotizing the formed amido-naphthalene azonaphthalene sulpho-acid, and coupling the obtained diazo compound with the sodium salt of the dihydroxynaphthalene monosulpho-acid S.

476,337—June 7, 1892. M. ULRICH AND R. LAUCH. *Blue dye.*

A direct-dyeing coloring matter: produced by combining molecular proportions of tetrazo-diphenol-dimethylether and alpha-naphthylamine, diazotizing and combining the resulting tetrazochloride with two molecular proportions of the sodium salt of the dihydroxynaphthalene monosulpho acid S.

476,371—June 7, 1892. C. DUISBERG. *Tetrazo blue dye.*

A direct-dyeing tetrazo dyestuff: produced by combining one molecular proportion of the tetrazo compound of dianisidine with one molecular proportion of beta-naphtholdisulpho acid R and then with one molecular proportion of alphanaphtholalphamonosulpho acid (Cleve's).

476,393—June 7, 1892. R. LAUCH. *Dyestuff.*

A coloring matter, dyeing unmordanted cotton in neutral or alkaline baths a greenish-black or dark-gray: produced by combining molecular proportions of tetrazo-diphenyl, salicylic acid, and alphanaphthylamine, sulphonating the product, diazotizing, and then further combining with one molecular proportion of the sodium salt of alpha-naphthol-alpha-monosulphonic acid.

476,413—June 7, 1892. F. RUNKEL. *Triphenylmethane dye.*

Produced by combining, in the presence of concentrated sulphuric acid, equimolecular proportions of tetramethyldiamidobenzhydrol and alpha-hydroxynaphthionic acid, removing the uncombined alpha-hydroxynaphthionic acid, and then further oxidizing the resulting leuco compound; yielding shades of pure blue.

476,418—June 7, 1892. R. E. SCHMIDT. *Alizarine derivative.*

A coloring matter, dyeing wool mordanted with chromium salts in greenish-blue shades: produced by oxidizing the alizarine bordeaux of No. 446,893 with manganese in concentrated sulphuric-acid solution, at not exceeding 25° C., and combining the resulting diquinone with salicylic acid, likewise in sulphuric-acid solution.

476,419—June 7, 1892. R. E. SCHMIDT. *Alizarine dye.*

An alizarine dye, dyeing wool mordanted with alumina salts clear and pure blue shades, with chromium salts greenish-blue shades: produced by the action of ammonia upon the anthraquinone formed by oxidizing alizarine bordeaux in sulphuric-acid solution with manganese at low temperatures.

476,420—June 7, 1892. R. E. SCHMIDT. *Alizarine derivative.*

An alizarine dyestuff containing nitrogen, dyeing wool mordanted with chromium salts similar to alizarine blue: produced by treating alizarine bordeaux with ammonia and precipitating the color with acids.

476,491—June 7, 1892. R. E. SCHMIDT. *Alizarine dye.*

An alizarine dye, giving a clear bluish green on wool mordanted with chromium salts: produced by oxidizing alizarine bordeaux in sulphuric-acid solution with manganese, treating the resulting anthraquinone with salicylic acid, and then with ammonia.

478,005—June 28, 1892. R. GNEHM AND J. SCHMID. *Violet dye.*

A greenish glittering crystalline powder of an intense metallic luster, dyeing mordanted wool and cotton violet to blue shades: produced by treating a mixture of tetra alkylized diamido-benzo-phenone, sulphuric acid, and pyrogallol with a condensing agent, diluting with water, neutralizing with soda-salt, dissolving in dilute acetic acid, and precipitating with common salt.

479,515—July 26, 1892. R. LAUCH. *Olive dye.*

A grayish-black powder, dyeing unmordanted cotton olive in alkaline-soap baths: produced by reacting with one molecule of tetrazo-diphenyl upon one molecule of salicylic acid and one molecule of alpha-napthylamine, treating said product with fuming sulphuric acid, diazotizing, combining the so-formed diazo compound with one molecular proportion of the sodium salt of dihydroxynaphthalene monosulpho acid, and treating the dyestuff thus obtained with fuming sulphuric acid.

480,326—August 9, 1892. M. HOFFMANN. *Disazo dye.*

Produced by introducing one molecule of amido-naphtholdisulpho acid H into the solution of one molecule of a diazo body in presence of a mineral acid; making the solution alkaline; adding a second molecule of a diazo body; and separating the dyestuff with common salt. It dyes animal fiber an intense and fast greenish blue black.

481,591—August 30, 1892. H. N. F. SCHAEFFER. *Process of dyeing with alizarin.*

The cloth or fiber is first treated with a soluble modification of alizarine, consisting of a soluble salt of boracic acid and alizarine, and then with a mordant.

481,934—September 6, 1892. C. DUISBERG. *Red dye and process of making the same.*

A substantive tetrazo dyestuff produced by combining one molecular proportion of the tetrazo compound of dianisidine with molecular proportions of alphanaphthylamine alpha-monosulphonic acid (naphthionic acid).

482,106—September 6, 1892. M. ULRICH AND J. BAMMANN. *Azo coloring matter.*

A blue direct-dyeing coloring matter: produced by combining one molecular proportion of tetrazo-diphenyl chloride with one molecular proportion of alphanaphthylamine; diazotizing the product, and combining the thus obtained hexazo compound with two molecular proportions of the sodium salt of a specified 1.8 amido-naphthol beta-disulpho-acid.

483,368—September 27, 1892. D. A. ROSENSTIEHL. *Process of making azo colors.*

A nitramine is coupled with a phenol amine, or the specified derivative thereof, and the product subjected to the action of a reducing agent in an alkaline medium.

484,521—October 18, 1892. H. KUZEL. *Yellow dyestuff.*

Produced by the action of diazotized diamido sulphones upon oxycarbonic acids.

484,697—October 18, 1892. R. BOHN. *Blue dye.*

Produced by combining tetraalkyldiamido-benzophenone with dihydroxy-naphthalene by the aid of a condensing agent such as phosphorus oxychloride. It dyes animal or vegetable fiber, with a metallic mordant, greenish to violet shades of blue.

488,430—December 20, 1892. R. GNEHM AND J. SCHMID. *Basic yellow dye.*

Produced by treatment of a new base—dimethyl-diamido-diortho-tolyl-methane—simultaneously with sulphur and ammonia. It dyes cotton mordanted with tannin and tartar emetic yellow shades of a slightly greenish tinge.

489,623—January 10, 1893. F. BENDER AND M. KÄMMERER. *Yellow-red dye.*

Bluish-red dyestuffs obtained from dialkylmetaamidophenols (such as the rhodamines of dialkylmeta-amidophenol, etc.) or their corresponding leuco compounds are transformed into coloring matters of a more yellowish-red tint by treating same with an oxidizing agent such as potassium permanganate.

490,403—January 24, 1893. A. HERRMANN. *Indigo-blue dye.*

An oxidation product of the sulphonic acids of meta substituted tetralkyldiamido-triphenylcarbinols, produced by oxidizing the sulphonic acids of meta-oxy-, meta-amido-, or alkylized meta-amidotetralkyldiamido-triphenyl carbinols with salts of iron or chromic acid.

491,378—February 7, 1893. J. SCHMID AND J. MOHLER. *Violet-blue induline dye.*

Produced by melting a mixture of para-phenylene-diamine, hydrochlorate of para-phenylene-diamine, and alpha-nitro-naphthylamine at from 160° to 190° C., dissolving the melt in dilute muriatic acid, and precipitating with common salt.

491,410—February 7, 1893. T. DIEHL. *Blue-black azo dye.*

Derived from the tetrazo compound of para-amido-benzene-azoamido-alpha naphthalene and gamma amido-naphtholmonosulpho-acid, beta naphthol-alpha monosulpho-acid, or naphthionic acid.

491,422—February 7, 1893. R. GNEHM AND J. SCHMID. *Brown dye.*

A soluble dyestuff obtained by converting the insoluble product of meta or para-diazo-benzoic acid with Bismarck brown, with the aid of potash or soda.

493,241—March 14, 1893. H. BOEDEKER. *Pink dye.*

The alkali salt of a sulphonic acid, of the formula $C_{33}H_{33}O_3N_2SO_2$ alk′, derived from fluorescein chloride and mesidine.

493,413—March 14, 1893. B. R. SEIFERT. *Dye from alpha oxyuvitic acid.*

Process consists in combining alpha oxyuvitic acid with diazo compounds by the same manipulations as are used in the manufacture of the ortho and para azo coloring matters.

493,562—March 14, 1893. J. SCHMID AND R. PAGANINI. *Monosulpho-dioxynaphthoic acid.*

Produced by heating the sodium salt of di-sulpho-beta-oxynaphthoic acid with caustic alkalis at from 200° to 260° C. and precipitating the dissolved melt with hydrochloric acid or sulphuric acid.

493,563—March 14, 1893. J. SCHMID. *Blackish-blue azo dye.*

Produced by combining one molecular proportion of diazotized dianisidin with one molecular proportion of the sodium salt of mono-sulpho-dioxy-naphthoic acid, combining the intermediate product with an alkaline solution of one molecular proportion of (1.4) alpha naphthol-alpha-sulphonic acid of Nevile & Winther, and precipitating with common salt.

493,564—March 14, 1893. J. SCHMID. *Gray-black tetrazo dye.*

Produced by combining one molecular proportion of tetrazo-diphenyl or ditolyl with two molecular proportions of the sodium salt of mono-sulpho-dioxy-naphthoic acid. It dyes cotton direct from gray to violet-black shades by the aid of sulphate of soda or common salt and soap.

493,583—March 14, 1893. R. GNEHM AND J. SCHMID. *Red dye.*

Produced by combining molecular proportions of diazotized mono-nitro-benzidine, salicylic acid, and alpha-naphthol-alpha-mono-sulpho acid (Nevile & Winther), and precipitating with common salt. Dark red shades are obtained on wool mordanted with chromium salts.

494,833—April 4, 1893. F. BENDER. *Blue dye.*

A greenish blue coloring matter produced by the reaction of dimethyl-meta-amido-cresol (prepared by diazotizing metaamidodimethyl orthotoluidine and decomposing the diazo-compound with water) with salts of paranitroso derivatives of aromatic amines.

496,139—April 25, 1893. R. E. SCHMIDT AND P. TUST. *Alizarin dye.*

Produced by oxidizing beta nitroanthrapurpurine in sulphuric acid solution with manganese dioxide, and boiling the intermediate product with water, acids, sulphites, or bisulphites. It dyes wool mordanted with alumina salts dull violet, mordanted with chromium salts, greenish-blue shades.

496,392—May 2, 1893. J. BAMMANN AND M. ULRICH. *Tetrazo dye.*

Produced by combining one molecular proportion of tetrazomono-ethoxydiphenyl chloride with two molecular proportions of the 1.8-amidonaphthol-beta-disulpho acid or its salts in alkaline solution. It dyes unmordanted cotton in alkaline soap bath greenish-blue, fast to alkalis.

497,032—May 9, 1893. C. RUDOLPH. *Orange azo dye.*

Produced by the reaction of diazotized toluylendiamin-sulpho acid with beta-naphthylamine. It dyes cotton directly.

497,114—May 9, 1893. J. BRACK. *Blue dye.*

Produced by heating an amine of the fatty series with a gallo-cyanine; colors varying from violet to greenish blue on chrome mordanted fiber.

498,303—May 30, 1893. E. VON PORTHEIM. *Glycine dye.*

Produced by combining one molecule of a tetrazo compound of a diamine with one molecule of naphthylglycine, and combining the product with one molecule of a suitable body, as an amine; direct dyeing; generally soluble in water, and not readily affected by alkalis.

498,404—May 30, 1893. P. OTT. *Greenish-blue dye.*

Produced by combining in equal molecular proportions diazotized aniline and Clève's alphanaphthylamine beta monosulpho acid, diazotizing the formed benzene azo alpha naphthylamine beta monosulpho acid, and coupling the diazo compound with paratolyl-alpha-naphthylamine monosulpho acid obtained from alpha naphthylamine monosulpho acid (1:8) and paratoluidine.

498,405—May 30, 1893. P. OTT. *Disazo dye.*

Produced by combining equal molecular proportions of diazotized aniline and Clève's alphanaphthylamine beta monosulpho acid beta or delta, rediazotizing the amidoazo product, and coupling the resulting diazo compound with one molecular proportion of phenylalphanaphthylamine alpha monosulpho acid, obtainable from alpha naphthylamine-monosulpho acid (1:8) and aniline. It dyes wool, with or without mordants, blue shades with a reddish hue.

498,471—May 30, 1893. H. HASSENCAMP. *Triphenylmethane dye.*

Produced by combining equi-molecular proportions of tetra-methyldiamido-benzhydrol and dibenzylanilin disulpho acid, or salts thereof, and then oxidizing the resulting leuco compound. It dyes wool in a sulphuric-acid bath, easily fixed on fiber, a violet color similar to methyl-violet 5 B.

498,753—June 6, 1893. J. BAMMANN AND M. ULRICH. *Blue substantive dye.*

Produced by combining one molecular proportion of tetrazo ortho ditolyl salt with one molecular proportion of 1:8-amidonaphthol beta disulpho acid, or an alkaline salt thereof, and with one molecular proportion of dihydroxynaphthalene.

498,873—June 6, 1893. J. BAMMANN AND M. ULRICH. *Blue tetrazo dye.*

Produced by combining equi-molecular proportions of a tetrazo orthoditolyl salt with 1:8-amidonaphthol beta-disulpho acid and alpha-naphthol alpha mono-sulpho acid; dyeing unmordanted cotton.

498,874—June 6, 1893. J. BAMMANN AND M. ULRICH. *Blue tetrazo dye.*

Produced by combining one molecular proportion of the tetrazo chloride of orthodiphenol ether with two molecular proportions of the 1:8-amidonaphthol-beta-disulpho-acid or its salts in alkaline solution; dyeing unmordanted cotton in alkaline soap bath greenish-blue shades, fast to alkalis.

498,882—June 6, 1893. M. HOFFMANN. *Naphthylene-diamine disulpho-acid.*

1.5-diamidonaphthalene-3.7-disulphonic acid, a light yellow insoluble tetrazo compound: produced by treating the naphthalene-beta-disulpho acid with nitric acid, and acting on the dinitro compound with reducing agents. It combines with phenols or amines, forming azo coloring matters.

498,982—June 6, 1893. C. KREKELER AND P. KRAIS. *Red dye.*

Produced by combining equal molecular proportions of alpha-naphthol-alpha-monosulpho acid (OH: SO_3H=1.5), or its alkaline salts, and diazotized amidobenzoic acid.

499,193—June 13, 1893. J. BAMMANN AND M. ULRICH. *Blue tetrazo dye.*

Produced by combining equi-molecular proportions of a tetrazodidiphenyl salt with 1.8-amidonaphthol beta disulpho acid and alphanaphthol alphamonosulpho acid, by preference in alkaline solution.

499,216—June 13, 1893. C. DUISBERG. *Blue tetrazo dye.*

Produced by combining one molecular proportion of a tetrazo salt of benzidine sulphone disulpho acid with two molecular proportions of monoethylbetanaphthylamine; dyeing unmordanted cotton, wool, or silk reddish blue.

499,243—June 13, 1893. E. MEYER. *Blue dye.*

Produced by acting with equal molecular proportions of tetra-alkyldiamido-benzhydrol on the products (new blue R) derived from nitrosodialkylanilines and beta naphthol; dyeing blue shades on cotton prepared with tannic acid or the like.

499,927—June 20, 1893. P. MONNET. *Anisolin, and process of making it.*

A coloring matter, or dye, having an alcoholic radical substituted for the metal of a rhodamin salt: produced by heating under pressure and above 100° C., a mixture of an alcoholic haloid salt, a rhodamin salt, and an alcohol—as ethyl alcohol, a potassium rhodamin salt, and a simple or compound alcoholic chloride—then diluting, distilling, adding hydrochloric acid, and precipitating with sea salt. It has a strong affinity for fiber, and dyes unmordanted cotton.

500,761—July 4, 1893. A. G. GREEN AND T. A. LAWSON. *Red azo dye.*

Para-azoxy-ortho-toluidin is prepared by treating a boiling solution of para-nitro-ortho-toluidin with a cold solution of sodium stannite. Substantive azo coloring matters of various shades of yellow, orange, and red are produced by converting para-azoxy-ortho-toluidin into its tetrazo compound, and combining the same with a phenol or amine, or their sulphonic or carboxylic acids, such as the para-sulphonic acid of alpha-naphthol, corresponding to Piria's naphthoic acid.

500,762—July 4, 1893. A. G. GEORGE AND T. A. LAWSON. *Red azo dye.*

Produced by treating azoxytoluidin of m. p. 168° C. with nitrous acid, combining the tetrazo compound thus obtained with one molecule of alpha-naphthol-para-sulphonic acid and one molecule of beta-naphthol-disulphonic acid R, and precipitating the coloring matter.

500,917—July 4, 1893. I. LIFSCHÜTZ. *Violet-red dye.*

Produced by treating ortho-nitro-anthraquinone with concentrated sulphuric acid and heating to about 200° C., and subsequently treating with a caustic potash solution. It shows a characteristic absorption spectrum.

501,069—July 11, 1893. H. HASSENCAMP. *Violet dye.*

A triphenylmethane dyestuff produced by combining equi-molecular proportions of tetramethyldiamidobenzhydrol and ethylbenzylanilin disulpho acid, or a salt thereof, oxidizing the resulting leuco compound, and converting it into the sodium salt. It dyes wool in an acid bath violet with a bluish tinge, fast to lime and ammonia.

501,104—July 11, 1893. F. RUNKEL. *Triphenylmethane dye.*

Produced by combining equi-molecular proportions of tetramethyldiamido-benzhydrol and benzoic acid in the presence of concentrated sulphuric acid, and oxidizing the resulting leuco compound. It gives green shades, fast against fulling.

501,118—July 11, 1893. M. ULRICH AND R. LAUCH. *Blue-black tetrazo dye.*

Produced by combining one molecular proportion of tetrazo-ortho-ditolyl salt with one molecular proportion of alphanaphthylamine, further diazotizing the product, and coupling the tetrazo compound thus obtained with two molecular proportions of 1.8-dihydroxynaphthalene alphamonosulpho acid or an alkaline salt thereof. It dyes unmordanted cotton in a neutral or alkaline soap bath from greenish-blue to bluish-black shades.

501,160—July 11, 1893. W. PFITZINGER. *Process of dyeing black.*

It consists, first, in dyeing cotton by a coloring matter such as is obtained by combining one molecule of tetrazo diphenyl, or analogous compounds thereof, with two molecules of amido naphthol monosulpho acid G; second, in diazotizing on the fiber; and, third, combining the resulting diazo compound with phenol.

501,235—July 11, 1893. B. R. SEIFERT. *Creosote compound.*

See Group XXIII, Fine Chemicals, Alcohols, and Phenols.

501,434—July 11, 1893. C. MÜLLER. *Violet dye.*

A sulphonated derivative of ortho-alkyl-oxy-para-rosaniline: produced by exposing the alkyl-ethers of meta-hydroxy-phenyl-para-tolylamine, meta-hydroxy-phenyl-ortho-tolylamine, or meta-hydroxy-phenyl-meta-xylyamine to the action of a condensing agent, such as phosphorus oxychloride or phosgene, in the presence of a diluent, such as toluene, and then sulphonating the basic coloring matter.

501,500—July 18, 1893. L. GANS AND M. HOFFMANN. *Black dye.*

Bluish-black coloring matters derived from tetrazo compounds of paradiamines, such as benzidine or analogous bodies, one molecule of gamma-amidonaphthol-sulpho acid, and one molecule of amidonaphtholdisulpho acid H. They produce blue to black shades on unmordanted cotton; can be diazotized, and secondary derivatives produced in substance or on the fiber.

502,368—August 1, 1893. R. LAUCH AND C. KREKELER. *Black azo dye.*

A greenish-black powder with metallic luster: produced by combining one molecular proportion of the diazo-compound of amidosalicylic acid with one molecular proportion of 1:8-dihydroxy-naphthalene. It dyes wool mordanted with chromium salts deep black, and produces the same shade on cotton when printed with chrome mordants.

502,369—August 1, 1893. R. LAUCH AND C. KREKELER. *Reddish-blue azo dye.*

A greenish-black powder with metallic luster: produced by combining equal molecular proportions of beta naptholcarbonic acid (m. p. 216° C.) and the diazo compound of amidosalicylic acid. It produces reddish-blue shades, fast against soap when printed with chromium mordants.

502,603—August 1, 1893. R. BOHN. *Green-blue alizarin dye.*

A dark-colored powder, soluble in alcohol, practically insoluble in ether and benzene, slightly soluble in cold water. Derived by the successive treatment of di-nitro-anthra-quinone, first with fuming and afterwards with concentrated sulphuric acid. It yields pure green-blue shades with chrome mordanted sheep's wool fiber.

502,765—August 8, 1893. R. E. SCHMIDT. *Blue alizarin dye.*

A dark-colored paste produced by treating the hexaoxyanthraquinone (alizarinhexacyanin of No. 506,265) with ammonia preferably in the presence of oxygen or atmospheric air. It produces on wool mordanted with alumina salts blue shades, and on wool mordanted with chromium salts greenish-blue shades.

502,912—August 8, 1893. A. F. POIRRIER AND D. A. ROSENSTIEHL. *Black azo dye.*

A secondary diazo of alkalized meta-diamine, produced by combining the diazo derivatives of the mono and disulphonic acids of aniline, of toluidins, of xylidins, and of isomeric naphthylamine, with naphthylamine, again diazotizing the compound obtained, and combining it with an alkalized secondary or tertiary meta-diamine (such as meta-phenylenediamine). It is but slightly soluble in water, characterized by great coloring power and dyeing wool in deep colors.

503,066—August 8, 1893. H. THOMS. *Salicylate of para-tolyldimethylpyrazolon.*

See Group XVIII, Fine Chemicals, Ketones.

503,148—August 15, 1893. R. LAUCH. *Substantive brown dye.*

A grayish-black powder, soluble in ammonia with brown color, produced by combining one molecular proportion of tetrazodiphenylchloride with one molecular proportion of salycilic acid and with one molecular proportion of alphanaphthylamine, sulphonating the tetrazo compound obtained and coupling one molecular proportion of the diazo derivative of this sulpho product with one molecular proportion of alphanaphthylamine. It dyes unmordanted cotton in neutral or alkaline baths.

503,295—August 15, 1893. R. E. SCHMIDT. *Hexaoxyanthraquinone, and process of making it.*

A new hexaoxyanthraquinone, which crystallizes out of nitro-benzene or glacial acetic acid in dark needles of metallic luster: produced by oxidizing with a body containing SO_3, alizarin, quinizarin, anthrachrysone or symmetrical dihydroxybenzoic acid, alizarin bordeaux, purpurin, purpuroxanthin or purpuro bordeaux, which latter product results when purpurin or purpuroxanthan is treated with fuming sulphuric acid. It dyes wool mordanted with alumina, violet, and mordanted with chromium salts, blue shades.

503,305—August 15, 1893. F. BENDER. *Orange dye.*

A basic orange coloring matter derived from acridin, which dissolves in water or spirit, and may be produced by eliminating ammonia from certain tetramido derivatives, which can be manufactured by condensing aldehydes (such as formaldehyde or benzaldehyde) with aromatic substituted metadiamins (such as meta-amidodimethylanilin).

506,265—October 10, 1893. R. E. SCHMIDT. *Alizarinhexacyanin.*

An alizarin dyestuff moderately soluble in alcohol and glacial acetic acid and crystallizing therefrom in dark brilliant crystals, produced by oxidizing alizarin pentacyanin or alizarin bordeaux. It produces violet shades with aluminum mordants and blue shades with chrome mordants.

506,284—October 10, 1893. M. ULRICH AND J. BAMMANN. *Blue coloring matter, and process of making same.*

A coloring matter giving on unmordanted cotton from blue to greenish-blue shades (fast to the action of alkali and acid), produced by the reaction of one molecular proportion of the tetrazo compound of tolidin or dianisidin with two molecular proportions of 1:8-amidonaphthol-alpha-mono-sulpho acid (NH_2:SO_3H:OH=1:4:8) in an alkaline solution. It is further diazotizable when fixed on the fiber.

506,918—October 17, 1893. R. KOTHE, F. REINGRUBER, AND H. HASSENCAMP. *Blue coloring matter.*

Blue triphenyl-methane dyestuffs, dark powders with bronze luster, produced by combining equi-molecular proportions of tetramethyl (or ethyl) diamidobenzhydrol and alpha naphthylamin sulpho acid (NH_2 : SO_3H=1 :2), sulphonating the resulting leuco compound and oxidizing the thus obtained new leuco sulpho acid (or its salts).

509,623—November 28, 1893. R. LAUCH. *Brown dye.*

A dark brown paste, produced by combining one molecular proportion of a diazotized amido hydroxy carbonic acid of the aromatic series with one molecular proportion of resorcinol or orcinol, and acting on the intermediate body thus obtained with nitrous acid. It dyes unmordanted wool brown, and produces brown shades on fibers mordanted with metallic mordants, either in dyeing or printing.

509,635—November 28, 1893. M. ULRICH AND J. BAMMANN. *Brown dye.*

A brown substantive coloring matter, which can be diazotized when fixed on the fiber, produced by the action of one molecular proportion of tetrazodiphenyl salt upon one molecular proportion of the amido-naphthol-disulpho acid (NH_2:SO_3H:SO_3H:=1:3:6:8), or an alkaline salt thereof, and one molecular proportion of the so-called Bismarck brown (which results from the action of nitrous acid on meta phenylene diamine).

509,929—December 5, 1893. M. MOELLER. *Blue azo dye.*

Blue azo dyes derived from 1:8-amidonaphtholmonosulphonic acid and tetrazoditolyl or tetrazodiphenolether, and which may be prepared by melting with alkali the alphanaphthylaminedisulpho acid mentioned in No. 333,934.

511,532—December 26, 1893. R. KOTHE, M. ULRICH, AND O. DRESSEL. *Blue dye.*

Bluish-black powder: produced by acting with one molecular proportion of a tetrazo compound of the paradiamines on two molecular proportions of the sodium salt of amidonaphtholdisulpho acid (NH_2: SO_3 H: SO_3 H: OH=1:2:4:8) in an alkaline solution. It produces on unmordanted cotton greenish-blue shades, fast against alkalies.

511,653—December 26, 1893. G. SCHULTZ. *Blue dye.*

Blue basic dyes, produced by the joint oxidation of alkalized derivations of para-phenylenediamin containing one free amido group with di-para-tolylmetaphenylenediamin in a suitable solvent by means of chromates; a violet-black powder easily soluble in water or alcohol, insoluble in ether.

511,708—December 26, 1893. M. MOELLER. *Production of amido naphthol disulphonic acid.*

A new amido-naphthol-disulphonic acid (a disulphonic acid of 1:8-amido naphthol), soluble in water, yielding no diazo compound when treated with nitrite, turning dark green on the addition of ferric-chloride; produced by converting the alphanaphthylaminedisulphonic acid (of German patent No. 40,571) by further sulphonation into alphanaphthylaminetrisulphonic acid, and melting the salts of the latter with caustic alkalis in an open or closed vessel.

511,898—January 2, 1894. H. KUŽEL. *Naphthol trisulfonic-acid monamid.*

The salts of naphtholtrisulphonic-acid monamid, which are soluble in water and precipitated by alcohol and acids, the latter precipitating moss like. They are produced by treating the naphthosulphton-disulphonic acid (described in German patent No. 56,058) with ammonia.

511,901—January 2, 1894. H. LAUBMANN. *Tetranitro-anthrachrysone.*

A yellow powder produced by submitting anthrachrysone to the action of nitric acid; easily soluble in the usual solvents except benzene, ligrone, and chloroform; from its pure glacial acid solution precipitated by chloroform in the form of small crystals, which decompose with detonation at 280° to 300° C.; forming with potassium, sodium, and ammonium, salts insoluble in alcohol, detonating on being heated.

512,116—January 2, 1894. R. KIRCHHOFF. *Crimson azo dye.*

A red-brown powder produced by combining paradiazobenzene-sulpho acid with ortho anisidin, further diazotizing the amidoazo compound thus obtained, and combining the rediazotized product with beta naphthol alpha monosulpho acid.

512,167—January 2, 1894. T. DIEHL. *Blue-black dye.*

An amorphous black-brown powder, derived from the diazo compound of para-amido-benzene-azoamido-alphanaphthalin and paraamidonaphtholmonosulpho acid, soluble in water, sparingly soluble in alcohol. The alpha-naphthol-alpha-monosulpho acid or the naphthionic acid may be substituted for the para-amidonaphtholmonosulpho acid.

512,493—January 9, 1894. M. ULRICH AND J. BAMMANN. *Blue dye.*

Blue substantive dyestuffs, easily soluble in water, produced by combining one molecular proportion of a paradiamin, such as dianisidin, with one molecular proportion of the alkaline salt of amidonaphtholdisulpho acid (NH_2: SO_3H:SO_3H: OH=1:3:6:8), and coupling the so-formed intermediate product with one molecular proportion of beta naphthol or alpha naphthol monosulpho acid (OH:SO_3H=1:5).

514,599—February 13, 1894. M. HOFFMANN AND C. F. DAIMLER. *Diazo dark-green dye.*

A dark-green powder, easily soluble in water with a bluish or greenish color, produced by treating one molecule of the amidonaphtholdisulphonic acid H with a solution of one molecule of a diazo body in presence of free acid, making the solution alkaline, and adding one molecule of a tetrazo body; the solution which now contains the intermediate product is mixed with the solution of a phenol, or of an amine, and the dyestuff is precipitated with common salt.

515,100—February 20, 1894. A. WEINBERG. *Basic yellow dye.*

New dyes, as a yellow powder, derived from diazobenzyl-dialkylamin and resorcin. HCL. (alk.) $_2N-CH_2-C_6H_4-N=N-C_6H_3(OH)_2$, are produced by combining diazobenzylalkylamins with phenols or amins.

515,339—February 27, 1894. A. ISRAEL AND K. PATHE. *Gray dye.*

A gray powder, soluble in cold water with difficulty, easily soluble in hot water with a grayish-black color: produced by combining one molecular proportion of diazotized dehydrothiotoluidinsulpho acid with one molecular proportion of alpha naphthylamin, further diazotizing the intermediate product and coupling the diazo product with one molecular proportion of dihydroxy-naphthalene monosulpho acid S, or a salt thereof. On unmordanted cotton it produces from bluish-gray to grayish-black shades, the latter fast against alkali and acid.

515,381—February 27, 1894. M. ULRICH, J. BAMMANN, AND M. HERZBERG. *Brown dye.*

A brown substantive coloring matter produced by treating tetrazo-diphenyl chloride with one molecular proportion of amidonaphtholdisulpho acid, (NH_2 : SO_3H : SO_3H.OH-1 : 3 : 6 : 8), adding to the product one molecular proportion of metaphenylene diamine, and acting on the dyestuff thus produced (an intermediate product) with one molecular proportion of diazoalpha-naphthalene chloride. When fixed on cotton fiber it can be diazotized and directly coupled with any dyestuff component.

515,897—March 6, 1894. J. J. BRACK. *Polyazo dye.*

Yellow polyazo coloring matters: produced by combining a molecule of dioxydiphenylmethane with two molecules of diazo-compounds, of which one at least is the intermediate product resulting from the union of a molecule of salicylic acid and a molecule of the tetrazo derivative of a paradiamido base, such, for example, as benzidin, tolidin, and formaldehyde-tolidin.

516,203—March 13, 1894. M. HOFFMANN AND C. KROHN. *Gray azo dye.*

A blackish-gray powder: produced by combining tetrazo bodies with two molecules of amidonaphtholdisulphonic acid H, brought together with nitrite in an acid solution, and the diazo compounds thus obtained are introduced into the solutions of phenols or amines in presence of alkalis. It dyes unmordanted cotton a fast gray.

516,380—March 13, 1894. C. RUDOLPH. *Brown azo dye.*

A blackish powder, dying cotton in an alkaline bath in yellow-brown shades: produced by reacting on diazotized toluylendiaminsulpho acid ($CH_3:NH_2:SO_3H:NH_2=1:2:4:6$) with meta-phenylendiamine and separating the dye.

516,381—March 13, 1894. C. RUDOLPH. *Azo dye from amidophenolsulfo-acid.*

A greenish-black powder, with a slight metallic luster, dyeing unmordanted cotton in a corinth shade: produced by adding tetrazo-ditolylchlorid to an aqueous solution of a sodium salt of amidophenolsulphonic acid and soda, next adding to the intermediate product a solution of resorcin in soda lye to form an intermediate dyestuff, treating said dyestuff with diazonaphthionic acid in an aqueous emulsion, heating the mass, and precipitating the dyestuff with common salt.

516,468—March 13, 1894. J. J. BRACK. *Yellow tetrazo dye.*

Yellow tetrazo coloring matters, as a compound derived from salicylic acid and the condensation product of formaldehyde with a paradiamin and a hydrochlorate of said paradiamin, which in a dry state is brownish powder readily soluble in water, dyeing unmordanted cotton, in an alkaline bath, are produced by first preparing diamido a base by the condensation of formaldehyde with a paradiamin and a hydrochlorate of said paradiamin, diazotizing, and then mixing the tetrazo derivative with a solution of a carboxylic acid in an alkali.

516,577—March 13, 1894. E. SCHLEICHER. *Basic yellow dye.*

A gold-yellow or orange dye, a diamido-phenyl-acridin, carboxylalkylester, soluble in alcohol and in water, giving red-yellow stable solutions possessing a strong yellowish-green fluorescence, may be produced by submitting a body—$C_{20}H_{15}N_3O_2$—to esterification, as by heating with an alcohol, in the presence of hydrochloric acid, sulphuric acid, and the like; said body being obtained by suitably treating fluorescein with ammonia.

516,584—March 13, 1894. H. A. BERNTHSEN. *Red dye.*

A dye, dialkyl-rhodamin-alkyl-ester, derived from dialkyl-rhodamin; as a base soluble in benzene, ether, and warm water, and in the commercial form of hydrochloric-acid salt, a bronze-like crystalline powder soluble in water, giving a scarlet-red solution, possessing a greenish-yellow fluorescence. The introduction of the alkyl-group into the symmetrical diakyl-rhodamins can be effected by the action of alcohols, especially methyl or ethyl, in presence of a mineral acid, muriatic or sulphuric.

516,585—March 13, 1894. H. A. BERNTHSEN. *Red rhodamin dye.*

A dye, a dialkyl-homo-rhodamin-alkyl-ester, readily soluble in water, giving red and strongly fluorescent solutions: produced by preparing a mono-alkyl-ortho-toluidin-sulpho-acid by sulphonation of mono-alkyl-ortho-toluidin, and converting this sulpho acid into mono-alkyl-meta-amido-cresol by melting with a caustic alkali, then obtaining therefrom diakyl-homorhodamin by heating with phthalic anhydrid and zinc chloride, and finally alkylating the dialkyl homo-rhodamin by treatment with alcohol and either hydrochloric or sulphuric acid.

516,588—March 13, 1894. M. CERESOLE. *Rhodamin dye.*

Coloring matters, produced by heating tetra-alkylated rhodamin to partially dealkylate the same. The dyestuff obtained by partially dealkylating the tetra-ethyl-rhodamin of the phthalic-acid series, in the form of its hydrocloric-acid salt is a dark-colored crystalline powder with a bronze-like sheen, soluble in water and in alcohol, dyeing more yellowish shades of red than the tetra-ethyl-rhodamin from which it can be obtained.

516,589—March 13, 1894. M. CERESOLE. *Rhodamin dye.*

A dyestuff, partially dealkylated tetra-methyl-rhodamin of the succinic-acid series, in the form of its hydrochloric-acid salt, appearing as a dark-colored crystalline powder soluble in water and in alcohol, but practically insoluble in ether or benzine.

516,604—March 13, 1894. R. KIRCHHOFF. *Black dye.*

A black dyestuff, readily soluble in water, sparingly soluble in alcohol, insoluble in ether: produced by combining one molecular proportion of tetrazoortho-ditolyl salt with one molecular proportion of the amido-oxynaphthalendisulphonic acid of No. 458,286, further diazotizing the intermediate product, and coupling the tetrazo compound thus obtained with two molecular proportions of meta-toluylendiamin. It dyes unmordanted cotton in a salt or alkaline bath a deep black.

516,752—March 20, 1894. J. J. BRACK. *Diamido base.*

Unsymmetric diamido-bases, suitable for the production of substantitive cotton dyes, as the base derived from formaldehyde, tolidin, and orthoamidophenol, a yellow-brown mass forming salts, the aqueous-acid solutions of which have a pronounced green fluorescence, are produced by the reaction under heat of one molecule of formaldehyde on a mixture of one molecule of a paradiamin and one molecule of the hydrochlorate of an aromatic monoamido-compound.

516,753—March 20, 1894. J. J. BRACK. *Diamido base.*

Diamido-bases, applicable to the manufacture of substantive cotton dyes, as the base derived from formaldehyde, tolodin, and metaphenylendiamin, which, in a dry state, is a light brown powder, are produced by condensing, with the aid of heat, one molecule of formaldehyde with a mixture of one molecule of a paradiamin and one molecule of the chlohydrate of an aromatic diamin.

516,754—March 20, 1894. J. J. BRACK. *Diamido base.*

Diamido-bases, applicable to the manufacture of substantive cotton dyes, are produced by condensing, with the aid of heat, one molecule of formaldehyde with a mixture of one molecule of dianisidin and one molecule of the basic hydrochlorate of an aromatic diamin. The base derived from hydrochlorate of metaphenylendiamin is a brown powder, insoluble in water, soluble in hydrochloric acid, and forms salts readily soluble in water.

516,755—March 20, 1894. J. J. BRACK. *Diamido base.*

A diamido-base, applicable to the manufacture of substantive cotton dyes, is produced by the reaction, under heat, of one molecule of formaldehyde on a mixture of one molecule of dianisidin and one molecule of the chlorhydrate of an aromatic monoamido-compound. The base derived from the hydrochlorate of aniline is a resinous mass, fusing at 75° to 80° C., and forms salts and a tetrazo-derivative soluble in water.

516,756—March 20, 1894. J. J. BRACK. *Red tetrazo dye.*

Tetrazo coloring matters are produced by combining two molecules of a naphthylamin-sulpho acid with one molecule of the tetrazo-derivative of the unsymmetrical diamido-base resulting from the condensation of one molecule of formaldehyde with one molecule of the hydrochlorate of a monoamido-compound. The tetrazo coloring matter derived from alpha-naphthionic acid and an unsymmetrical diamido-base obtained by the condensation of formaldehyde with tolidin and the hydrochlorate of a monoamido compound, is a red-brown powder, readily soluble in water, dyeing unmordanted cotton a red tint.

516,757—March 20, 1894. J. J. BRACK. *Blue tetrazo dye.*

Tetrazo coloring matters are produced by combining two molecules of a naphtholsulpho-acid with one molecule of the tetrazo-derivative of the unsymmetrical diamido-base resulting from the condensation of equivalent quantities of formaldehyde, dianisidin, and the hydrochlorate of a monoamido compound, as of aniline or orthoamidophenol. The tetrazo coloring matter derived from an unsymmetrical diamido-base in a dry state is a brown powder possessing a metallic luster, and dyes unmordanted cotton a blue tint.

516,758—March 20, 1894. J. J. BRACK. *Blue tetrazo dye.*

Tetrazo coloring matters are produced by combining two molecules of alpha-naphthol-alpha-sulpho-acid with one molecule of the tetrazo-derivative of the diamido-base resulting from the condensation of equivalent quantities of formaldehyde, tolidin, and the hydrochlorate of an aromatic diamin. The coloring matter derived from alpha-naphthol-alpha-monosulpho-acid and the diamido-base from the condensation of formaldehyde, tolidin, and the hydrochlorate of metaphenylenediamin is a brown powder with a metallic luster, soluble in water, and dyes unmordanted cotton in an alkaline bath a blue tint.

516,759—March 20, 1894. J. J. BRACK. *Red tetrazo dye.*

Tetrazo coloring matters are produced by combining two molecules of a naphthylamin-sulphonic acid with one molecule of the tetrazo-derivative of the diamido-base resulting from the condensation of equivalent quantities of formaldehyde, a paradiamin and the hydrochlorate of an aromatic diamin. The coloring matter derived from alpha-naphthionic acid and the diamido-base from the condensation of formaldehyde with tolidin and hydrochlorate of metaphenylendiamin is a red powder and dyes unmordanted cotton a red tint.

516,760—March 20, 1894. J. J. BRACK. *Blue tetrazo dye.*

Tetrazo coloring matters are produced by combining two molecules of alpha-naphthol-sulphonic acid with one molecule of the tetrazo-derivative of the diamido-base resulting from the condensation of equivalent quantities of formaldehyde, dianisidin, and the hydrochlorate of an aromatic diamin. The coloring matter derived from alpha-naphthol-alpha-mono-sulpho acid and the diamido base from condensation of formaldehyde with dianisidin and the hydrochlorate of an aromatic diamin is a brown powder, dyeing unmordanted cotton a blue tint.

517,533—April 3, 1894. A. WEINBERG. *Process of dyeing by the aid of paramido-diphenylamin.*

Fast colors are produced on fiber dyed with a diazotizable dyestuff, by treating such dyeings in a first bath with free nitrous acid, and developing the color in a second bath containing paramidodiphenylamin.

518,458—April 17, 1894. K. KREKELER AND P. KRAIS. *Blue dye.*

A blue coloring matter is produced by the reaction of nitrosodiethylaniline hydrochlorate and gallamic acid in the presence of solvents, as alcohol or acetic acid. It is soluble in hot water and dyes wool and cotton, mordanted with chromium salts, from blue to bluish violet.

518,989—May 1, 1894. H. A. FRASCH. *Petroleum sulfo-acid.*

Sulpho acids are obtained by sulphonating the aromatic series of hydrocarbons contained in petroleum or the distillates or residuums thereof; leaching the sulphonated product with cold water; subjecting the remainder to the action of hot water; separating the matter soluble in hot water, adding a base, such as lime, to the hot-water solution; separating the soluble and insoluble sulpho salts thereby obtained; and liberating from the solution of the soluble salt an acid by the addition of a reagent, such as hydrochloric acid. The new sulpho acid is unaffected by concentrated hydrochloric acid, decomposes into sulphur dioxide and a greenish-black oil at a red heat, is of a greenish-black color when solid, capable of dyeing silk and wool, without mordant, a yellowish color, and its alkaline salts dye wool and silk a bright yellow.

518,990—May 1, 1894. H. A. FRASCH. *Petroleum sulfo-acid.*

A sulpho acid, whose calcium salt is insoluble in water, is obtained from petroleum, its derivatives or distillates, by sulphonating the material; removing the free sulphuric acid; separating the soluble and the insoluble and oily matters from the remainder; converting the soluble matter into a soluble and an insoluble salt by, for example, the addition of carbonate of lime; separating the insoluble salt, and rendering it soluble by a suitable reagent, such as carbonate of sodium, caustic soda, or other substance that will displace the base contained in the insoluble salt, and precipitating from such solution the sulpho acid by hydrochloric or equivalent acid. It is of greenish-black color, soluble in water, fluorescent in solution, and dyes wool or silk a brownish color without a mordant.

518,991—May 1, 1894. H. A. FRASCH. *Brown petroleum nitro dye.*

A nitro body, in the form of a reddish-brown powder, is produced by nitration of petroleum, or the residuum of the distillation, or refining thereof, with nitro-sulphuric acid; washing the resulting product with water, heating with water, settling; removing the solution from the sediment and treating it with a base, such as lime, and thereby forming a soluble and an insoluble salt; and precipitating from the soluble salt solution the dyestuff by a reagent, such as sodium chloride. It is soluble in water, glycerine, and acetone, capable of dyeing wool or silk, without a mordant, a reddish brown, and its calcium salt is soluble in water.

518,992—May 1, 1894. H. A. FRASCH. *Petroleum dye.*

A yellow dyestuff, a sulpho body of the petroleum series of hydrocarbons, is produced by subjecting natural mineral oil, the distillates or residuums thereof, to sulphonation; washing the products of sulphonation with water, treating the products soluble in hot water with a base, such as lime; and isolating from the sulpho salts thereby obtained the dyestuff by treatment with an alkali and then with a precipitant, such as sodium chloride. It is soluble in water, glycerine, and acetone, fluorescent in solution, and dyes wool or silk, without a mordant, in acidulated solution, a canary yellow.

519,036—May 1, 1894. H. A. FRASCH. *Brown petroleum dye.*

A brown dyestuff is obtained from petroleum, or the distillates or residuums thereof, by nitrating the material, washing with water, dissolving the nitro products in hot water, decanting the solution from the remainder and treating it with a base, such as lime; separating the insoluble salt formed and rendering it soluble by the addition of an alkali, such as sodium carbonate; dissolving it in water and precipitating the dyestuff from the solution by the addition of a reagent, in whose solution the dyestuff is insoluble, such as sodium chloride.

It is soluble in water, acetone, and glycerine, dyes cotton without a mordant, and its calcium salt is insoluble in water.

519,522—May 8, 1894. J. J. BRACK. *Polyazo yellow dye.*

A polyazo coloring matter is produced by combining one molecule of dioxydiphenylmethane with two molecules of diazo-compounds, one of said compounds constituting the intermediate product resulting from the union of one molecule of sulphanilic acid with one molecule of the tetrazo-derivative of a paradiamin, such for instance as benzidin. It is a brown powder soluble in water, and soluble in sulphuric acid with a reddish-violet coloration, and dyes unmordanted cotton in an alkaline bath yellow.

519,523—May 8, 1894. J. J. BRACK. *Polyazo yellowish dye.*

Polyazo coloring matters, varying from red to orange, are produced by combining one molecule of dioxydiphenylmethane with two molecules of diazo-compounds, of which compounds one at least is the intermediate product resulting from the union of one molecule of naphthionic acid and one molecule of the tetrazo-derivative of a paradiamido base, such as benzidin, tolidin, tolidin-formaldehyde, dianisidin, or dianisidin-formaldehyde. A brown powder is produced from dioxydiphenylmethane, tetrazoditolyl, and naphthionic acid, which dyes unmordanted cotton a yellowish-red color in an alkaline bath, is soluble in water, and in concentrated sulphuric acid with a blue coloration.

519,971—May 15, 1894. J. SCHMID AND J. BACHELUT. *Blue dye.*

A blue acid coloring matter is produced by heating mixtures of equal molecular proportions of dialkylized aniline, alkylized ortho-toluidin, and meta oxybenzaldehyde in presence of condensing agents, then sulphonating, and finally oxidizing the thus obtained new leoco-sulpho acid. It is a dark powder with metallic luster, soluble in water with blue coloration, soluble in alcohol, but insoluble in ether and benzene.

521,095—June 5, 1894. H. A. BERNTHSEN AND P. JULIUS. *Substantive blue dye.*

A coloring matter which can be derived from tetrazo-ditolyl, the 2.4′.2-amidonaphtholsulpho acid and 1.4-naphthol-sulpho acid. It is readily soluble in water, giving red-violet solutions; soluble in sulphuric acid, giving a blue solution and on diazotizing on the fiber, assumes a blue color.

521,096—June 5, 1894. H. A. BERNTHSEN AND P. JULIUS. *Substantive violet dye.*

A dark powder which can be derived from tetrazo-diphenyl and the 2.4′.2′-amidonaphthol-sulpho acid. It is readily soluble in water, giving claret-red solutions; soluble in sulphuric acid, giving a blue solution; and on diazotizing on the fiber, assumes a grayish-green color.

521,985—June 26, 1894. M. MOELLER. *Blue dye.*

A blue dyestuff derived from 1.8-amidonaphtholdisulpho acid (No. 511,708) and the tetrazo compound of ortho-tolidin. It is easily soluble in water, nearly insoluble in alcohol, dissolving with indigo-blue color in strong sulphuric acid.

521,986—June 26, 1894. M. MOELLER. *Blue dye.*

A blue dyestuff derived from 1.8-amidonaphtholdisulpho acid and the tetrazo compound of diamidodiphenol ether. It is easily soluble in water, nearly insoluble in alcohol, and soluble in strong sulphuric acid, with indigo-blue color.

522,042—June 26, 1894. A. BLANCHON AND A. ALLEGRET. *Process of printing indigo.*

Textile fabrics or yarns are printed with a mixture of refined or crude indigo and a solution of a thickening substance in water, then passed through a reducing bath, as of hyposulphite of lime, to reduce the indigo deposited on the fabric or yarn, and the indigo is then reoxidized in the usual manner.

522,897—July 10, 1894. W. HERZBERG AND O. WEBER. *Blue dye.*

Blue coloring matters are obtained by the condensation of orthoquinones or their sulpho acids with alkyl-para-phenylendiamins or their sulpho acids, when heated with sulphur and fuming sulphuric acid; capable of forming with metallic mordants, lakes, which dye with fast blue tints; specially suited for dyeing and printing wool and cotton, previously mordanted with chromium.

523,138—July 17, 1894. R. VIDAL. (*Reissue: 11,659—April 5, 1898. Black dye and process of making same.*

Greenish-black, bluish-black, and black dyestuffs, capable of dyeing without mordants, are produced by heating ortho or para-dioxybenzene, such as quinone, hydroquinone, toluquinone, or paracatechin in the presence of sulphur and of ammonia, or substances which will generate ammonia during the reaction. They are soluble in alkalis and alkaline sulphites.

524,069—August 7, 1894. C. O. MULLER. *Blue tetrazo dye.*

A new dioxy-naphthalene mono-sulpho acid is produced by melting alpha oxy-naphthoic acid ($OH.COOH.SO_3H.SO_3H$=1.2.4.7) with caustic alkali at 230° to 290° C.

Tetrazo coloring matters are produced by the combination of one molecule of the tetrazo derivative of an aromatic para-diamido compound (such as tetrazo-diphenyl and its homologues, tetrazo-oxydiphenyl-alkyl ethers, tetrazo-stilbene, and tetrazo-azobenzene and its homologues) with one molecule of the dioxy-naphthalene mono-sulpho acid ($OH.OH.SO_3H$=1.7.4.); and the subsequent combination of the intermediate product with a sulpho derivative of a naphthol compound, such as the mono-sulpho and disulpho acids of alpha and beta naphthols, of oxy-naphthols, of amido-naphthols, and the sulpho-acids of carboxylic oxy-naphthols.

The coloring matter derived from dianisidin, dioxy-naphthalene mono-sulpho acid, and disulpho acid of beta-naphthalene, dyes unmordanted cotton, in an alkaline bath, a fast greenish blue; and, in a dry state, is a brown powder with a metallic luster, readily soluble in water and concentrated sulphuric acids with a blue coloration.

524,070—August 7, 1894. C. O. MULLER. *Blue tetrazo dye.*

A new dioxy-naphthoic-mono-sulpho acid is produced by fusing alpha-oxy-naphthoic-disulpho acid ($OH.COOH.SO_3H.SO_3H$=1.2.4.7) with caustic alkali at 189° to 200° C.

Coloring matters are produced by substituting this sulpho acid for the dioxy-naphthalene mono-sulpho acid of No. 524,069.

524,220—August 7, 1894. C. SCHRAUBE. *Substantive blue dye.*

A substantive blue dyestuff is produced by combining the tetrazo-compound of diamido-diphenyl-dicarboxylic acid with 1.1′-benzoyl-amido-naphthol-sulpho acid. It is slightly soluble in cold water, more so in hot water, and insoluble in absolute alcohol, ether, and benzene.

524,221—August 7, 1894. C. SCHRAUBE AND E. ROMIG. *Phenylrosindulinsulfo-acid.*

A monosulpho acid of phenyl-rosindulin—isomeric with No. 428,539—is obtained by the reaction of ortho-amido-diphenylamin-para-sulpho acid and beta-hydroxy-naphthoquinone anil. It is almost insoluble in water, yields alkaline salts, soluble in hot and cold water, and is converted by sulphonation into a disulpho acid which is a violet-red dye for animal fiber.

524,222—August 7, 1894. C. SCHRAUBE AND E. ROMIG. *Violet-red dye.*

A disulpho acid of phenyl-rosindulin is produced by heating together ortho-amido-diphenylamine-para-sulpho acid and beta-hydroxy-naphtholquinone-anil with water and alcohol, and subsequently introducing the second sulpho groups into the monosulpho acid obtained by treatment with concentrated sulphuric acid. It is a violet powder, and, in the form of its alkaline salts, is soluble in water, and dyes animal fiber from an acid bath.

524,235—August 7, 1894. O. BALLY. *Blue dye.*

A coloring matter—in the dry form a coppery-lustered powder—produced by heating gallic acid and the dialkyl-anilins (diethyl and dimethyl-anilin) in the presence of a condensing reagent, such as phosphorus oxychloride, and afterwards zinc chloride. It is slightly soluble in cold water, more soluble on boiling; gives a violet solution in alcohol, and a reddish-yellow solutionin concentrated sulphuric acid.

524,251—August 7, 1894. P. JULIUS. *Soluble safranin azo naphthol.*

Saffranin-azo-alpha-naphthol, containing a saffranin proper, and soluble in water, may be prepared from a solution of saffarin proper and alpha or beta naphthol. When dry it is a dark powder with a slight metallic sheen, insoluble in alkalis, soluble in alcohol, and gives in sulphuric acid a blackish yellow-brown solution.

524,252—August 7, 1894. P. JULIUS. *Dimethyl safranin azo naphthol.*

Dimethyl-saffranin-azo-beta naphthol, soluble in water, may be prepared from a solution of dimethyl-saffranin and alpha or beta naphthol. It gives in sulphuric acid a blackish-green solution.

524,253—August 7, 1894. P. JULIUS. *Safarin azo naphthol dye.*

Dimethyl-saffranin-azo-alpha naphthol, soluble in water, may be prepared from dimethyl saffranin and alpha or beta naphthol. It gives in sulphuric acid a blackish-yellow solution.

524,254—August 7, 1894. P. JULIUS. *Safranin azo naphthol lake.*

A soluble saffranin-azo-naphthol body, obtained by treating a saffranin-azo-naphthol with an acid. A coloring-matter lake resembling indigo in color is obtained by combining a soluble saffranin-azo-naphthol body with a tanno-metallic mordant.

524,256—August 7, 1894. R. KNIETSCH. *Blue dye.*

A blue dyestuff, soluble in water and in alcohol, is produced by dissolving phenyl-glycocoll in strongly fuming sulphuric acid, then diluting by adding sulphuric acid containing water, then passing a current of air through the solution, and finally isolating the coloring matter formed.

524,261—August 7, 1894. C. L. MULLER. *Orange disazo dye.*

A diazo dye, which can be derived from meta-phenylene-diamin-disulpho acid and the diazo-compounds from primulin and anilin sulpho acid, occurring as a brown powder, soluble in water, giving an orange-colored solution, and a brilliant red solution in concentrated sulphuric acid.

524,262—August 7, 1894. C. L. MULLER. *Orange dye.*

An orange-yellow dye, produced by first preparing a disulpho acid of meta-phenylene-diamin by treating meta-phenylene-diamin with fuming sulphuric acid (with at least two molecular proportions of free sulphuric anhydride present for one molecular proportion of meta-phenylene-diamin), and then combining this disulpho acid with diazo-primulin. It is a brown powder soluble in water, giving an orange-yellow solution; same in sulphuric acid.

524,323—August 14, 1894. B. HEYMANN. *Blue dye.*

Blue coloring matters, dyeing cotton and wool with the aid of mordants: produced by the action of the nitroso compounds of alkylated benzylanilin sulpho acids on beta naphthoquinone sulpho acid (1:2:4) in the presence of sodium thiosulphate.

524,665—August 14, 1894. C. BULOW. *Black disazo dye.*

Black dyes, the diazo compounds of 1.8 amido-naphthol-monosulpho acid, can be obtained by the combination of two molecular proportions of a diazo compound with one molecular proportion of the aforesaid sulpho acid. They are soluble in hot water, giving blackish-blue solutions, which are changed to a pure blue to violet on the addition of a caustic alkali. The specific black dye obtained from a diazo compound of sulphanilic acid, aniline, and the aforesaid sulpho acid yields a green solution in sulphuric acid.

524,677—August 14, 1894. E. ELSAESSER. *Blue dye.*

A blue coloring matter produced by treating the beta-dinaphthyl-meta-phenylendiamin disulphonic acid in a dilute acetic solution with nitroso-dimethylaniline. It easily dissolves in water and dyes wool and silk in an acid bath.

525,656—September 4, 1894. P. JULIUS. *Azo dye.*

An azo dye which can be derived from meta-dinitro-aniline and dialkyl-meta-sulphanilic acid, occurring as a crystalline powder readily soluble in hot water, giving a scarlet solution, turning red on the addition of hydrochloric acid, and a bluish-red solution in concentrated sulphuric acid.

525,657—September 4, 1894. P. JULIUS. *Azo dye.*

An azo dye which can be derived from para-nitraniline and diakyl-meta-sulphanilic acid, occurring as a crystalline powder, soluble in water and alcohol, and gives a red to reddish-yellow solution in concentrated sulphuric acid.

531,148—December 18, 1894. J. BIERER AND C. DE LA HARPE. *Blue dye.*

Blue coloring matters are produced by oxidizing the product of condensation of the beta-naphthol sulphonic acid of Schaeffer and a gallocyanin dye resulting from the condensation of hydrochlorate of nitrosodialkylaniline, or of hydrochlorate of dialkylamidoazobenzene and gallic acid or its derivatives. It dyes wool mordanted with chrome mordants, in an acid bath, a blue tint, and is soluble in alkalis with a violet-blue coloration.

531,149—December 18, 1894. J. J. BRACK. *Substantive red dye.*

A hexazo-coloring matter produced by combining three molecules of a naphthylaminsulpho-acid with one molecule of the hexazo-derivative of the triamido-base derived from the condensation of formaldehyde with tolidin: formaldehyde is heated with tolidin in the presence of an excess of hydrochloric acid in dilute aqueous solution. It is a brick-red powder which dyes unmordanted cotton red, readily soluble in hot water, slightly soluble in alcohol, and soluble in concentrated sulphuric acid with a blue-violet coloration.

531,973—January 1, 1895. C. SCHRAUBE AND C. SCHMIDT. *Nitrosamin compound.*

The nitrosamins of the primary amins are produced by treating certain diazo compounds, such as diazo-nitro aniline, with a caustic alkali. As sodium salts they are soluble in water, with somewhat alkaline reaction, and produce no azo-dye in the presence of beta-naphtholate of sodium and alkali, but on treatment with an excess of acid are converted into the corresponding diazo compound which yields coloring matter on combination with beta-naphtholate of sodium. Para-nitro-phenyl-nitrosamin occurs as a yellowish paste or powder.

531,974—January 1, 1895. C. SCHRAUBE AND C. SCHMIDT. *Nitrosamin compound.*

A nitrosamin derived from the tetrazo-compound of benzidin, both in the free state and as a salt, in the form of a sodium salt occurring as a yellowish powder; soluble in water, yielding a brownish-violet color when brought on the fiber with sodium beta-naphtholate and subsequently exposed to the air.

531,975—January 1, 1895. C. SCHRAUBE AND C. SCHMIDT. *Nitrosamin compound.*

A nitrosamin derived from the diazo compound of para-dichloraniline, both in the free state and as a salt, as a sodium salt occurring as a yellowish powder; readily soluble in water; and yielding an orange color when brought on the fiber with beta-naphtholate and subsequently exposed to the air. On treatment with a molecular proportion of an acid it assumes the free state.

531,976—January 1, 1895. C. SCHRAUBE AND C. SCHMIDT. *Nitrosamin compound.*

A nitrosamin derived from diazo-naphthalene; a yellowish powder and in the form of sodium salt soluble in water; yielding red shades when brought on the fiber together with sodium beta-naphtholate and subsequently exposed to the air.

531,977—January 1, 1895. C. SCHRAUBE AND C. SCHMIDT. *Nitrosamin compound.*

A nitrosamin, which in the form of sodium salt can be derived from tetrazo-dianisidin; occurring as a yellowish powder; soluble in water; and yielding a blue color when brought together with sodium beta-naphtholate on the fiber and subsequently exposed to the air.

532,125—January 8, 1895. A. WEINBERG. *Blue disazo dye.*

A dark blue or black powder, produced by treating the diazo-derivative of amidonaphtholdisulpho acid H (Pat. No. 464,135) with cuprous chloride, and combining the thus obtained perchlornaphtholdisulpho acid with tetrazo bodies in an alkaline solution. It is readily soluble in water with violet-blue color, insoluble in alcohol, soluble in concentrated sulphuric acid with greenish-blue color, and dyes unmordanted cotton a blue shade in alkaline or neutral baths.

532,479—January 15, 1895. K. PATHE AND O. DRESSEL. *Red dye.*

Red substantive dyestuffs produced by the combination of one molecular proportion of diazotized dehydrothio-para-toluidin base with one molecular proportion of the amidonaphtholdisulpho acid $(NH_2:OH:SO_3H:SO_3H=2:5:7:1)$ in an alkaline solution. Red shades are produced on unmordanted cotton, fast to the action of alkali and acid.

532,484—January 15, 1895. A. F. POIRRIER. *Sulfur dye.*

Coloring matters dyeing fiber direct in black or blackish shades are produced by heating with sulphur or sulphur compounds the doubly substituted derivatives of benzene, such as the dihydroxyl derivatives or the diamid derivatives, the first class including the dioxynaphthalenes and the naphthoquinones, and the second class embracing the diamins of the benzene and naphthalene series, and the substances capable of producing them. They are very soluble in water, alkaline solutions and alkaline sulphids, insoluble in acid, and changeable on exposure to air.

532,503—January 15, 1895. R. VIDAL AND A. F. POIRRIER. *Sulfur dye.*

Process of producing coloring matters dyeing nonmordanted fibers: consists in heating with sulphur or a sulphur compound the joint amin and phenol derivatives, or bodies capable of producing them by reduction.

533,463—February 5, 1895. M. HOFFMANN. *Black azo dye.*

New black azo dyestuffs are produced by combining the diazo compound of alpha 1 alpha 2 naphthylenediamin-beta-sulpho acid with a diazotizable amin, diazotizing again, combining with gamma-amidonaphthol-sulpho acid and saponifying.

533,508—February 5, 1895. M. ULRICH AND J. BAMMANN. *Blue dye.*

Blue substantive dyestuffs: produced by combining one molecular proportion of tetrazotized diamins, as benzidin, tolidin, dianisidin, with one molecular proportion of amidonaphtholdisulpho acid $(NH_2:SO_3H:SO_3H:OH=1:3:6:8)$ and one molecular proportion of amidonaphtholmonosulpho acid $(NH_2:SO_3H:OH=1:4:8)$. A dark powder with metallic luster, easily soluble in water with a blue color, diazotizable, when fixed on the fiber, and giving with developers, especially beta-naphthol, deep black shades.

533,829—February 5, 1895. C. SCHRAUBE. *Red basic dye.*

A red basic coloring matter, beta-alkyl-eurhodin, produced by heating together alpha-naphthylamin hydrochlorate and an azo dye derived from mono-alkyl-para-toluidin, diazo sulphanilic acid, and phenol. It dyes bright scarlet shades on cotton mordanted with tannin and on silk.

534,573—February 19, 1895. R. PAGANINI. *Blue disazo dye.*

A disazo dyestuff produced by exposing an alkaline solution of alpha-oxy-disulpho-naphthoic acid to the action of a tetrazo derivative, such as the tetrazo derivative of toluidin, and subsequently combining the resulting intermediate product with alpha-naphthol-mono-sulphonate of soda. A dark-brown powder with a bronze luster, soluble in water with a blue-violet, in concentrated sulphuric acid with a pure blue, and in solution of caustic soda with a carmine-red coloration.

534,809—February 26, 1895. J. BIERER. *Blue dye.*

Sulphonated gallocyanin dyes are produced by heating a dialkylamidoazo benzenesulpho acid, having a sulpho group in the second benzene nucleus—that is, in the benzene nucleus which forms a diamido derivative on the splitting of the amidoazo compound by reduction—with a gallic compound, in a suitable solvent. It is soluble in water, insoluble in alcohol, dissolving in a solution of sodium acetate with blue color, in caustic alkalis with violet-blue color, in ordinary and diluted hydrochloric acid with red color, and in concentrated sulphuric acid with a bluish to violet-red color; dyeing wool and silk directly in an acid bath and presenting great affinity for metallic mordants.

535,036—March 5, 1895. A. WEINBERG. *Brown dye.*

Brown disazo dyestuffs are produced by combining the tetrazo derivatives of paradiamins, such as benzidin, with one molecule of phenyl-gamma-amido-naphtholsulpho acid and one molecule of an oxycarbonic acid, such as salicylic acid. The dyestuff derived from salicylic acid is a dark brown powder, easily soluble in hot water and alcohol, with a brown color; in concentrated sulphuric acid with a violet shade, and it dyes unmordanted cotton dark brown shades in alkaline or neutral baths.

535,037—March 5, 1895. A. WEINBERG. *Bluish-red azo dye.*

A red coloring matter produced by bringing together the alkaline solution of perchlornaphtholdisulpho acid with the diazotized dehydrothio compounds, such as dehydrothioparatoluidin, dehydrothiometaxylidin, or their sulpho acids. A dark brown powder easily soluble in cold water and in hot spirit with red color, in concentrated sulphuric acid with violet color; and dyes unmordanted cotton a bright bluish-red shade.

536,431—March 26, 1895. M. KAHN AND F. RUNKEL. *Black dye.*

A substantive black azo dye: produced by combining one molecular proportion of tetrazotized diamidodiphenylamin sulpho acid, first, with one molecular proportion of amidonaphtholsulpho acid G, in an alkaline solution, rediazotizing the resulting intermediate product, and finally combining the so-formed tetrazo compound with two molecular proportions of a meta diamin, such as meta phelyleudiamin or meta toluylendiamin, in an acetic acid solution. A brownish-black powder easily soluble in water, insoluble in alcohol and strong soda lye, soluble in concentrated sulphuric acid, with a bluish-black color.

536,524—March 26, 1895. W. HERZBERG. *Amidotriazin.*

"Amidotriazins" are formed by the action of aldehydes, of the aromatic or fat series, upon chrysoidins—the coloring matters formed by the action of diazotized amins or tetrazotized paradiamins or their sulpho or carbo acids on the metadiamins—and the sulpho derivatives of those of the said substances which contain no sulpho or carbonyl groups, produced by the action of sulphonating agents on those. A white crystalline powder, more or less soluble in water, insoluble in alcohol, soluble in alkaline liquors, and possessing a strong sweet taste. They may be diazotized and combined with phenols, amins, the sulpho and carbo acids of phenols and amins to form azo coloring matters.

536,626—April 2, 1895. R. HIRSCH. *Blue dye.*

Two basic coloring matters, blue and gray violet, are produced by oxidizing amido-dimethylaniline with chromic acid in the presence of one molecule of hydrochloric acid to one molecule of amido-dimethylaniline; the blue coloring matter being easily soluble, the gray violet less soluble in water, but perfectly soluble in acidulated water. The blue dyes cotton a dark blue when mordanted with tannin, and black when mordanted with iron; the gray violet dyes cotton mordanted with tannin, and will work on unmordanted cotton.

536,878—April 2, 1895. R. KIRCHHOFF. *Black dye.*

A tetrazo dye is produced by reacting with one molecule of tetrazotized para-amidobenzene-azo-amido-para-cresolether upon one molecule of salicylic acid, and combining the intermediate product with one molecule of gamma-amido-naphthol-monosulpho acid in alkaline solution. It is soluble in cold, more readily in hot water, with dark violet color; in concentrated sulphuric acid, with dark blue color, produces on unmordanted cotton black shades, and after fixation on fiber can be rediazotized and combined with amins and phenols.

536,879—April 2, 1895. R. KIRCHHOFF. *Blue-black dye.*

A dye produced by reacting with one molecule of tetrazotized para-amido-benzene-azo-amido-para-cresolether upon one molecule of alpha$_1$-naphthylamine-beta$_4$-monosulpho acid (Clève's beta acid) and combining the intermediate product with one molecule of gamma-amidonaphtholmonosulpho acid in alkaline solution. It is soluble in cold, more readily in hot water, with a violet-blue color; in concentrated sulphuric acid, with a dark indigo-blue color; and produces on unmordanted cotton bluish-black shades, and after fixation on the fiber, can be rediazotized and combined with amins and phenols.

536,880—April 2, 1895. R. KIRCHHOFF. *Blue dye.*

A dye produced by reacting with two molecules of gamma-amido-naphthol-monosulpho acid in weakly acid solution upon one molecule of tetrazotized para-amidobenzene-azo-amido-para-cresolether. It is soluble in cold, more readily in hot water, with violet-blue color; in concentrated sulphuric acid, with blue-black color; and produces on unmordanted cotton, fast blue shades.

537,511—April 16, 1895. A. WEINBERG. *Phenylamidonaphtholsulfo acid.*

A new compound, $C_{10}H_5.SO_3H.OH.NH—C_6H_5$, colorless small needles, forming dyestuffs with diazo or tetrazo compounds, is produced by heating gamma-amido-naphtholsulpho acids with aromatic amins in presence of means of condensation, such as hydrochlorate of aniline.

537,723—April 16, 1895. J. SCHMID AND K. JEDLICKA. *Orange dye.*

Orange coloring matters, similar to phosphine, produced by exposing a yellow acridin dyestuff to the action of an alcohol in the presence of a mineral acid. According to the degree of alkalization, orange-yellow to red-orange tints are produced, suitable for dyeing leather and cotton mordanted with tannin.

538,183—April 23, 1895. J. SCHMID AND J. MOHLER. *Blue dye.*

A poly-oxythionin coloring matter produced by condensation of 7 oxy 1.2 naphthoquinone 4. monosulpho acid with thiosulphonic acid of para-amido-alkyl-benzylanilin-sulphonate of soda; forming a dark violet powder, which dissolves with a blue-violet coloration in concentrated sulphuric acid, hot water, or in a dilute ammonia solution.

538,215—April 23, 1895. T. SANDMEYER. *Blue dye.*

A blue dyestuff, the sodium salt of the symmetrical trisulpho acid of triphenylrosanilin: produced by the condensation of two molecules of monosulpho acid of diphenylamin with one molecule of formaldehyde in acid solution to the disulpho acid of diphenyldiamidodiphenylmethan, and the oxidation of the said derivative in combination with a further molecule of diphenylamin-monosulpho acid. It dissolves in concentrated sulphuric acid, with a reddish-brown shade, in cold water, with a pale blue shade; its trisulpho acid dissolving in concentrated alkali-lye and ammonia with a brown shade.

539,699—May 21, 1895. M. MOELLER. *Blue dye.*

Blue coloring matters are produced by acting with one molecular proportion of a tetrazo compound of a paradiamin on two molecular proportions of the sodium salt of amidonaphtholdisulpho acid $(NH_2:SO_3H:SO_3H:OH=1:2:4:8)$ in an alkaline solution. The dyestuff derived from 1.8 amidonaphtholdisulpho acid and the tetrazo compound of benzidin is easily soluble in water, dissolving with indigo-blue color in strong sulphuric acid; and they dye unmordanted cotton, in an alkaline or neutral bath containing common salt or Glauber's salt, a pure blue.

539,733—May 21, 1895. W. HERZBERG AND O. WEBER. *Blue dye.*

Blue dyes are produced by heating with sulphur and fuming sulphuric acid the condensation products obtained from an alpha$_1$-beta$_1$-amidoanaphthol derivative and a para-nitroso derivative of an alkylated amin. The dye, in case alpha$_1$-beta$_1$-amidonaphthol-beta$_3$-monosulpho acid and para-nitroso-dimethylanilin be used, is moderately soluble in cold, more readily in hot water with a violet-blue color, dissolves in concentrated sulphuric acid, with a green color, and yields by reduction a leuco compound readily reoxidizable. They form lakes with metallic mordants which dye fast-blue tints.

540,412—June 4, 1895. M. ULRICH AND J. BAMMANN. *Amidonaphtholdisulpho acid.*

An alpha-amido-alpha-naphthol-beta-disulpho acid is produced by melting with caustic alkalis, most practically at from 180° to 190° C., the alpha-naphthylamine-trisulpho acid, which is derived from the naphthalenetrisulpho acid obtained at first by Gürke and Rudolph by sulphonating naphthalene or its mono or disulpho acid, prepared first by Koch by nitrating the said naphthalenetrisulpho acid and reducing the alpha-nitronaphthalene-trisulpho acid thus formed. It crystallizes in small, thin, white needles, showing in aqueous solution a weak reddish-violet fluorescence; by combining with the salts of diazobenzene or analagous diazo compounds, red colors with a strong bluish tinge result, while the tetrazo dyestuffs obtained produce, in general, blue shades.

540,864—June 4, 1896. L. WACKER. *Blue acid dye.*

An acid coloring matter is produced by first heating together amido-phthalic acid and monochlor-acetic acid, preferably in an alkaline solution; next heating the phenyl-glycocol-dicarboxylic acid so obtained in a caustic alkaline melt and treating the resulting leuco compound with oxidizing agents; and finally sulphonating the resulting carboxylated product by treating with fuming sulphuric acid. It is soluble in water, giving green-blue solutions; yellow, in alkaline solutions, and green in concentrated sulphuric acid. The carboxylated compound (free and in combination) yields a blue solution of the alkali salts, and on reduction yields a leuco compound from which the dye can be regenerated by oxidation.

545,333—August 27, 1895. H. A. BERNTHSEN AND P. JULIUS. *Azo orange dye.*

A dark reddish-brown powder which can be obtained by the combination of the tetrazo compound of benzidin-disulpho acid with a nitro diamin, such as nitro-meta-phenylene-diamin; soluble in water, precipitated from its aqueous solution by soda solution, and yielding a deep orange precipitate from its aqueous solution on the addition of dilute sulphuric acid; in concentrated sulphuric acid giving a yellow-red solution.

545,336—August 27, 1895. R. BOHN. *Black dye.*

Black coloring matter obtained by treating dinitro-naphthalene with sodium sulphide, yielding fast-black shades on vegetable fiber on dyeing from a bath rendered strongly alkaline with soda. The specific coloring matter obtained as above and subsequently treated with hydrochloric acid is almost insoluble in caustic soda and in concentrated sulphuric acid.

545,337—August 27, 1895. R. BOHN. *Black dye.*

Black coloring matter obtained by treating dinitro-naphthalene with sodium sulphide and subsequently with acetic acid; soluble in soda solution giving a violet coloration.

546,604—September 17, 1895. J. THIELE. *Amido-tetrazotic acid and process of making same.*

A new white crystalline product, soluble in water, and precipitated from its solution by copper salts, is produced by treating a solution of diazo-guanidin with sodium acetate, concentrating by evaporation, and crystallizing.

547,173—October 1, 1895. C. A. MAYER AND C. DE LA HARPE. *Leuco compound and process of making it.*

A leuco body, suitable for printing on textures, is produced by the condensation of a phenol, as resorcin, with a gallocyanin dye obtained by the action of hydrochlorate of nitrosodialkylanilin or of hydrochlorate of dialkylamidoazobenzene on gallic acid or its derivatives. The leuco body, produced from resorcin, colors textures a blue tint when printed thereon and oxidized on the fiber.

548,344—October 22, 1895. A. ASHWORTH AND J. BURGER. *Brown dye.*

A coloring matter: produced by adding alpha amido beta naphthol to a solution of tannin in a condensing agent, such as sulphuric acid, and heating the mixture; little soluble in cold water, easier soluble in hot water, soluble in caustic soda with violet color, changing into brown on agitation and with admixture of air; soluble in concentrated sulphuric acid with a crimsom red color; producing on chrome mordants brown shades.

548,345—October 22, 1895. A. ASHWORTH AND J. BURGER. *Brown dye.*

Coloring matters: produced by adding ortho oxy beta nitroso naphthalene to a solution of tannin in a condensing agent, such as sulphuric acid, and heating the mixture; a dark, nearly black powder slightly soluble in cold water, more soluble in boiling water, soluble in cold dilute caustic soda with a brown color, in concentrated sulphuric acid with a deep purplish brown coloration; producing on chrome mordants brown shades.

548,346—October 22, 1895. A. ASHWORTH AND J. BURGER. *Nitrosonaphthol dye and process of making same.*

Nitrosobetanaphthol is treated with bisulphites at a temperature of 40° to 50° C. The dye consists of grayish to white crystals, easily soluble in water, which solution grows darker on standing. It is decomposed on addition of caustic alkalis, producing green shades with iron mordants and brown shades with chrome mordants.

548,416—October 22, 1895. A. ASHWORTH AND J. BURGER. *Brown dye.*

Coloring matters produced by combining diazo compounds with the condensation product of alpha-nitroso-beta-naphthol and sodium bisulphite, consisting of a brownish powder easily soluble in water, soluble in caustic soda, carbonate of soda, and in alcohol with yellowish-brown color, dyeing on unmordanted wool from an acid bath brown shades and dyeing and printing with chrome mordants brown shades.

548,460—October 22, 1895. C. RIS. *Brown dye and process of making same.*

Tetraoxyazobenzene, a brown coloring matter produced by suojecting the diazo compound of para-amido-phenol or its sulpho acids to the action of pyrogallic acid in an alkaline solution; soluble in alkalis with an intensely brown color, and forming with concentrated sulphuric acid an orange-colored solution.

549,036—October 29, 1895. R. VIDAL. *Process of treating sulphur compounds of aromatic series with sulfites.*

Soluble dyestuffs and coloring matters, characterized by solubility in water and in acids, are produced by treating with alkaline sulphites and bisulphites the coloring matters obtained by the action of sulphur upon bodies of the aromatic series, as the substituted amines of the benzene series.

565,359—February 25, 1896. H. A. BERNTHSEN AND P. JULIUS. *Red dye and process of making same.*

A red substantive diazo body produced by converting a benzidin salt into a tetrazo compound and combining one molecular proportion of the same with one molecular proportion of salicylic acid and subsequently with one molecular proportion of 2. 4′.2′ amido-naphthol-sulpho-acid in alkaline solution, boiling and precipitating with common salt; readily soluble in hot and cold water giving red solutions, in sulphuric acid giving a violet-blue solution, and with nitrous acid yielding a gray to black diazo compound capable of uniting with beta-naphthol to yield a dark shade of color.

555,658—March 3, 1896. R. NIETZKI. *Yellow coloring matter.*

A yellow dyestuff produced by combining the monosulphonic acids of beta-diazo-naphthalene with salicylic acid; forming a yellow-brown powder, difficultly soluble in cold water, petroleum, and benzene, readily soluble in hot water; dissolving in concentrated sulphuric acid with a dark orange-red color; and producing pure yellow shades with alum mordant and olive-yellow shades with chromium mordant.

555,904—March 3, 1896. H. LAUBMANN. *Dye from dinitro-anthrachrysone-disulfo acid.*

A green dyestuff produced by treating dinitro-anthrachrysone-disulphonic acid with sodium sulphide in alkaline solution; forming a black crystalline powder, soluble in hot water with red-blue color, in dilute alkali with red-violet color, in concentrated sulphuric acid with blue-red color: difficultly soluble in glacial acetic acid with red color; completly absorbed by wool from an acid bath, the colored stuff giving green tints on treatment with chromium fluoride.

556,164—March 10, 1896. C. RIS AND C. SIMON. *Gray dye and process of making same.*

A gray coloring matter produced by subjecting the alkyl derivative of beta-amido-alpha$_4$-naphthol-beta$_3$-sulpho acid to the action of a tetrazo compound, as tetrazodiphenyl or tetrazoditolyl; soluble in water with a bluish-gray color, in concentrated sulphuric acid with a blue color; and producing on unmordanted cotton bluish-gray to black shades of considerable fastness.

566,298—March 10, 1896. J. BAMMANN AND M. ULRICH. *Blue dye.*

Violet-blue to greenish-blue mixed substantive dyestuffs produced by combining equi-molecular proportions of any of the known tetrazo bodies, as tetrazoditolyl, with 1.8 amidonaphtholdisulpho acid and any of the hydroxy derivatives of naphthalene, as dihydroxynaphthalene; dyeing unmordanted cotton violet-blue to greenish-blue shades which can be rediazotized on the fiber and converted into deeper blue or bluish-black shades by means of developers; they form grayish-black powders soluble in water, insoluble in diluted hydrochloric or sulphuric acid, but dissolve in concentrated sulphuric acid with blue color.

557,002—March 24, 1896. R. REYHER. *Azine dye.*

Red azine dyes produced by condensing salts of nitroso derivatives of secondary aromatic amins with phenylmetatoluylendiamin, forming a brown powder with metallic luster, easily soluble in water and alcohol, with a red color; insoluble in soda lye; soluble in concentrated sulphuric acid, with a green color, and producing on cotton mordanted with tannin brilliant red shades fast to alkali and light.

557,435—March 31, 1896. J. SCHMID. *Blue dye.*

Blue polyazo dyes are obtained by coupling together two molecules of tetrazo bodies derived from benzidine and the analogous bodies—such as tolidin, diamidostilbene, diamidodiphenol ethers, diamidoethoxydiphenyl—with one molecular proportion of 1.8 amidonaphthol, 3.6 disulphonate of soda, or 1.8 dioxynaphthalene, 3.6 disulpbonate of soda; forming black powders with a metallic luster, soluble in water with a blue and in concentrated sulphuric acid with a green-blue coloration; dyeing unmordanted cotton blue tints of a pure shade.

557,436—March 31, 1896. J. SCHMID. *Blue dye.*

Dark violet-blue to blue polyazo dyestuffs are produced by the action of 1.4 naphtholmonosulphonate of soda upon the products of No. 557,435; forming black powders of metallic luster, soluble in water with a violet, in concentrated sulphuric with a blue coloration; dyeing unmordanted cotton in a neutral or alkaline bath violet to pure blue shades.

557,437—March 31, 1896. J. SCHMID. *Black trisazo dye.*

Black triazo coloring matters are produced by subjecting the diazo dyes of No. 525,626 to further diazotation and combination with amins and phenols, as by diazotizing and treating the rediazotized compound with a cold solution of metaphenylenediamin; or metatoluylenediamin or metaamidophenol; or resorcin kept alkaline by an excess of carbonate of soda; forming black powders with a metallic luster, soluble in hot water, with a blue-black coloration and dyeing deep black shades on unmordanted cotton.

557,438—March 31, 1896. J. SCHMID. *Blue dye.*

Triazo dyestuffs obtained by the combination of 1.8 amidonaphthol, 3.6 disulphonate of soda with the rediazotized intermediate products resulting by the action of one molecular proportion of a tetrazo compound, such as the tetrazo compound of benzidine upon one molecule of metaamidoparacresol ether; easily soluble in water with a dark-blue coloration, in concentrated sulphuric acid with a green-blue coloration; and producing indigo-blue tints on unmordanted cotton, which may be rediazotized and developed on the fiber to blue black with amins and phenols.

557,439—March 31, 1896. J. SCHMID. *Polyazo black dye.*

A blue-black polyazo dye obtained by the reaction of two molecular proportions of amidonaphtholmonosulpho acid and one molecular proportion of the intermediate product, resulting by the action of two molecular proportions of tetrazo-diphenyl with one molecular proportion of 1.8 amidoöxynaphthalene 3.6 disulpho acid; a black powder with a bronze-like luster, soluble in water with a black violet—in concentrated sulphuric acid with a pure blue coloration; and dyeing unmordanted cotton blue-black shades in an alkaline bath which may be developed on the fiber to a deep black.

557,440—March 31, 1896. J. SCHMID. *Blue-black disazo dye.*

Asymmetrical coloring matters derived from one molecular proportion of naphthalene-diamine-disulpho acid 1.8.3.6, one molecule of paranitrodiazobenzene and one molecule of another diazo body; forming black powders of a bronze luster, easily soluble in water with a dark violet to dark blue coloration, in concentrated sulphuric acid with a dark-green coloration; and producing deep blue-black to black tints of great fastness on wool in an acid bath or on a mordant of a chrome salt.

558,344—April 14, 1896. H. A. BERNTHSEN AND P. JULIUS. *Blue dye.*

A substantive coloring matter, a mixed disazo dye: derived from tetrazo-dianisidin, 1.5.7 amido-naphtholsulpho acid combined in alkaline solution and alphanaphtholsulpho acid (1.4; 1.5), which in the form of sodium salt is soluble in water, and on treatment with nitrous acid on the fiber yields a more violet diazo compound which combines with beta-naphthol and gives deeper and more violet shades than the original blue.

558,612—April 21, 1896. C. RUDOLPH. *Brown azo dye.*

A brown azo dyestuff produced by first combining diazotized metatoluylendiamin sulpho-acid with one molecule of beta-naphthylamin, one molecule of a metadiamin and afterwards acting upon the thus formed intermediate product with one molecule of diazo-naphthionic acid; it dyes unmordanted cotton a yellow brown, and forms a deep dark-brown powder soluble in concentrated sulphuric acid to a dirty violet solution, and in water to a yellowish-brown solution.

558,613—April 21, 1896. C. RUDOLPH. *Oxyquinolin azo dye.*

A red-blue tetrazo dyestuff produced by combining dianisidin with the sodium salt of alpha$_1$-alpha$_4$-amidoöxynaphthalene-beta$_2$-beta$_3$-disulpho-acid and afterwards combining with this intermediate product an alkaline solution of paraoxyquinolin; a greenish-brown powder of a metallic luster, soluble in water to a blue and in strong sulphuric acid to a pure green-blue solution, and dyeing unmordanted cotton reddish blue.

558,614—April 21, 1896. C. RUDOLPH. *Brown azo dye.*

A brown polyazo dyestuff, dyeing unmordanted cotton: produced by first combining two molecules of Bismarck-brown sulpho-acid with one molecule of diazotized diamido-beta-naphthalene-disulpho acid and afterwards combining with this intermediate compound two molecules of diazo-naphthionic acid; a black-brown powder, dissolving in concentrated sulphuric acid to a violet-brown solution.

559,062—April 28, 1896. R. REYHER. *Azin dye and process of making it.*

Azin dyes produced by condensing salts of nitrosomonoalkylorthotoluidin with paratoluymetatoluylenediamin and then separating the dye by filtration; forming a brown powder with metallic luster; soluble in water and alcohol with a red color, in concentrated sulphuric acid with a green color, insoluble in soda-lye; and dyeing cotton mordanted with tannin brilliant red shades, fast to alkali and light.

559,063—April 28, 1896. R. REYHER. *Azin dye and process of making it.*

Azin dyes produced by condensing salts of nitrosodialkylanilin with paratolylmetatoluylenediamin and then separating the dye by filtration; forming a greenish-black powder with metallic luster, soluble in water with a violet-red color, in alcohol with a bluish-red color, in concentrated sulphuric acid with a green color; insoluble in soda-lye, and dyeing cotton mordanted with tannin violet-red shades, fast to alkali and light.

560,448—May 19, 1896. A. WEINBERG. *Black azo dye.*

Azo dyes of the general formula: Amidonaphtholsulfo-acid I-amidonaphtholsulpho-acid II-metadiamin paradiamin-metadiamin, are produced by treating the intermediate compound of the general constitution paradiaminamidonaphtholsulpho-acid I amidonaphtholsulpho-acid II with nitrous acid and combining the thus produced tetrazo compounds with two molecules of a metadiamin; forming a black powder soluble in hot water and in concentrated sulphuric acid with a bluish-black color; insoluble in alcohol, ether, or benzene, and dyeing unmordanted cotton a deep black, fast to alkalis.

560,449—May 19, 1896. A. WEINBERG. *Black dye.*

Azo dyes produced by treating the intermediate compounds formed from one molecule of a tetrazo body and one molecule of an amidonaphtholsulpho acid with nitrous acid, as by mixing one molecule of diazotized acetparaphenylenediamin with one molecule of an amidonaphtholsulpho acid, heating with caustic alkalis to remove the acetyl group and treating the diamidoazo body with nitrous acid, and combining the thus produced tetrazoazo compound with one molecule of an amidonaphtholsulpho acid and one molecule of a metadiamin; forming a black powder soluble in hot water with bluish-black color, in concentrated sulphuric acid with a dark-blue color, and dyeing unmordanted cotton a deep black.

560,795—May 26, 1896. B. HEYMANN. *Blue dye.*

Blue coloring matters produced by the action of nitrosomethylbenzylanilinsulpho-acid with beta-naphthoquinonesulpho-acid (1:2:6 or 1:2:7) in the presence of sodium thiosulphate, or with the nitrosonaphtholsulpho-acid (1:2:6 or 1:2:7) which furnishes the corresponding beta-naphthoquinonesulpho-acid by reduction and subsequent oxidation in the presence of sodium thiosulphate; a dark powder with metallic luster, soluble in water with a blue color, in concentrated sulphuric acid with a green color, and dyeing wool and cotton mordanted with chromium salts.

560,796—May 26, 1896. M. HOFFMANN. *Blackish-blue azo dye.*

Azo dyestuffs produced by combining the diazo compound of alpha$_1$-alpha$_2$-amidoacetnaphthalid-beta-sulpho acid with a diazotizable amin, diazotizing again, combining with a hydroxylated naphthalenesulpho-acid and saponifying the product; a black powder soluble in water with a dark-blue color, in sulphuric acid with a bluish-black shade, insoluble in alcohol, and dyeing wool and cotton a blackish blue.

560,890—May 26, 1896. E. BROEMME. *Process of producing lakes.*

Dyestuff-lakes are obtained, for example, from acid tar dyes, by the precipitation of soluble dyestuffs by the addition of a soluble strontium salt to a solution of the dyestuff and sodium carbonate or sodium sulphate.

561,276—June 2, 1896. A. F. POIRRIER. *Sulfureted dye.*

"Thiocatechins;" coloring matters which dye unmordanted cotton in tints varying from yellow to brown and red brown, are produced by heating to prescribed temperatures—200° to 300° C.—with sulphur or sulphur compounds, acetylated paradiamins, and acting on the product with sodium sulphite.

561,277—June 2, 1896. A. F. POIRRIER. *Sulfureted dye.*

Yellow, brown, and yellowish-brown coloring matters, dyeing vegetable fibers without mordant, are produced by the action of sulphur upon the substituted aromatic amins or the acetylated aromatic diamins at between 200° and 250° C.

561,615—June 9, 1896. F. RUNKEL. *Red azo dye.*

A red azo coloring-matter produced by combining molecular proportions of the diazotized ethyl paramidobenzoate with the dioxynaphthalene monosulpho-acid ($OH:SO_3H:OH$=1.4.8) of No. 444,679; forming a brown powder with a green luster, soluble in hot water and alcohol with a red color, in concentrated sulphuric acid with a bluish-black color, and producing on wool clear red shades fast against alkalis.

561,694—June 9, 1896. A. BLANK, A. ISRAEL, AND M. HERZBERG. *Black azo dye and process of making same.*

A substantive black azo dye produced by combining one molecular proportion of tetrazotized dianisidin or tolidin, first, with one molecular proportion of amidonaphthol disulpho-acid ($NH_2:SO_3H:SO_3H:OH$=1:3:6:8) or an alkaline salt thereof, then, with one molecular proportion of a metadiamin (such as metaphenylenediamin or metatoluylenediamin) and finally coupling the so-formed mixed dyestuff with one molecular proportion of diazotized acetyl paraphenylenediamin; a black powder soluble in water with a violet-black color, in concentrated sulphuric acid with a bluish-black color.

561,709—June 9, 1896. M. HERZBERG, A. BLANK, AND A. ISRAEL. *Black azo dye.*

Substantive black azo dyes, produced by combining one molecular proportion of tetrazotized paradiamins (as benzidin), first with one molecular proportion of amidonaphthol disulpho-acid ($NH_2:SO_3H:SO_3H:OH$=1:3:6:8), or an alkaline salt thereof, then with one molecular proportion of a metadiamin, such as metaphenylenediamin, and finally coupling the so-formed mixed azo dyestuffs with one molecular proportion of diazotized acetylparaphenylenediamin: black powders soluble in water with a black color, in concentrated sulphuric acid with a bluish-black color.

562,200—June 16, 1896. J. SCHMID AND K. JEDLICKA. *Dark-green dye.*

A new dye is produced by heating the unsymmetric diazo coloring matter of No. 557,440 with water in the presence of a suitable condensing agent; dyeing with more blue or more green shades than the original coloring matter.

563,382—July 7, 1896. F. KRECKE AND I. ROSENBERG. *Amidonaphtholdisulpho-acid K.*

The 1.8.4.6-amidonaphtholdisulpho acid K, produced by sulphonating 1.5-naphthalenedisulpho acid with fuming sulphuric acid at temperatures not above that of a water bath, transforming the so-produced 1.3.5-naphthalenetrisulpho acid by nitration and reduction into the 1.4.6.8-naphthylamintrisulphonic acid, the diazo derivative of which can not be precipitated from its aqueous solutions by common salt; heating this naphthylamintrisulpho-acid with caustic-soda lye, and precipitating it as acid sodium salt from the alkaline liquid thus obtained, by acidulation with muriatic acid. It is readily soluble in water and gives azo colors more reddish in shade than those prepared with the H acid.

563,383—July 7, 1896. F. KRECKE AND I. ROSENBERG. *Azo dye.*

Azo dyestuffs prepared by combining the "K" acid of No. 563,382 with the molecular proportion of a diazo body; with diazo benzene there is formed a crystalline bronzy powder easily soluble in water, and dyeing wool a bright red from an acid bath.

563,384—July 7, 1896. F. KRECKE AND I. ROSENBERG. *Diazo dye.*

Diazo dyestuffs produced by combining one molecule of acid "K" of No. 563,382 with one molecule of a diazo body in acid solution and acting upon the so-formed intermediate azo product with another molecule of a diazo body; a crystalline powder of reddish-bronze color, dying wool a dark greenish blue in an acid bath.

563,385—July 7, 1896. F. KRECKE AND I. ROSENBERG. *Blue tetrazo dye.*

Tetrazo dyestuffs produced by combining one molecule of a tetrazo body with two molecules of acid "K" of No. 563,382 in alkaline solution; a crystalline yellow-bronze powder, dyeing unmordanted cotton a bright violet blue of great depth.

563,386—July 7, 1896. F. KRECKE AND I. ROSENBERG. *Greenish-blue tetrazo dye.*

Tetrazo dyestuffs produced by combining one molecule of acid "K" of No. 563,382 with one molecule of a tetrazo body, and acting on the so-formed intermediate diazo azo body with an aromatic amin or phenol, or sulpho or carbo acid thereof; forming bronzy crystalline powder, dyeing unmordanted cotton a bright greenish blue.

567,413—September 8, 1896. C. RIS. *Brown diazo dye and method of making same.*

A brown coloring matter, obtained by combining the tetrazo compound of benzidin with salicylic acid and with alkylated beta$_1$-alpha$_4$-amido-naphthol-beta$_3$-sulpho-acid; a dark brown powder soluble in water, with a dark brown color, in concentrated sulphuric acid with a violet-blue color, and producing fast and intense brown shade on unmordanted cotton.

567,473—September 8, 1896. W. HERZBERG AND H. HEIMANN. *Red dye of rosindulin series.*

The disoda salt of phenylrosindulin-trisulphonic acid, derived from alpha-naphthylamin and orthoamidodiphenylamin-sulphonic acid by joint oxidation, subsequent phenylation and sulphonation by means of fuming sulphuric acid; of the formula $C_{22}H_{16}N_3SO_3H(SO_3Na)_2$; producing on wool clear red shades of a bluish tint.

567,567, September 8, 1896. A. HERRMANN. *Blue coloring matter.*

Fast-blue coloring matter produced by condensing monobenzylanilin or its homologues, including the sulphonic acids, with metaoxybenzaldehyde; sulphonating the metaoxyleuco bases obtained thereby; and then oxidizing the resulting leuco-sulphonic acid with a suitable reagent, such as lead peroxide.

567,615—September 15, 1896. F. RUNKEL. *Blue azo dye.*

The azo coloring matter produced by combining one molecular proportion of the diazo compound of dimethyl-paraphenylenediamin, $NH_2.C_6H_4.N.(CH_3)_2$, with one molecular proportion of the sodium salt of dihydroxynaphthalene sulpho-acid; a dark powder with bronze-like luster, soluble in alcohol and in hot water with a blue color, in concentrated sulphuric acid with a violet color, and dyeing wool in acid bath.

568,344—September 29, 1896. A. GANSWINDT. *Mordanting textile fabrics.*

Cotton or other vegetable textile fibers are mordanted with lactate of zinc and subsequently dyed.

568,549—September 29, 1896. C. RUDOLPH AND E. VOGES. *Yellow dye.*

A yellow tetrazo dyestuff obtained by the combination of diazotized toluylendiamin-sulpho-acid ($CH_3.NH_2.SO_3H.NH_2$=1.2.4.6) with nitro-meta-phenylenediamin; a light-brown powder dissolving in water to a yellow solution, from which a gelatinous precipitate is obtained by the addition of an acid; dyeing unmordanted cotton a pure yellow from an alkaline soap bath.

569,395—October 13, 1896. E. ULLRICH AND M. VON GALLOIS. *Process of dyeing phenetidin red.*

A bluish-red color is produced by combining on the fiber orthonitroparaphenetidin with beta-naphthol to an azo compound, and fixing the color by turkey-red oil and a metallic compound, as aluminate of soda.

569,404—October 13, 1896. R. BRASCH. *Alizarin dye and method of making same.*

Alizarin coloring matters—alpha-amido-flavo and anthra purpurin—dyeing mordanted wool and cotton scarlet-red shades: are produced by heating the alizarin of commerce with benzoyl-chloride, nitrating the product at ordinary temperature with nitrosulphuric acid, separating the benzoylized alpha-nitro-alizarin by pouring it into water, saponifying by means of soda-lye and reducing to the amido compound by means of reducing agents, such as zinc.

569,405—October 13, 1896. R. BRASCH. *Green alizarin dye and method of making same.*

Green coloring matters are produced from alpha-amido and alpha-nitro compounds of alizarin by mixing with glycerin and sulphuric acid, gradually heating to a temperature of 110° to 120° C., and separating the quinolized product by pouring into water. Easily soluble compounds are obtained by heating the quinoline compounds with concentrated solutions of alkaline-bisulphites, such as sodium bisulphite. The alpha-quinolin compound of alizarin is nearly insoluble in water, difficultly soluble in the ordinary organic solvents, soluble in sulphuric acid, in alkaline-sulphite compounds with a carmine color, and dyes mordanted wool and cotton in green shades.

569,418—October 13, 1896. H. LAUBMANN. *Blue dye and method of making same.*

Blue coloring matter, produced by treating an acid solution of dinitroanthrachrysone-disulphonic acid—No. 569,419—with reducing agents, such as iron, zinc, etc., and subsequently boiling with alkalis; a red crystalline powder dissolving in hot water with a beautiful red, in diluted alkalis with blue, in concentrated sulphuric acid with bluish-red color, taken up by wool in an acid bath, the fibers assuming shades ranging from blue to violet, with metallic mordants.

569,419—October 13, 1896. H. LAUBMANN. *Dinitroanthrachrysone-disulphonic acid and method of making same.*

Anthrachrysone is sulphonized and the product nitrated. The acid is easily soluble in water and alcohol, ether, benzene, chloroform, and glacial acetic acid, decomposing at above 230° C., soluble in alkalis with red color, its sodium salts crystallizing from water in gold-yellow leaflets with formula of $C_{14}H_4O_6(NO_2)_2(SO_3Na)_2H_2O$; available as coloring matter and for the production of other coloring matters.

571,933—November 24, 1896. C. RIS. *Black triazo dye.*

A black triazo coloring matter produced by diazotizing a mixed diazo dyestuff obtained from benzidin, an alkylated beta, alpha$_4$-amidonaphthol-beta$_3$, sulpho acid and a nonalkylated beta$_1$-alpha$_4$-amidonaphthol-beta$_3$-sulpho acid; and combining the diazo compound thus obtained with resorcin; a black powder soluble in water with bluish-black color, in concentrated sulphuric acid with a grayish-blue color, and dyeing unmordanted cotton in gray to deep-black shades.

572,723—December 8, 1896. C. RUDOLPH. *Trisazo dye.*

Triazo dyestuffs obtained by first forming intermediate products by combining the paradiamins, as, for instance, benzidin, with a metaämidoöxysulpho acid of the benzene series which contains the OH group and the NH_2 group in the so-called "meta" position; then combining these intermediate products with metaphenylendiamin or resorcin; and finally causing diazonaphthionic acid to act upon the thus resulting intermediate dyestuffs; a black powder soluble in water with brown to brown-red solutions, in concentrated sulphuric acid with violet to blue solutions, and dying unmordanted cotton from an alkaline bath brown red to corinth.

573,299—December 15, 1896. T. SANDMEYER. *Red dye.*

A red dyestuff produced by condensing benzaldehydeorthosulpho acid with an alkylated metaämido phenol, such as diethylmetaämidophenol, removing one molecule of water from the thus obtained dihydroxylated tetraethyl-diamidotriphenylmethanmonosulpho acid, as by treating with concentrated sulphuric acid, and oxidizing the thus-formed derivative of triphenylmethan oxide; a greenish crystalline powder, easily soluble in alcohol and acetic acid with a bluish-red shade showing a yellowish-red fluorescence, in hydrochloric acid and diluted sulphuric acid with a yellowish-red shade turning to bluish red by addition of water, and producing on wool and silk pure red shades fast against alkalis.

575,228—January 12, 1897. M. VON GALLOIS. *Stable diazo compound.*

Stable, soluble, nonexplosive, diazo compounds of paranitranilin and dianisidin in the form of a paste or powder, produced by concentrating or evaporating to dryness solutions of paranitranilin and dianisidin at a low temperature, below 45° C., in presence of an excess of a mineral acid and in presence of an acid mineral salt. The paranitro diazo benzol sulphate is a light-yellow powder.

575,904—January 26, 1897. C. RIS. *Black azo dye.*

Black azo colors produced by combining the tetrazo compound of a paradiamin, such as paradiamidoditolylamin, with beta$_1$-alpha$_4$-amidonaphtholbeta$_3$-sulpho acid and with a metadiamin; a black powder, soluble in water with a bluish-black color, in concentrated sulphuric acid with blue color, dyeing unmordanted cotton, or mixed goods, deep bluish-black shades of great fastness.

576,222—February 2, 1897. C. O. MULLER. *Rhodamin dye.*

Unsymmetrical dimethyldiethyl rhodamin dyestuff: produced by the condensation of one molecule of a dialkylamidoöxybenzoylbenzoic acid derived from one molecule of anhydrous phthalic acid and one molecule of dialkylmetaämidophenol, with one molecule of an alkyl derivative of metaämidophenol; constituting green crystals, dyeing wool, silk, and cotton a fine red, soluble in water, and dissolving in concentrated sulphuric acid and in hydrochloric acid with yellow coloration which turns red on adding water.

576,223—February 2, 1897. C. O. MULLER. *Rhodamin dye.*

Rhodamin dyes, consisting of an alkylester of the unsymmetrical coloring matter of No. 576,222, produced by boiling same with alcohol and hydrochloric acid; a green powder with metallic luster, dyeing cotton, silk, and wool a blue red.

576,511—February 2, 1897. G. STEINIKE AND F. SCHMIDT. *Blue trisazo dye.*

Mixed triazo coloring matters produced by combining one molecule of dioxynaphthalenemonosulphonic acid S, of No. 444,679, with one molecule of a diazo compound and coupling the monoazo coloring matter thus formed with one molecule of a tetrazo compound, and then coupling the resulting intermediate product with a further molecule of a phenol, naphthol, or their carbonic or sulphonic acids; a gray-black powder, dissolving in water with violet-blue color, soluble in sulphuric acid with blue color, and dyeing cotton blue tints.

578,093—March 2, 1897. A. COBENZL. *Blue dye.*

A blue basic dyestuff, obtained by heating diethylsaffranin, obtained from diethylparaphenylenediamin and anilin, with paraphenylenediamin under pressure and in presence of an indifferent solvent.

578,432—March 9, 1897. M. ULRICH AND J. BAMMANN. *Dark-blue azo dye.*

Dark-blue substantive dyestuffs produced by combining one molecular proportion of a tetrazotized diamin with one molecular proportion of amidonaphthol-disulpho acid (NH_2:SO_3H:SO_3H:OH=2:3:6:8) and one molecular proportion of amidonaphtholmonosulpho acid (NH_2:SO_3H:OH=1:4:8), or alkaline salts thereof; a dark powder soluble in water with a bluish-black color; diazotizable when fixed on the fiber.

578,578—March 9, 1897. C. O. MULLER. *Rhodamin dye.*

Rhodamin dyes produced by the condensation of one molecule of the dialkylamidoöxybenzoyl-benzoic acid, obtained by the action of one molecule of anhydrous phthalic acid on one molecule of dialkylmetaämidophenol, with one molecule of a metaämidophenol, as metaämidocresol (CH_3:NH_2:OH=1:2:4), and the subsequent conversion of the product of condensation into salt by heating it with an acid. The unsymmetrical dimethyl-methyl-rhodamin dye derived from dimethylamidoöxybenzoylbenzoic acid and metaämidocresol dyes with tannin and tartar emetic mordanted cotton vividly red tints.

578,580—March 9, 1897. F. PETERSEN. *Substantive cotton dye.*

Substantive cotton dyestuffs produced by combining one molecule of the tetrazo derivative of the Griess benzidinsulpho acids with two molecules of gammaämidonaphtholsulpho-acid, diazotizing the dyestuff thus obtained, and subsequently combining the diazotized dyestuff with two molecules of aromatic amido compounds, as an aromatic metadiamin; a black powder, dyeing cotton an intense blue black.

579,773—March 30, 1897. C. RUDOLPH. *Red-blue disazo dye.*

Red-blue diazo dyestuffs produced by combining tetrazo-ditolyl, or tetrazo-diphenyl, with one molecule of alpha$_1$-alpha$_4$-amidoöxynaphthalene-beta$_2$-beta$_3$-disulpho acid in an alkaline solution, and then combining the intermediate compound thus obtained with one molecule of 2.3-dioxynaphthalene; a dark blackish-brown powder with a feeble metallic luster, dyeing unmordanted cotton pure red blue.

580,186—April 6, 1897. A. HERRMANN. *Blue dye.*

The monosulphonic acid of tetraälkylmonobenzyltriamidodiphenyl-orthotolylcarbinol, a copper-colored powder of metallic luster: produced by condensing tetraälkyldiamidobenzhydrol with monobenzyl-orthotoluidin monosulphonic acid, and then oxidizing the thus-obtained sulphonic acid of tetraälkylbenzyl-triamidodiphenyl-orthotolylmethan. It dyes wool and silk an even and fast blue in an acid bath.

580,187—April 6, 1897. A. HERRMANN. *Fast blue dye.*

The monosulphonic acid of pentaälkyltriamidodiphenyl-orthotolylcarbinol, a copper-red powder of metallic luster: produced by condensing tetraalkyldiamidobenzhydrol with monoalkyl-orthotoluidin sulphonic acid, and then oxidizing the thus-obtained sulphonic acid of pentaälkyltriamidodiphenyl-orthotolylmethane. It dyes wool and silk an even and fast blue in an acid bath

580,188—April 6, 1897. A. HERRMANN. *Blue acid dye.*

The disulphonic acid of monobenzyl-tetraälkyltriamidodiphenyl-orthotolyl-carbinol, a copper-red powder of metallic luster: produced by condensing tetraälkyldiamidobenzhydrol with monobenzyl-orthotoluidin disulphonic acid, and then oxidizing the thus-obtained sulphonic acid of monobenzyltetraälkyl-triamidodiphenyl-orthotolylmethane.

582,853—May 18, 1897. A. FEER. *Stable diazo compound.*

Compounds for dyeing and printing: produced by combining one molecule of a sulpho acid of an aromatic hydrocarbon, as a disulpho-acid of naphthalene, with one molecule of the diazo derivative of an aromatic amido compound, as of paranitranilin. The disulphonaphthalate of paranitrodiazobenzene is a yellow crystallized stable salt which can be preserved in a dry state. Fabrics, etc., are dyed and printed by first padding with an alkaline solution of beta-naphthol and then applying a solution of the salt.

582,958—May 18, 1897. F. SCHMIDT AND O. ERNST. *Trisazo dye.*

A bluish black triazo dyestuff: produced by combining one molecule of diazonaphthalenesulphonic acid with one molecule of dioxynaphthalenemonosulphonic acid 1.8.4, subjecting the monoazo dyestuff thus formed to the action of one molecule of tetrazotized benzidin until an intermediary product is obtained; and lastly, treating this intermediary product with metaphenyldiamin; a grayish-brown powder, soluble in water with a blue-violet color, in concentrated sulphuric acid with a blue color; the direct-dyeing color of 4 per cent on unmordanted cotton being bluish black.

582,959—May 18, 1897. F. SCHMIDT AND O. ERNST. *Trisazo dye.*

The intermediary product of No. 582,958 is treated with naphthylamin (instead of metaphenylendiamin), producing a violet-brown powder of metallic luster, but dyeing bluish black.

583,267—May 25, 1897. J. SCHMID AND H. WEIL. *Blue-green dye.*

Coloring matters are produced from benzaldehyde disulpho acids (COH:SO_3H:SO_3H=1:2:5 and 1:2:4) and nonsulphonated benzylanilin derivatives, by first forming leuco compounds by the condensation of one molecule of benzaldehyde disulpho acid with two molecules of anilin derivatives, one of which at least is one of the following nonsulphonated benzylanilin derivatives: benzylethylanilin, benzylmethylanilin, dibenzylanilin, monobenzylorthotoluidin, or their products of substitution, which contain a methyl, or nitro group, or chlorin in the radical of benzyl; and subsequently treating these leuco compounds by means of oxidizing agents, as peroxids or chromic acid; dyeing animal fiber in an acid bath a blue-green to green-blue tint, fast against alkalis and dilute acids.

583,439—May 25, 1897. W. HERZBERG AND O. HANSMANN. *Black azo dye.*

A dark-brown powder of metallic luster, obtained by rediazotizing the compound produced by the action of diazotized picramic acid on alpha$_1$-naphthyl-amin-beta$_3$-monosulphonic acid, and by combining the diazo compound thus obtained with beta-naphthol. It produces on wool blackish-violet tints, which by treatment with chromium salts are converted into fast, deep black shades.

583,634—June 1, 1897. J. SCHMID AND K. JEDLICKA. *Black trisazo dye.*

Black triazo dyestuffs: produced by combining one molecule of the tetrazo derivative of a paradiamido base of the series of diphenyl with one molecule of a monoazo coloring matter derived from one molecule of an amidonaphthol-disulphonic acid and one molecule of an aromatic diazoaldehyde, and one molecule of an aromatic amido compound, such, for example, as metatoluylenediamin, metaphenylenediamin, naphthylamins, naphthylamin-sulphonic acids, amidonaphthols, and amidonaphthol-sulphonic acids; a dark powder of a light-bronze luster, soluble in water with violet-black to blue-black coloration and dyeing cotton violet black to green black.

583,635—June 1, 1897. J. SCHMID AND K. JEDLICKA. *Blue trisazo dye.*

Blue triazo dyestuffs: produced by combining one molecule of the tetrazo derivative of a paradiamido base of the series of diphenyl with one molecule of a monoazo coloring matter derived from one molecule of an amidonaphthol-disulphonic acid and one molecule of a diazo-benzoic-acid compound, and one molecule of a naphtholic compound, such as naphthols, amidonaphthols, oxynaphthols, and their sulphonic acids; a powder of bronze luster, soluble in water with a dark-blue to green coloration, and dyeing unmordanted cotton dark-blue to greenish-blue fast tints.

584,119—June 8, 1897. C. O. MULLER. *Rhodamin dye.*

The alkyl ether of the unsymmetrical dimethyl-methylrhodamin derived from dimethylamidoöxybenzoyl-benzoic acid and metaämidoparacresol, constituting, in the form of its hydrochloric salt, fine green crystals, soluble in water and alcohol with a red tint, in concentrated sulphuric acid with a yellow tint, and dyeing cotton, silk, and wool in red tints.

584,981—June 22, 1897. M. BONIGER. *Blue dye.*

Blue coloring matter: produced by combining one molecule of the tetrazo compound of dianisidin in an alkaline-soda solution with one molecule of 1. naphthol 3.6.8 trisulphonic acid and combining the intermediate product thus formed with one molecule of beta-naphthol; a bronze powder soluble in water with a pure blue shade; in strong sulphoric acid with a greenish-blue; dyeing unmordanted cotton in a boiling-salt or Glauber-salt bath.

585,104—June 22, 1897. K. JEDLICKA. *Green triazo dye.*

Green triazo dyestuffs: produced by combining one molecule of the tetrazo derivative of a paradiamido base of the series of diphenyl with one molecule of a monoazo coloring matter derived from one molecule of an amidonaphthol-disulphonic acid and one molecule of a diazobenzoic-acid compound and one molecule of a phenolic compound, as phenol, cresol, resorcin, and cresotinic acid; a bronze powder soluble in water with a green coloration, and dyeing unmordanted cotton in fast dark-green to yellowish-green tints.

585,934—July 6, 1897. C. DE LA HARPE. *Blue dye.*

Blue coloring matter: produced from the leuco body obtained by the condensation of resorcin with a gallocyanin dye (No. 547,173) by sulphonating the said body with sulphuric acid, then subjecting an alkaline solution of the sulpho derivative to contact with the air, precipitating the product of oxidation with sufficient acid to neutralize the alkali employed, and finally forming the product of oxidation into an alkaline salt; dyes unmordanted wool and chromed wool and mordanted vegetable fibers.

587,757—August 10, 1897. I. ROSENBERG AND F. KRECKE. *Naphthylenediamin-sulfo acid, and process of making it.*

A new naphthylenediamin, characterized by containing two amido groups in meta or 1.3 position, producible by heating 1.3.6 naphthol or naphthylamin-disulpho-acid with an excess of ammonia in an autoclave at temperatures of 160° to 190° C., forming easily soluble alkali salts, and combining with diazo and tetrazo compounds to form valuable cotton dyes.

588,180—August 17, 1897. I. ROSENBERG. *Bluish-scarlet dye.*

Azo dyestuffs produced by combining molecular proportions of diazotized monamins with 1.3 naphthylenediamin-sulpho-acids, as diazotized dehydrothio paratoluidin monosulpho acid with 1.3.6-naphthylenediamin-mono-sulpho acid; a brownish-red bronzy powder soluble in hot water, in concentrated sulphuric acid with violet coloration, dyeing unmordanted cotton a bright bluish scarlet.

588,181—August 17, 1897. I. ROSENBERG. *Reddish-violet dye.*

Tetrazo dyestuffs: produced by combining molecular proportions of tetrazotized diamins, employed in the manufacture of tetrazo dyestuffs, with bimolecular proportions of 1.3 naphthylenediamin-sulpho-acids; black bronzy powders, soluble in hot water, dyeing unmordanted cotton bright reddish violet.

588,182—August 17, 1897. I. ROSENBERG. *Mixed substantive dye.*

Produced by combining molecular proportions of any of the tetrazo bodies usually employed for the manufacture of substantive dyestuffs with molecular proportions of an amin or phenol or a sulpho or carbo acid thereof, and reacting with the so-contained intermediate bodies on molecular proportions of a 1.3 naphthylenediamin mono or di sulpho acid (No. 587,757).

588,183—August 17, 1897. I. ROSENBERG. *Brown substantive dye.*

Substantive dyestuffs: produced by combining the rediazotized primary or mixed tetrazo dyestuffs, characterized by containing a 1.3 naphthylenediamin sulpho-acid as component part, with an amin.

588,388—August 17, 1897. V. G. BLOEDE. *Process of dyeing anilin-black.*

The fiber or fabric is impregnated with anilin, its homologues, or analogues, or a salt of these combined with a suitable oxidizer, and then subjected to the fumes or vapors of a mineral acid capable of liberating the oxidizer.

588,397—August 17, 1897. A. COBENZL. *Gray dye.*

A gray dyestuff produced by condensing alkylsaffranin with formaldehyde in a strong mineral-acid solution; a black powder easily soluble in water, difficultly soluble in alcohol, insoluble in ether, benzene, ligroin, etc., and soluble in concentrated sulphuric acid with a green color.

589,766—September 7, 1897. J. VILLE. *Red dye.*

Red coloring matters formed by heating aromatic hydrazins, as phenylhydrazin, with rosolic acid in the presence of alcohol, the vapors evolved being condensed, and the proportions varied in accordance with the depth of color desired.

590,088—September 14, 1897. C. BULOW. *Black disazo dye.*

Black diazo dyes derived from the oxynaphthylamin-sulpho-acid ($NH_2.OH.SO_3H$—1.8.4) by combining one molecular proportion of this acid with two molecular proportions of one and the same diazo compound or one molecular proportion each of two different diazo compounds, as of diazo-benzene-sulphonic acid and diazo compound of alpha-naphthylamin.

591,309—October 5, 1897. J. VILLE. *Red dye.*

Red coloring matters produced by heating a fatty hydrazin with rosolic acid; soluble in alcohol and acetic acid, forming red solutions, and in hydrochloric and sulphuric acid forming yellowish solutions.

591,616—October 12, 1897. M. BÖNIGER. *Trisazo dye.*

Substantive triazo coloring matters produced by combining one molecule of the tetrazo compound of a paradiamin, such as benzidin, with one molecule of paraxylidin, rediazotizing the intermediate products and combining the thus produced tetrazo compounds with two molecules of amidonaphthol-disulphonic acid H; being powders of slaty to purplish-brown color; soluble in water and methylic alcohol; dyeing unmordanted cotton from a bath containing common salt in intense blue shades ranging between indigo and dark-greenish blue; producing when diazotized on the fiber by combination with beta-naphthol a deep black, with metaphenylene-diamin a greenish-black, and with resorcin a dark green.

592,608—October 26, 1897. B. HEYMANN AND R. REYHER. *Red azin dye.*

Azin dyes produced by oxidizing first one molecular proportion of the hydrochlorate of paraämidomonoalkyl-orthotoluidin with one molecular proportion of monoalkyl-ortho-toluidin, and secondly oxidizing the resulting indamin compound with any primary amin of the aromatic series; brown powder, soluble in water with a splendid red color, same in alcohol, in concentrated sulphuric acid with a green color; producing clear fast red shades on mordanted and unmordanted cotton.

593,347—November 9, 1897. F. BENDER. *Violet disazo dye.*

Diazo dyes derived from 2 amido 5 naphthol 7 sulpho-acid—No. 521,095—and forming dark powders of metallic luster, soluble in water with a red to violet color, dying cotton without mordant, yielding red to violet shades, and the solution in concentrated sulphuric acid having a greenish to bluish shade.

593,790—November 16, 1897. M. ULRICH AND J. BAMMANN. *Blue-black disazo dye.*

A wool-dyeing diazo coloring matter produced by combining one molecular proportion of paradiazobenzene-sulpho acid with one molecular proportion of $alpha_1$, amido-$alpha_4$ naphthol-$alpha_2$ sulpho acid, or salts thereof, in a weakly mineral-acid solution and combining the intermediate product thus obtained with one molecular proportion of alpha-diazonaphthalene in alkaline solution.

594,105—November 23, 1897. H. R. VIDAL. *Sulfur dye.*

Coloring matters are produced by reacting with sulphur upon specified derivatives of benzene (resorcin, metaämidophenol, sulphaminol, chrysoidin), the substances being heated together in the presence of an alkaline sulphide; dyeing cotton fibers a black or brown black.

594,106—November 23, 1897. H. R. VIDAL. *Mixed sulphur dye.*

A coloring matter produced by heating paraphenylenediamin and hydroquinone in equal parts in presence of sulphur; constituted in part by a body directly soluble in acids and dyeing animal fibers an intense black, and in part by a body soluble in alkalis and dyeing vegetable fibers dull blue.

594,107—November 23, 1897. H. R. VIDAL. *Thiazin dye.*

Paradioxythiazin is produced by heating with sulphur a mixture of paramidophenol and hydroquinone; paramidoöxythiazin by heating sulphur, paramidophenol, paraphenylenediamin, and hydroquinone.

594,123—November 23, 1897. C. H. RUDOLPH AND J. HERBABNY. *Blue-red tetrazo dye.*

Bluish-red tetrazo dye: produced by combining tetrazo-dichlordiphenyl, derived from diorthochlorbenzidin, with two molecules of beta-naphthylamin-beta-disulpho-acid, the so-called "amido R acid;" dyeing cotton without mordants a fast and brilliant bluish red.

594,996—December 7, 1897. M. KAHN AND F. RUNKEL. *Black azo dye.*

Black azo dye produced by combining equimolecular proportions of tetrazotized paradiamidodiphenylaminsulphonic acid with alphanaphthylaminbeta-sulphonic acid 1.6 or 1.7, coupling the intermediate product thus obtained with one molecular proportion of amidonaphtholsulphonic acid G, rediazotizing the diazo compound thus obtained and finally combining with two molecular proportions of a metadiamin, such as metaphenylenediamin or metatoluylenediamin; a brownish-black powder, soluble in hot water, with a violet-black color, yielding an unmordanted cotton deep bluish-black shades, fast to alkalis, acids, and light.

595,021—December 7, 1897. M. KAHN AND F. RUNKEL. *Black azo dye.*

A substantive black dyestuff produced by combining one molecular proportion of tetrazotized paradiamidodiphenylaminsulphonic acid with two molecular proportions of amidonaphtholmonosulphonic acid G in an alkaline solution, rediazotizing the diazo dyestuff thus obtained and further combining the so-formed tetrazo compound thereof with two molecular proportions of a metadiamin, such as metaphenylenediamin or metatoluylenediamin.

595,349—December 14, 1897. R. E. SCHMIDT. *Anthrarufin dye.*

A blue-alizarin dyestuff, the disulpho-acid of paradiamidoanthrarufin, produced by treating paradinitroanthrarufin-disulpho acid with reducing agents such as stannous chloride and hydrochloric acid; dyeing unmordanted wool in acid baths pure and even blue shades, with chromium mordants greenish-blue shades.

595,350—December 14, 1897. R. E. SCHMIDT. *Blue dye from chrysazin.*

A blue alizarin dyestuff, a disulpho acid of the paradiamidochrysazin: produced by sulphonating chrysazin and then subjecting the thus obtained disulpho acid of chrysazin to agents of nitration, and finally reducing the disulpho acid of dinitrochrysazin to the disulpho acid of diamidochrysazin; a dark-violet powder with a copper-like luster, dyeing wool in acid baths fast blue shades and yielding on chrome-mordanted fibers greenish-blue shades.

596,333—December 28, 1897. C. O. MULLER. *Rhodol dye.*

Dyestuffs of the phthalein series are produced by condensing the dialkylamidoöxybenzoylbenzoic acids with resorcinol, and the dyestuffs thus obtained may be converted into derivatives soluble in water by treating them with an alcohol and an acid. The dyestuff formed by the hydrochloride of an alkyl ether of dimethyl rhodol dyes wool, silk, and tannin-mordanted cotton in yellow-red tints.

596,559—January 4, 1898. A. WEINBERG. *Brown sulpureted dye.*

A brown coloring matter produced by heating one part of dinitrocresol with 4 to 6 parts of an alkali sulphide and 1 to 3 parts, all by weight, of sulphur; soluble in water in presence of sulphides or strong alkalis; dyeing unmordanted cotton brown.

597,983—January 25, 1898. M. H. ISLER. *Black substantive cotton dyestuff.*

Black coloring matter produced by energetically treating the anthraquinone derivatives, such as dinitroanthraquinones, the corresponding amidoanthraquinones, the intermediate reduction compounds, alizarin, anthrapurpurin, flavopurpurin, anthraquinone-monosulpho-acid, anthraquinone alpha and beta di-sulpho-acids, with alkaline sulphides or polysulphides until a water-soluble product results, free from unchanged initial material; giving greenish to violet-blue solutions.

598,118—February 1, 1898. H. SCHMID. *Process of discharging red.*

Paranitranilin red is discharged by printing thereon a discharging color containing a tin salt and acetin, a new product, having a dissolving action upon the red, and then allowing the discharge to act in the usual manner by steaming.

599,425—February 22, 1898. R. E. SCHMIDT. *Blue-black alizarin dye.*

Alizarin dyestuffs produced by first condensing purpurin with a primary amin, as anilin, which process may be carried out under the addition of condensing agents, such as boric acid, and, secondly, treating the intermediate condensation product thus obtained with sulphonating agents, such as concentrated sulphuric acid.

599,426—February 22, 1898. R. E. SCHMIDT. *Green dye derived from anthraquinone.*

Anthraquinone dyestuffs, being monosulpho acids of condensation products obtainable from one molecule of quinizarin and two molecules of certain primary aromatic amins, as paratoluidin: produced by treating the said condensation products with agents of sulphonation, such as sulphuric monohydrate, containing 99.7 per cent H_2SO_4, until a test portion is clearly soluble in a large quantity of water, introducing the reaction mixture into cold water and precipitating the dyestuff; dyeing wool in acid baths fast green shades.

599,427—February 22, 1898. R. E. SCHMIDT. *Green dye derived from quinizarin.*

Anthraquinone dyestuffs, being disulpho acids of the condensation products, as per No. 599,426, are obtained by sulphonating with weakly fuming sulphuric acid, containing 5 per cent of SO_3, in lieu of the sulphuric monohydrate of said prior patent.

599,532—February 22, 1898. C. RIS. *Black trisazo dye.*

A black triazo color produced by combining the tetrazo compound of paraphenylenediaminazobeta$_1$ alpha$_4$ amidonaphthol beta$_3$ sulpho-acid$_1$ first, in acid solution with one molecule of a metadiamin (such as metaphenylenediamin), and then in alkaline solution with one molecule of beta$_1$ alpha$_4$ amidonapthol beta$_3$ sulpho-acid; dyeing unmordanted cotton in deep black shades.

601,033—March 22, 1898. M. BÖNIGER. *Blue-black mixed trisazo dye.*

Mixed triazo coloring matters produced by combining in an alkaline solution one molecule of the simple azo color obtained in acid solution from diazotized beta$_1$ alpha$_4$ amidonaphthol beta$_2$ beta$_3$ disulphonic acid and alpha-naphthylamin with one molecule of tetrazo-diphenyl, and further combining this intermediate product with one molecule of an amidonaphtholsulphonic acid.

601,063—March 22, 1898. C. RIS. *Benzidin-orange.*

An orange coloring matter produced by condensing a paradiamin, such as benzidin, with paranitrotoluolsulpho acid in a solution of a caustic alkali; a brownish powder soluble in water with a deep orange color, in concentrated sulphuric acid with a red-violet color.

601,363—March 29, 1898. H. R. VIDAL. *Thiazin dye.*

Coloring matters derived from thiazin compounds: produced by reaction of sulphur on one or more para substitution products of thiazin derivatives, or mixtures for yielding the same, and consequent condensation of the thiazin molecules to tetraphenetrithiazin products, one or more of said thiazin derivatives having amidogen in the para position in one nucleus and one of specified hydrogen-containing groups in the para position in the other nucleus, and the resulting tetraphenetrithiazins having one of the hydrogen-containing groups in the para position in each of the nuclei at the ends of the chain of four nuclei.

601,364—March 29, 1898. H. R. VIDAL. *Process of obtaining dyes from sulfanilic acid.*

An amidophenol is heated with parasulphanilic acid, yielding a blue coloring matter, dyeing cotton directly in an alkaline bath.

601,365—March 29, 1898. H. R. VIDAL. *Black dye.*

Black coloring matters: produced by heating the condensation products of parasulphanilic acid and paraamidophenol in presence of sulphur, the mass being dissolved in a solution of caustic soda and then evaporated; dyeing unmordanted cotton in shades of very deep black.

601,859—April 5, 1898. C. RUDOLPH. *Blue azo dye.*

Blue tetrazo dyestuff: produced by combining tetrazo diphenyl or ditolyl first with one molecule of amidoöxy-alpha-naphthalene-disulpho-acid in an alkaline solution, and then with one molecule of dioxynaphthalene 2.6 dissolved in alkali; a black-violet powder with a metallic luster, soluble in water with a blue-violet and in sulphuric acid with a greenish-blue color.

602,540—April 19, 1898. M. KAHN. *Violet dye.*

Tetrazo dyestuff: produced by combining one molecule of tetrazotized dianisidin with one molecule of 2.3.6 naphtholdisulpho acid, and further coupling the intermediate product thus obtained with one molecule of paraxylidin; a brownish-black powder with a bronze-like luster, soluble in water with a browish-violet color, in concentrated sulphuric acid with a blue color, dyeing unmordanted cotton violet shades.

602,544—April 19, 1898. P. OTT AND T. KROEBER. *Blue azin dye.*

Azin dyestuffs: produced by condensing sulpho acids of symmetrically disubstituted 1.3 naphthylenediamins having the sulpho group in position 8 with certain disubstituted amidoazo-benzene sulpho acids; dissolving in water yielding blue solutions, in concentrated sulphuric acid with a green color; dyeing unmordanted wool in acid baths fast blue shades.

602,637—April 19, 1898. E. KÖNIG. *Bassic red disazo dye.*

Scarlet-red dyestuff obtained from diazotized meta-trimethyl ammonium phenyl-azo-meta-toluidin and beta-naphthol; a brown-red powder, soluble in water with a blue-red color, and dyeing tanned and untanned cotton, as well as half wool, scarlet red in an acid solution.

602,638—April 19, 1898. E. KÖNIG. *Basic yellow disazo dye.*

Yellow dyestuff obtained from diazotized meta-trimethyl ammonium phenyl-azo-meta-toluidin and 1 phenyl 3 methyl 5 pyrazolon; an orange-yellow powder, soluble in water, alcohol, ether, and benzene; dyeing tanned and untanned cotton, as well as half wool, in an acid bath, yellow.

602,639—April 19, 1898. E. KÖNIG. *Coppery-brown dye.*

Brown dyestuff obtained from diazotized meta-trimethyl ammonium phenyl-azo-meta-toluidin and chrysoidin; a black-green powder, soluble in water, with a reddish-yellowish-brown color, and dyeing tanned and untanned cotton, as well as half wool, a coppery brown.

602,640—April 19, 1898. E. KÖNIG. *Red-violet basic disazo dye.*

Reddish-violet dyestuff obtained from diazotized meta-trimethyl ammonium phenylazo-meta-amido-para-cresol ether and beta-naphthol; a brown powder soluble in water with a cherry-red color, and dyeing tanned and untanned cotton, as well as half wool, a reddish violet in an acid bath.

602,641—April 19, 1898. E. KÖNIG. (*Reissue: 11,714—January 31, 1899.*) *Basic disazo dye.*

Brown diazo and polyazo dyestuffs: produced by diazotizing the amidoazo dyestuffs from diazotized aromatic amido-ammonium bases and primary alphylamins, and then combining them with phenols, alphylamins, oxy, or amido azo dyestuffs; yielding, when chrysoidin is used, a blackish-brown powder, easily soluble in water with a brown color, in concentrated sulphuric acid with an olive-green color, and dyeing tanned and untanned cotton, as well as half wool, brown in an acid bath.

602,855—April 26, 1898. K. KREKELER AND A. BLANK. *Blue-black trisazo dye*

Triazo dyestuffs: produced by first combining in an alkaline solution one molecule of a tetrazotized paradiamin, such as benzidin, tolidin, dianisidin, with one molecule of amidonaphtholsulpho acid G; secondly, rediazotizing the resulting intermediate product; and, finally, coupling the intermediate product with two molecules of alpha$_1$, alpha$_4$, dioxynaphthalene alpha$_2$, monosulpho acid; dark powders dissolving in water with a blue color, dyeing unmordanted cotton blue shades which change into blackish blue with chromium and copper salts.

602,856—April 26, 1898. K. KREKELER AND A. ISRAEL. *Black trisazo dye.*

Triazo dyestuffs: produced by first combining one molecule of a tetrazotized paradiamin, such as benzidin, tolidin, or dianisidin, with one molecule of a betamonosulpho acid of alpha-naphthylamin, such as 1.6 and 1.7; secondly, diazotizing the resulting intermediate product; and, finally, combining the tetrazo compound thus produced with two molecules of 1.8 dioxynaphthalene, 4 sulpho acid; dyeing unmordanted cotton blue, changing to black when treated with solutions of chromium and copper salts.

602,857—April 26, 1898. K. KREKELER, A. ISRAEL, AND A. BLANK. *Black trisazo dye.*

Triazo dyestuffs: produced by combining one molecule of a tetrazotized paradiamin, such as benzidin, tolidin, or dianisidin, with one molecule of a betamonosulpho acid of alpha-naphthylamin, such as 1.6 and 1.7; secondly, diazotizing the resulting intermediate product; thirdly, coupling the tetrazo compound thus obtained with one molecule of 1.8 dioxynaphthalene, 4 monosulpho acid; and, finally, combining the body thus produced, which contains still one free diazo group, with a metadiamin of the benzene series, such as metaphenylenediamin; dark powders soluble in water with violet-gray to violet-black color and yielding violet-black shades on unmordanted cotton, changing to fast black with solutions of chromium and copper salts.

602,858—April 26, 1898. K. KREKELER AND E. MARTZ. *Brown trisazo dye.*

Triazo dyestuffs: produced by combining the diazo derivatives of certain diazo compounds (such as the combination of one molecule of tetrazodiphenyl with one molecule of salicylic acid and one molecule of Clève's naphthylamin-sulpho acid) with one molecule of an orthoöxycarbonic acid of the benzene series; dark powders soluble in water, dyeing unmordanted cotton yellowish brown to brown, becoming fast and more reddish brown on treatment with solutions of chromium and copper salts, and dyeing wool in acid baths similar shades.

603,008—April 26, 1898. M. KAHN. *Violet azo dye.*

Coloring matter: produced by combining in acid solution one molecule of a tetrazodiphenyl salt and two molecules of 1.8 amidonaphthol and 4 monosulpho acid; a black powder of a bronze-like luster soluble in water with a violet color and dyeing unmordanted cotton violet shades which change to fast black when treated with solutions of diazotized paranitranilin and sodium acetate.

603,009—April 26, 1898. M. KAHN AND F. RUNKEL. *Bluish-red dye.*

Tetrazo coloring matter: produced by combining one molecule of the tetrazo derivative of a certain diamidodiphenylaminsulpho acid with two molecules of metaphenylenediamin; dark-brown powder soluble in water yielding a red solution, yielding on unmordanted cotton intense bluish-red shades which change to fast brown on treatment with a solution of diazotized paranitranilin and sodium acetate.

603,013—April 26, 1898. P. OTT AND T. KROEBER. *Blue azin dye.*

Azin dyestuffs: produced by condensing sulpho acids of symmetrically-disubstituted 1.3 naphthylenediamins, such as 8 mono, 6.8 disulpho-acid with the sulpho-acids of paranitroso derivatives of secondary and tertiary aromatic amins; dark powders dissolving in water with a blue color, dyeing unmordanted wool in acid baths bright blue shades.

603,016—April 26, 1898. A. STEINER. *Triphenylmethane-blue dye.*

Violet to blue dyestuffs: produced by first combining the alkylated derivatives of phenyl-beta-naphthylamin with tetraälkylated diamido-benzophenone, next adding phosphorus oxychloride and keeping an elevated temperature, and finally sulphonating the so-obtained compounds; dissolving easily in concentrated sulphuric acid with a red-brown shade, and in water and in ethyl alcohol with a violet shade.

603,090—April 26, 1898. K. KREKELER AND E. MARTZ. *Brown trisazo dye.*

Triazo dyestuffs: produced by combining one molecule of the diazo derivatives outlined in No. 602,858 with one molecule of a metadiamin of the benzene series, such as metaphenylenediamin, metatoluylenediamin or a sulpho-acid thereof; dyeing cotton from reddish-brown to dark-brown shades which, when treated with solutions of chromium and copper salts, become more yellowish brown and fast.

603,093—April 26, 1898. G. STEINIKE AND F. SCHMIDT. *Black disazo wool dye.*

Black diazo dyestuffs: produced by the action of one molecule of a diazotized naphthylaminsulphonic acid and one molecule of a diazotized amin of the benzene or naphthalene series upon one molecule of dioxynaphthalenemonosulphonic acid S of No. 444,679; dark powders of bronze-like luster, soluble in water with a violet color, and dyeing wool in an acid bath.

603,300—May 3, 1898. H. R. VIDAL. *Process of making carboxylated products of triphenylmethane.*

Mono and di carboxylated products are derived from phenolic and amidated compounds of triphenylmethane by heating a mixture of phenol and the compound of triphenylmethane in presence of condensing agents, such as oxalic and sulphuric acid. They constitute light-yellow products in an acid state, and as salts they are a bright scarlet red.

603,645—May 10, 1898. K. KREKELER AND E. MARTZ. *Green trisazo dye.*

Triazo dyestuffs: produced by combining the diazo derivatives of the diazo compounds of the general formula

$$P{<}\begin{matrix} N=N-R \\ N=N-C, \end{matrix}$$

in which P represents a radical of the benzidin series, such as diphenyl, ditolyl, diphenol ether, or the like; R, the radical of an orthoöxycarbonic acid of the benzene series, such as salicylic acid or cresotinic acid; and C, the radical of "Cleve's" alpha-naphthylamin-beta-sulphonic acid (1.6 or 1.7), with one molecule of a mono or di sulpho acid of 1.8 amidonaphthol; forming black powders soluble in water with green color, dyeing unmordanted cotton green shades.

603,646—May 10, 1898. K. KREKELER, E. MARTZ, AND A. ISRAEL. *Gray trisazo dye.*

Triazo dyestuffs: produced by combining the diazo derivatives of the diazo compounds of the general formula R—N=N—P—N=N—C (as per No. 603,645) with one molecule of 1.4 or 1.5 naphtholmonosulpho-acid; forming dark powders dyeing unmordanted cotton greenish-gray shades.

603,647—May 10, 1898. K. KREKELER, E. MARTZ, AND A. ISRAEL. *Green trisazo dye.*

Triazo dyestuffs, produced by combining the diazo derivatives of the diazo compounds of the general formula R—N=N—P—N=N—C (as per No. 603,645) with one molecule of a 1.8 dioxynaphthalene mono or di sulpho acid; forming black powders dyeing unmordanted cotton green shades.

603,648—May 10, 1898. K. KREKELER, E. MARTZ, AND A. ISRAEL. *Brown trisazo dye.*

Triazo dyestuffs: formed by combining the diazo derivatives of the diazo compounds of the general formula R—N=N—P—N=N—C (as per No. 603,645) with one molecule of alpha-naphthylamin, or of a monosulpho acid thereof; dyeing unmordanted cotton dark-brown shades, and wool similar shades in acid baths.

603,659—May 10, 1898. R. E. SCHMIDT. *Dark-green alizarin derivative.*

Alizarin dyestuffs: obtainable by sulphonation of the condensation products from one molecule of alizarin pentacyanin and two molecules of a primary aromatic amin, as paratoluidin; forming dark powders, dyeing unmordanted and chrome-mordanted wool green shades, yielding on chrome-mordanted cotton fast green shades.

603,755—May 10, 1898. R. DEMUTH. *Brown sulphur dye.*

Coloring matter: produced by subjecting cresols and sulphur in a strong alkaline solution to a heat above 200° C.; forming, in the case of its alkaline salts, a black mass, soluble in water, with a greenish-black or blueish-black color, dyeing cotton a fast brown.

605,103—June 7, 1898. M. KAHN AND K. HEIDENREICH. *Black disazo dye and process of making same.*

Diazo dyestuffs: produced by first combining one molecule of the diazo derivative of amidodiphenylaminsulpho-acid, having the formula $C_6H_5.NH.C_6H_4.NH_2$ (1), SO_3H (3), with one molecule of alphanaphthylamin; secondly, diazotizing the resulting amidoazo compound; and finally, coupling the diazoazo compound thus obtained with an alpha-naphthol-alpha-monosulpho-acid, such as 1.4 naphtholsulpho-acid, 1.5 naphtholsulpho-acid; forming dark powders, soluble in water, with a bluish-black color, dyeing wool in acid bath fast black shades.

605,119—June 7, 1898. O. NASTVOGEL. *Diphenylnaphthylmethane dye.*

A diphenylnaphthylmethane dye: produced by first condensing tetraälkyldiamidobenzhydrol with certain alpha-naphthylaminsulpho acids; secondly, diazotizing the resulting leuco compound; thirdly, transforming the diazo group of the body thus obtained into the sulphinic group; and finally, changing the so-produced leuco sulphinic-sulphonic acid into the corresponding dyestuff, sulphonic acid, by means of oxidizing agents; forming a brown powder, dyeing wool in acid bath greenish-blue shades fast to alkalis.

605,568—June 14, 1898. R. E. SCHMIDT. *Anthraquinone dye.*

Paradiamidoanthrarufin-monosulpho acid: produced by sulphonating paradiamidoanthrarufin, by means of fuming sulphuric acid with the addition of boric acid; forming a blackish powder dyeing unmordanted wool in acid baths blue shades fast to light, and yielding on chrome mordanted wool fast greenish-blue shades.

605,921—June 21, 1898. R. E. SCHMIDT AND P. TUST. *Blue anthraquinone dye.*

Paradiamidochrysazin-monosulpho acid: produced by sulphonating paradiamidochrysazin by means of fuming sulphuric acid with the addition of boric acid; a blackish powder, dyeing unmordanted wool in acid baths blue shades fast to light, yielding on chrome mordanted wool greenish-blue shades.

606,181—June 28, 1898. J. BAMMANN. *Blue tetrazo dye and process of making same.*

Tetrazo dyestuffs: produced by combining one molecule of a tetrazotized paradiamin with two molecules of 1.8 amidonaphthol 4.6 disulpho-acid; forming dark powders soluble in water with from reddish-blue to blue color; dyeing unmordanted cotton fast violet-blue to blue shades.

606,193—June 28, 1898. R. DEMUTH. *Yellow-brown cotton dye.*

A yellowish-brown cotton dye: produced by subjecting dinitrotoluenesulpho-acid ($CH_3NO_2NO_2SO_3H$ 1:2:4:6), or salts thereof, to the action of an alkaline-sulphid-carrying compound at elevated temperatures, up to 250° C.

606,212—June 28, 1898. B. HEYMANN. *Blue dye and process of making same.*

Dyestuff produced by the reaction of paraämidodimethylanilinthiosulpho acid and nitroso 2.7 oxynaphthoxyacetic acid; dyeing chrome-mordanted wool fast bright-blue shades.

606,264—June 28, 1898. J. BAMMANN. *Dark-blue tetrazo dye and process of making same.*

Tetrazo dyestuffs: produced by combining one molecule of tetrazotized paradiamin, such as benzidin, tolidin, or dianisidin, with one molecule of the 1.8 amidonaphthol, 4.6 disulpho-acid (German patent No. 80,741); and further combining the resulting intermediate product with one molecule of amidonaphtholmonosulpho-acid G; being soluble in water, rediazotizable in solution or on fiber, and dyeing unmordanted cotton from blackish-blue to blue shades.

606,295—June 28, 1898. P. OTT AND T. KROEBER. *Blue azin dye and process of making same.*

Azin dyestuffs: produced by acting with oxidizing agents such as bichromate of sodium on a mixture of equimolecular proportions of paraämidodiphenylaminorthosulpho acid and of a sulpho acid of a symmetrically-disubstituted 1.3 naphthylene diamin; forming a dark powder dyeing wool brilliant-blue fast shades.

606,437—June 28, 1898. F. BENDER. *Amidonaphtholdisulpho acid and process of making same.*

Acid "B," 1.8 amidonaphthol 3.5 disulpho-acid: produced by sulphonating 1.8 amidonaphthol 3 monosulpho acid; soluble in hot water, with difficulty in cold water; the diazo compound being soluble in water with an intensely yellow color; the acid, when boiled with dilute sulphonic acid at 140° C., yielding 1.8 amidonaphthol 3 sulpho-acid, and when heated with dilute caustic-soda lye up to 230° C., yielding 1.8 dioxynaphthaline 3.5 (4.6) disulpho acid, and adapted to form an acid sodium salt.

606,438—June 28, 1898. F. BENDER. *Blue-black dye.*

Diazo dyes derived from one molecular proportion of acid "B," No. 606,437, and two molecular proportions of a diazo compound, such as diazo-benzene; soluble in water with a greenish to reddish-blue color, and dyeing wool in an acid bath in greenish to bluish-black shades.

606,439—June 28, 1898. F. BENDER. *Green disazo dye.*

A coloring matter, dyeing unmordanted cotton in green shades; prepared by sulphonating 1.8 amidonaphthol 3 monosulpho-acid (acid "B," No. 606,437), benzidin-azo-salicylic acid, or analogous compounds.

607,408—July 12, 1898. E. ELSAESSER. *Blue dye for wool.*

Blue dyestuff for wool: produced by oxidizing a mixture of beta-dinaphthylmetaphenylenediamin-disulphonic acid and dimethylparaphenylenediaminthiosulphonic acid in an aqueous solution, and then boiling the oxidized product with soda; a dark-bronze shining powder, readily soluble in water, with difficulty in alcohol.

608,024—July 26, 1898. M. BONIGER. *Brown azo dye.*

Substantive brown polyazo coloring matters: produced by combining, first, one molecule of the azo color beta$_1$ azo alpha$_4$ naphthol beta$_2$ beta$_3$ disulphonic acid metaphenylen or metatoluylen diamin with one molecule of a diazo compound and combining the disazo color thus obtained with one molecule of the intermediate product obtained by combination of one molecule of tetrazo-diphenyl or tetrazo-ditolyl with one molecule of salicylic acid; dyeing unmordanted cotton in yellow-brown to blue-brown tints.

606,238—August 2, 1898. K. THUN. *Green alizarin dye.*

Alizarin dyestuffs: produced by sulphonating the condensation products obtainable from one molecule of alizarin bordeaux and two molecules of a primary aromatic amin, as paratoluidin; forming dark powders, dyeing unmordanted and chrome-mordanted wool green shades and yielding on chrome-mordanted cotton green shades fast to light.

608,354—August 2, 1898. H. R. VIDAL. *Process of making violet dyes.*

Violet coloring matters are produced by heating parasulphanilic acid with diamins, one to four, of benzene and naphthalene.

608,355—August 2, 1898. H. R. VIDAL. *Brown-black sulfur dye.*

Coloring matters: produced by heating with sulphur a condensation product of the amidobenzene sulphonic acids with a derivative of phenol or a diamin, such as the condensation product of the parasulphanilic acid and orthoamidophenol; soluble in alkalis, insoluble in acid and directly dyeing unmordanted cotton a brown black.

608,999—August 16, 1898. J. BAMMANN AND M. ULRICH. *Blue-black azo dye.*

A coloring matter: produced by combining equimolecular proportions of a tetrazo-diphenyl salt with 1.8 amido-naphthol-beta-disulpho acid and alpha-naphthylamin; soluble in water and alcohol with reddish-violet color, in ammonia with bright, reddish violet, dyeing unmordanted cotton in an alkaline bath violet-black shades, changing to black on treatment with nitrous acid and an alkaline solution of beta-naphthol.

609,327—August 16, 1898. R. BOHN. *Blue-black dye and process of making same.*

A violet-blue to blue-black dyestuff: produced by submitting a dinitronaphthalene to the action of a reducing agent—such as sodium sulphide, grape sugar, sodium stannate, zinc dust, or the like—in alkaline solutions of the sulphites or the bisulphites of the alkalies or the alkaline earths.

609,352—August 16, 1898. P. JULIUS. *Blue dye.*

A blue coloring matter: produced by condensing the nitrosodiethylmetaämidophenol with alpha-naphthylaminmonosulpho acid, yielding fast indigo-like shades.

609,598—August 23, 1898. H. R. VIDAL. *Red dye and process of making same.*

Coloring matters: produced by heating hydrazins with a carboxylated carbinol compound, such as dicarboxylated trioxyphenylcarbinol, forming a vivid red-blue mass, soluble in alkalis, directly dyeing animal and mordanted cotton fibers.

609,599—August 23, 1898. H. R. VIDAL. *Process of obtaining triphenylmethane derivatives.*

Tricarboxylated derivatives of phenolic or aminated compounds of triphenylmethane are produced by heating said compounds in presence of a condensing agent, such as oxalic and sulphuric acid. (See No. 603,300.) They form orange-colored masses, soluble in alkalis and concentrated acids, little soluble in water.

609,997—August 30, 1898. J. SCHMID AND H. REY. *Red-violet phthalein dye.*

In the manufacture of dyestuffs of the phthalein series, equal molecular parts of phthalic anhydrid and metaoxyphenylorthotolylamin are melted until the molten mass thickens, and then the product of condensation is extracted. One molecule of this product is condensed with one molecule of a meta-substituted phenol, such as resorcinol, monoethylmetaämidocresol, dimethylmetaämidophenol, etc., and the monoörthotolylphthalein dye thus obtained converted into a sulpho acid, and then into an alkaline salt. It dyes wool and silk in acid bath in red-violet tints.

609,998—August 30, 1898. J. SCHMID AND H. REY. *Sulfonated monobenzylphthalein dye.*

The alkaline sulphonate of a monobenzylated-phthalein dye is produced by condensing one molecule of the product, resulting from the condensation of equivalent quantities of phthalic anhydrid and of a benzylalkylmetaämidophenol, with one molecule of a meta-substituted phenol; then converting the monobenzylated-phthalein dye into a sulpho acid, and then into an alkaline salt. It dyes textile fibers in fiery-red tints.

610,345—September 6, 1898. B. DEICKE. *Red-acid dye and process of making it.*

Azo dyestuffs: produced by diazotizing amidobenzylamin and its alkyl derivatives, the salts of which are expressed by the general formula $NH_2.C_6H_4.CH_2-NR_3x$ (in which R represents hydrogen or an alkyl and x an acid radical), and combining with a primary aromatic amin, then rediazotizing and combining with an aromatic amin, phenol (pyrazolon), amido or oxyazo dyestuff; soluble in water and alcohol, with a red color, and dyeing half wool red in an acid bath.

610,349—September 6, 1898. O. ERNST. *Violet azo dye and process of making it.*

A monoazo dyestuff: produced by combining diazotized 1.8.4 amidonaphtholmonosulphonic acid with alpha-naphthylamin; a green-black powder of metallic luster, dyeing wool violet in an acid bath and producing by treatment with chromates or chromic acid a fast brown color.

610,367—September 6, 1898. A. PHILIPS. *Basic diazo dye.*

Basic diazo dyestuffs of the general formula, alphyl N_2 alphyl N_2 alphyl, $OHNR_3Cl$., (in which alphyl means an aromatic radical and R an alkyl): produced by diazotizing amidoazo compounds and allowing them to act upon phenol-ammonium bases; the product obtained by diazotizing amidoazo-benzene and treating it with 2.7 naphtholtrimethyl-ammonium being a red powder, dyeing wool and cotton cherry red in an acid bath.

610,541—September 13, 1898. G. KALISCHER. *Black dye and process of making same.*

A black coloring matter produced by heating oxydinitrodiphenylamin with sulphides of alkalis and sulphur in aqueous solution; soluble in water with a blue-black color and dyeing unmordanted cotton directly in an alkaline bath a deep blue-black.

611,111—September 20, 1898. E. ELSAESSER. *Brown dye and process of making it.*

A brown diazo dyestuff: produced by combining the sodium-bisulphite compound of nitroso-beta-naphthol in an acetic-acid solution with a tetrazo compound, such as tetrazo-diphenyl and tetrazo-ditolyl, and then combining the intermediate product thus formed with an alkaline solution of $beta_1$ amido $alpha_4$ naphthol $beta_3$ sulphonic acid; dyeing unmordanted cotton in a neutral or alkaline bath dark brown.

611,112—September 20, 1898. E. ELSAESSER. *Blue-black dye and process of making same.*

A direct-dyeing blue-black cotton dyestuff produced by the action of sodium sulphide upon $alpha_1$ $alpha_4$ dinitronaphthalene $alpha_2$ monosulphonic acid.

611,597—October 4, 1898. J. BAMMANN. *Green-blue tetrazo dye.*

Tetrazo dyestuffs produced by combining one molecule of a tetrazotized paradiamin of the benzidin series (such as benzidin, tolidin, dianisidin) with one molecule of 1.8 amidonaphthol 4.6 disulpho acid and coupling the intermediate product with one molecule of any of the known azo dyestuff components, such as 1.8 amidonaphthol 3.6 disulpho acid, 1.4 naphtholsulpho acid, alphanaphthylamin, or the like; dark powders, soluble in water, rediazotizable in solution or on the fiber, dyeing unmordanted cotton from violet to blue and greenish-blue shades.

611,610—October 4, 1898. R. DEMUTH. *Brown cotton dye.*

A reddish-brown cotton dye produced by subjecting 1 naphthol 4.8 disulpho acid to the action of an alkaline-sulphide carrying compound at temperatures of 260° to 270° C.

611,611—October 4, 1898. R. DEMUTH. *Indigo-blue cotton dye.*

An indigo-blue cotton dye produced by subjecting 1.8 amidonaphthol to the action of an alkaline sulphide and sulphur at 240° C., repeatedly extracting the resulting melt when cold with small quantities of hot water until the blue dye is wholly dissolved out, and finally isolating from the joint filtrates the dye by precipitation with a metallic chloride, such as zinc chloride; dyeing unmordanted cotton in alkaline bath, and in bath containing suitable reducing agents, fast indigo-blue shades.

611,628—October 4, 1898. H. HASSENCAMP. *Violet dye and process of making same.*

A triphenylmethane dyestuff produced by combining in equimolecular proportions tetramethyldiamidobenzhydrol and methylbenzylanilindisulpho acid, oxidizing the resulting leuco compound and converting the oxidation product into an alkaline salt; dyeing unmordanted wool in acid baths fast bluish-violet shades.

611,663—October 4, 1898. M. ULRICH. *Orange dye and process of making same.*

Orange dyestuffs, dyeing unmordanted cotton: produced by combining one molecule of a diazotized paraämidoazo sulpho acid of the benzene series—such as amidoazo-benzene sulpho acid, amidoazo-toluene sulpho acid, or the like—with one molecule of a nitrometadiamin of the benzene series, such as nitrometaphenylenediamin; fast to acids, alkalis, and light.

611,664—October 4, 1898. M. ULRICH. *Blue dye and process of making same.*

Monoazo dyestuffs produced by combining one molecule of a diazotized periamidonaphtholsulpho acid, such as 1.8 amidonaphthol 3.6 disulpho acid, with one molecule of a monosubstituted 1.8 naphthylaminsulpho acid of the general formula $C_{10}H_6$. NHR (1). SO_3H (8), in which R represents an aromatic radicle such as phenyl; dyeing unmordanted wool in acid bath from reddish blue to fast blue shades.

613,113—October 25, 1898. J. J. BRACK. *Rhodol derivative and process of making same.*

Dyestuffs of the phthalein series produced by condensing an alkyl ether of a dialkylrhodol with formic aldehyde; a brilliant greenish powder, dyeing tannin-mordanted cotton a yellowish red, and on printing with potassium ferrocyanide and zinc oxide it yields a lake of the same color, not changed by steaming.

613,578—November 1, 1898. C. DE LA HARPE AND C. VAUCHER. *Blue dye from gallocyanin and process of making same.*

A coloring matter: produced by treating the gallocyanin dye of No. 518,458, with sulphurous acid in a free state or as a sulphite or bisulphite; dyeing and printing bluer tints than the original gallocyanin.

613,638—November 1, 1898. K. ELBEL AND I. ROSENBERG. *Primary disazo blue-black dye.*

A primary diazo coloring matter, dyeing wool a blue black: produced by combining the 1.8.4.6 amidonaphtholdisulpho-acid (K) with one molecule of alpha-diazonaphthalene in presence of free mineral acid and then acting upon the so-formed monoazo color with one molecule of diazo-benzene in an acid combination liquid.

613,639—November 1, 1898. K. ELBEL AND I. ROSENBERG. *Primary disazo blue-black dye.*

A primary diazo coloring matter: produced by combining the 1.8.4.6 amidonaphtholdisulpho-acid (K) with one molecule of paranitrodiazobenzene in presence of free mineral acid and then acting upon the so-formed monoazo color with one molecule of diazo-benzene in an acid combination liquid; dyeing wool from an acid bath blue to deep blue-black shades.

613,640—November 1, 1898. I. ROSENBERG AND K. ELBEL. *Greenish-blue polyazo dye.*

A polyazo dyestuff produced by combining one molecule of alpha-diazonaphthalene with one molecule of 1.8.4.6 amidonaphtholdisulpho-acid (K) in presence of free mineral acid to a monoazo color, acting upon same in presence of free acetic acid with one molecule of tetrazo-diphenyl and uniting the so-formed intermediate product with 2.8.6 amidonaphtholsulpho-acid (G) in presence of alkali; dyeing unmordanted cotton a deep greenish blue.

613,641—November 1, 1898. I. ROSENBERG AND F. KRECKE. *Greenish-blue mixed disazo dye.*

A dyestuff obtained by combining the intermediate product from one molecule of tetrazo-diphenyl and one molecule of 1.8.4.6 amidonaphtholdisulpho acid (K) with one molecule of 2.8.6 amidonaphtholsulpho-acid (G), effected in alkaline solution, characterized by giving with concentrated sulphuric acid a cornflower-colored solution; dyeing unmordanted cotton greenish-blue to greenish-black shades.

613,642—November 1, 1898. I. ROSENBERG. *Deep-blue dye and process of making same.*

A mixed substantive dyestuff produced by combining the tetrazo compound of benzidin first with one molecular proportion of 1.8.4.6 amidonaphtholdisulpho-acid (K), to form an intermediate product which i ther pu intc reaction with one molecular proportion of 1.3 naphthylenediaminsulpho acid dyeing unmordanted cotton deep-blue indigo-like shade from a weakly alkaline or salt bath.

613,643—November 1, 1898. I. ROSENBERG AND B. HELMERT. *Orange-brown polyazo dye.*

Polyazo dyestuffs produced by combining monoazo colors containing the 1.3.6 naphthalenediaminsulpho acid (No. 587,757), as component part with the intermediate products obtained from one molecule of one of the usually employed paradiamins and one molecule of an oxycarbonic acid; dyeing unmordanted cotton a fast orange-brown shade from an alkaline or salt bath, and dyeing mixed goods from a neutral bath.

613,644—November 1, 1898. I. ROSENBERG AND B. HELMERT. *Reddish-brown polyazo dye.*

A polyazo dyestuff produced according to No. 613,643, using the diazo compound of alpha-naphthylamin; dying unmordanted cotton reddish-brown shades from alkaline or salt baths; dyeing wool same shades from a neutral bath; and especially suited for dyeing mixed goods.

613,645—November 1, 1898. I. ROSENBERG. *Black polyazo dye.*

A polyazo dyestuff produced by reducing in alkaline solution the nitro group of the monoazo color obtained from one molecule of paranitrodiazo-benzene and one molecule of 1.8.4.6 amidonaphtholdisulpho acid (K) in acid solution, combining the reduced product with one molecule of tetrazo-diphenyl to form an intermediate body and acting upon this with one molecule of 1.3.6 naphthalenediaminsulpho acid; a black powder soluble in water with black, in concentrated sulphuric acid with indigo-blue color, dyeing unmordanted cotton black, which can be rediazotized and combined with developers.

613,646—November 1, 1898. I. ROSENBERG AND F. KRECKE. *Substantive disazo dye.*

A mixed substantive diazo dyestuff produced by combining the tetrazo compound of tolidine, first with one molecular proportion of 2.8.6 amidonaphtholsulpho-acid (G) and then reacting on the same with one molecular proportion of 1.3.6 naphthylenediaminsulpho-acid; dyeing unmordanted cotton bluish-violet shades; diazotizable on the fiber, and combining with the usual developers; yielding, for instance, with beta-naphthol indigo-blue shades fast to light and washing.

613,911—November 8, 1898. C. RIS. *Yellow dye and process of making same.*

An orange-yellow powder, dyeing unmordanted cotton, wool, and silk in fast greenish-yellow shades, and produced by condensation of paradinitrodibenzyldisulpho acid with a base of the aniline series in presence of caustic-alkali lye and then further oxidizing the product.

613,920—November 8, 1898. H. GUTZKOW. *Green-blue soluble dye and process of making same.*

Greenish-blue dyestuffs soluble in water, produced by causing the diazo compounds of asymmetric dialkylsaffranin to act upon naphthylamin.

613,926—November 8, 1898. C. HOFFMANN. *Red rhodamin dye and process of making same.*

Rhodamindialkylamids, red dyestuffs, are produced by treating rhodamin with oxychloride of phosphorous and then with dialkylamins.

614,391—November 15, 1898. A. ISRAEL AND R. KOTHE. *Disazo dye and process of making same.*

Diazo dyestuffs: obtainable from acidyl 1.4 naphtylenediamins, Cleve's alphanaphtylaminebetamonosulpho acid and naphtolsulphonic acids; forming dark powders, dyeing unmordanted cotton from reddish blue to grayish-blue shades, which can be further diazotized on fiber and coupled with amins or phenols.

614,538—November 22, 1898. R. DEMUTH. *Indigo-blue dye and process of making it.*

Dyes giving blue shades on unmordanted cotton in alkaline baths, or in baths containing suitable reducing agents: produced by subjecting sulpho-acid compounds of 1.8 amidonaphthol, such as their free acids, or salts thereof, to the action of an alkaline sulphide-carrying compound at elevated temperatures, repeatedly extracting the resulting melt when cold with small quantities of hot water until the blue dye is wholly dissolved out, and finally isolating the dye by precipitation with metallic salts, as zinc chloride.

615,472—December 6, 1898. E. BOURCART. *Green dye and process of making same.*

A green dyestuff produced by treating the sulphonic acids of alkylated metaoxydiamidotriphenylmethane or their homologues at a low temperature with concentrated nitric acid, and then oxidizing the leuco compounds thus obtained; dyeing wool and silk green in an acid bath.

615,485—December 6, 1898. C. HOFFMANN. *Green dye and process of making same.*

Green to blue-green dyestuffs: produced by condensing metaälkyl-oxysulphonic acids with tetraalkyl-paradiamidobenzhydrols, sulphonating with fuming sulphuric acid, and then oxidizing the leucosulphonic acids thus obtained with peroxide of lead.

615,497—December 6, 1898. C. RIS AND C. SIMON. *Black trisazo dye and process of making same.*

A black triazo color produced by combining the tetrazo compound of paraphenylenediaminazo $beta_1$ $alpha_4$ amidonaphthol $beta_3$ sulpho acid first in acid solution with a metadiamin, and then with resorcin; dyeing unmordanted cotton, wool, and silk deep-black shades.

615,791—December 13, 1898. H. BOEDEKER. *Process of making sulfonic acids of asymmetric rhodamins.*

Asymmetric rhodamin dyestuffs are obtained by first substituting in the fluorescein chloride one chlorine atom by the rest of a primary or secondary base of the fat or aromatic series, and then acting on the intermediate product thus obtained with another primary or secondary base of the fat or aromatic series, and transforming the dyestuff thus obtained into the sulphonic acid by treatment with concentrated sulphuric acid. Wool is dyed a bright red in an acid bath.

616,123—December 20, 1898. I. LEVINSTEIN AND C. MENSCHING. *Process of making alphylamidonaphthol-sulfonic acids.*

They are produced by heating $beta_1$ $alpha_4$ dioxynaphthalene-$beta_3$ sulphonic acid with aromatic amins in the presence of means of condensation, such as the hydrochlorides of the aromatic amins, as anilin and anilin hydrochloride at from 120° to 160° C. Dyestuffs are obtained by treatment with diazo or tetrazo bodies.

616,622—December 27, 1898. C. DE LA HARPE. *Blue dye from gallocyanin and process of making same.*

A leuco body suitable for dyeing and printing on textile fabrics: produced by boiling the product of condensation of resorcinol and a gallocyanin dye, with an aqueous solution of an alkali while out of contact with the air; forming a greenish-black powder which colors fibers when applied and oxidized thereon, in redder-blue tints than the said product of condensation.

617,340—January 10, 1899. P. JULIUS AND G. E. DARIER. *Phosphin dye and process of making same.*

Phosphins and their alkyl substitution products (substitution in the amido group) are obtained by condensing paraämidobenzaldehyde, or its substitution products, with the alphyl derivatives of the metatoluylenediamin; the dyestuff obtained by condensing dimethyl-paraämidobenzaldehyde with phenyl-metatoluylenediamin, dissolving in hot water with a reddish-yellow color, becoming light yellow by the addition of dilute mineral acids.

617,544—January 10, 1899. F. SCHOLL. *Yellow basic disazo dye and process of making same.*

Azo dyestuffs: produced by diazotizing amidoazo dyestuffs obtained from diazotized aromatic amidoammonium bases and primary alphylamins and then acting with the same upon aceto-acetanilid; forming orange-yellow powders, dyeing cotton, as well as wool and half-wool, light yellow in an acid bath.

617,627—January 10, 1899. O. BALLY. *Process of making green dyes.*

A green mordant-dyeing coloring matter is produced by melting together brom-fluoresceins and concentrated sulphuric acid and then adding boracic acid.

617,628—January 10, 1899. H. A. BERNTHSEN AND G. J. JAUBERT. *Blue dye and process of making same.*

A blue mordant-dyeing dyestuff is produced by treating an oxynaphthindophenolthiosulphonic substance with a concentrated mineral acid.

617,551—January 10, 1899. L. GIFFORD, ADMINISTRATOR OF K. HEUMANN, DECEASED. *Blue dye and process of making same.*

Dyestuff: produced by melting ethyl-phenyl-glycocol with alkali, and subsequently oxidizing, as by an air blast. It dyes both from the vat and in the form of sulpho acid greenish shades of blue.

617,652—January 10, 1899. L. GIFFORD, ADMINISTRATOR OF K. HEUMANN, DECEASED. *Process of making indigo coloring matters.*

In the manufacture of indigo coloring matters from glycocol derivatives, quicklime is added to the caustic alkaline melt, in which the glycocol derivatives are treated, giving a higher yield of the leuco compound.

617,686—January 10, 1899. M. H. ISLER. *Blue dye and process of making same.*

Blue coloring matters: produced by treating dinitro-anthraquinones with fuming sulphuric acid containing about 30 to 40 per cent SO_3 and boracic acid in presence of sulphur at 120° to 130° C. for two to two and a half hours.

617,703—January 10, 1899. W. HERZBERG AND H. HEIMANN. *Blue safranin dye.*

A blue saffranin dye: prepared from neutral blue by first treating the latter with sulphites and subsequently reacting on the sulpho acid thus formed with dimethylparaphenylenediamin, and forming a dark-brown powder and producing on mordanted cotton blue shades.

617,963—January 17, 1899. H. KIRCHHOFF. *Red dye.*

A dye: produced by combining one molecule of diazotized metaämidoparacresol-ether with one molecule of a salt of naphtholsulphamidosulphonic acid; dyeing wool clear red shades of bluish tint.

617,981—January 17, 1899. O. BALLY. *Anthraquinone derivative and process of making same.*

Coloring matters: produced by condensing the sulphuric acid esters of a polyoxyanthraquinone sulpho acid, which can be obtained by the treatment of a nitro-anthraquinone or reduction product thereof, with fuming sulphuric acid and a reducing agent, such as sulphur, with a phenolic body (including the hydroxycarboxylic and sulphonic acids); dyeing unmordanted wool violet to blue shades which become greenish-blue to blue on treatment with chrome.

618,000—January 17, 1899. O. BALLY. *Yellow dye and process of making same.*

Yellow mordant-dyeing coloring matters: produced by oxidizing an aromatic hydroxycarboxylic acid in sulphuric-acid solution, as by the action of a persulphate.

618,152—January 24, 1899. H. R. VIDAL. *Black sulphur dye.*

Black dyestuffs are produced by causing sulphur to react upon a trisubstituted derivative of benzene, such as diamidophenol.

618,688—January 31, 1899. E. KÖNIG AND F. SCHOLL. *Aromatic amidoammonium and process of making same.*

Aromatic amido-ammonium bases (valuable for the production of azo dyestuffs), of the general formula (aromatic radical) $NH_2N(alkyl)_3x$ in the form of their salts (x representing chlorine or the equivalent radical of an acid), are produced by reducing aromatic nitro-ammonium bases with metals, such as zinc or iron, in an acid or neutral solution.

618,963—February 7, 1899. R. TAGGESELL. *Blue-black azo dye and process of making same.*

Azo dyestuffs: produced by combining one molecule of the diazo derivative of a monosulpho-acid of the benzene series—sulphanilic acid, metanilic acid, or toluidin-monosulpho-acid—with one molecule of alphanaphthylamin, rediazotizing the intermediate product, and combining it with amidonaphtholdisulpho-acid (H) or its equivalent; dyeing wool in an acid bath bluish-black shades of great fastness.

619,114—February 7, 1899. O. BALLY. *Green-black dye and process of making same.*

Coloring matters: produced by heating 1.5-dinitro-naphthalene with sulphuric acid to obtain the well-known naphthazarin intermediate product, and adding to the sulphuric-acid solution of this body a phenolic body; giving with cold anilin a color within the range of violet to blue.

619,115—February 7, 1899. O. BALLY. *Bluish dye and process of making same.*

A coloring matter obtained by heating 1.5-dinitro-naphthalene with sulphuric acid to obtain the naphthazarin intermediate product, and adding alpha-naphthol to the sulphuric-acid solution of this body, giving a bluish-green color in anilin.

619,181—February 7, 1899. M. H. ISLER. *Product from dinitro-naphthalene and process of making same.*

New bodies: produced by submitting 1.8 or 1.5 dinitro-naphthalene to the action of weak fuming sulphuric acid containing not more than 23 per cent SO_3; by treatment with fuming sulphuric acid, or by heating with caustic soda, it yields a brown dyestuff suited for dyeing wool; with dilute caustic soda and a little zinc dust a red color.

619,194—February 7, 1899. I. LEVINSTEIN AND R. HERZ. *Naphthylene-diamin-sulphonic acid and process of making same.*

$Alpha_1$ $alpha_2$ naphthylenediamin $beta_1$ sulphonic acid is produced by reducing the azo coloring matters obtained by the combination of diazo bodies, with $alpha_1$ naphthylamin $beta_1$ sulphonic acid. It forms a sodium salt soluble in water and oxydizes in a neutral or an alkaline solution by the oxygen of the air to a yellowish crystalline substance, the aqueous solution of which shows a greenish-yellow fluorescence like that of fluorescein.

619,503—February 14, 1899. C. RIS. *Black trisazo dye and process of making same.*

Black colors: produced by diazotation of the intermediary compounds from one molecule of a paradiamin and one molecule of $beta_1$ $alpha_4$ amidonaphthol $beta_3$ sulpho-acid, and then combination of the formed tetrazo body with one molecule of a derivative of a metadiamin and one molecule of a metadiamin: dyeing unmordanted cotton in deep black shades.

619,518—February 14, 1899. M. ULRICH. *Yellow dye and process of making same.*

Tetrazo dyestuffs: produced by combining one molecule of a tetrazo derivative of diamidodibenzyldisulpho acid with two molecules of a nitrometadiamin of the benzene series, such as nitrometaphenylenediamin; dyeing unmordanted cotton bright fast yellow shades.

619,577—February 14, 1899. P. JULIUS AND A. TKATSCH. *Process of making yellow phosphin dye.*

Alkalated para-amido-benzaldehyde and an alphyl-meta-toluylene-diamin are heated together in alcoholic solution and in the presence of ferric chloride.

619,574—February 14, 1899. M. H. ISLER. *Xanthopurpurin.*

A sulpho-acid of xantho-purpurin obtained by diazotizing and subsequently heating 1.3 diamido-antbra-quinone in fuming sulphuric acid solution; dyeing unmordanted wool dull yellow shades.

619,883—February 21, 1899. L. GIFFORD, ADMINISTRATOR OF KARL HEUMANN, DECEASED. *Dimethyl indigo and process of making it.*

A blue dyestuff of the formula C_{18} H_{18} N_4 O_2: produced by melting ortho-tolyl-glycocol with alkali and then oxidizing, as by an air blast; giving greener shades on cotton when dyed from the vat than ordinary indigo, and redder shades on wool than the ordinary indigo sulpho acids when dyed from its soluble sulpho acids.

619,488—February 21, 1899. L. GIFFORD, ADMINISTRATOR OF KARL HEUMANN, DECEASED. *Blue dye and process of making same.*

Coloring matters of the indigo series: produced by heating ethyl-para-tolyl-glycocol with a caustic alkali, and oxidizing the leuco compound so produced. When sulphonated it is soluble in water and dyes directly.

620,368—February 28, 1899. J. SCHMID. *Blue tetrazo dye and process of making same.*

Blue coloring matters: produced by combining the intermediate product obtained from one molecule of a naphthacetoldisulpho acid and one molecule of the tetrazo derivative of a paradiamin of the series of diphenyl with one molecule of a naphtholic compound, as naphtholsulpho-acids, naphthols, and oxynaphthols; dyeing unmordanted cotton pure reddish to greenish-blue tints.

620,369—February 28, 1899. J. SCHMID. *Blue tetrazo dye and process of making same.*

Blue substantive coloring matters: obtained by first combining molecular proportions of a naphthacetoldisulpho-acid and the tetrazo derivative of a paradiamin of the series of diphenyl, and then combining one molecule of the intermediate product with one molecule of an amidonaphtholsulpho acid.

620,428—February 28, 1899. R. DEMUTH. *Blue cotton dye.*

Blue substantive cotton dyes: produced by subjecting sulpho-acids of 1.8 chloronaphthol to the action of an alkaline sulphide and sulphur at elevated temperatures (to 240° C.), repeatedly extracting the resulting melt when cold with small quantities of hot water, until the blue dye is dissolved out, and finally isolating the dye from the joint filtrates by precipitation with zinc chloride.

620,442—February 28, 1899. L. GIFFORD, ADMINISTRATOR OF K. HEUMANN, DECEASED. *Blue glycocol dye.*

Coloring matters of the indigo series: produced by heating ethyl-ortho-tolyl-glycocol with caustic alkali, and oxidizing the leuco compound so produced; unsulphonated, the blues are greener on cotton than ordinary indigo; when sulphonated, it is soluble in water and dyes directly.

620,562—March 7, 1899. R. BLANK. *Amido malonic ester and process of making same.*

Amidomalonic acid esters having the formula $A-NH-CH=(CO_2C_2H_5)_2$, where $A-NH_2$ represents an aromatic amin, one H of which is substituted by the malonic acid ester root, are produced by allowing aromatic amins to react upon halogen malonic acid esters. They lend themselves to the formation of indoxylic compounds, readily converted into compounds of the indigo series.

620,574—March 7, 1899. K. ELBER AND J. OPPERMANN. *Black trisazo dye.*

Triazo dyestuffs: produced by diazotizing the intermediate products formed by combination of tetrazotized diamidodiphenylamincarbonic acid with one molecular proportion of an amin suitable for further diazotization as amidonaphtholsulpho acid G, and combining the so-obtained unsymmetrical tetrazo compound with meta-diamins of the benzene series, as meta-toluylendiamin; dyeing dark blue to black shades on unmordanted cotton or mixed goods from neutral or weakly alkaline baths.

621,393—March 21, 1899. H. R. VIDAL. *Triphenylmethane dye and process of making same.*

Violet and blue coloring matters: produced by condensation of tetralyl hydrols with aromatic hydrazins at from 60° to 80° C., the action being prolonged until the leuco base, appearing in the first phase, becomes transformed into coloring matter.

621,652—March 21, 1899. L. GIFFORD, ADMINISTRATOR OF K. HEUMANN, DECEASED. *Blue dye.*

Blue dyestuff, derived from ortho-tolyl-glycocol by heating tolyl-glycocol and caustic alkali at elevated temperatures, up to 340° C.; dyeing wool from a boiling acid bath, yielding redder shades than indigo-carmine.

621,679—March 21, 1899. M. H. ISLER. *Oxyanthraquinone sulfo acid and process of making same.*

Sulpho-acid of oxy-anthra-quinone: produced by diazotizing amido-anthraquinone in fuming sulphuric acid and subsequently heating. The sulpho-acid of anthra-rufin, obtained by diazotizing and subsequently heating 1.5-diamido-anthra-quinone in fuming sulphuric acid solution, dyes unmordanted wool yellow shades, and is an initial material for the production of dyestuffs

622,139—March 28, 1899. L. GIFFORD, ADMINISTRATOR OF K. HEUMANN, DECEASED. *Blue coloring matter and process of manufacturing same.*

Blue dyestuff produced by melting a phenyl-glycocol body with alkali, and subsequently oxidizing, as by a blast of air; in its sulphonated form it is soluble in water.

622,299—April 4, 1899. H. R. VIDAL. *Black dye and process of making same.*

Coloring matters, varying from brown black to deep black, are produced by heating a nitro-cellulose substance, as gun cotton, with sulphur and sodium sulphide; soluble in the raw state in water and capable of directly dyeing cotton without oxidation.

622,961—April 11, 1899. I. LEVINSTEIN AND C. MENSCHING. *Brown tetrazo dye and process of making same.*

Direct cotton dyes are produced by acting with one molecular proportion of a tretrazo compound of a paradiamin on one molecular proportion of an ortho-oxycarbonic acid of the benzene series, combining the intermediate product with one molecular proportion of a rediazotizable primary aromatic monamin of the benzene series (a combination, for example, of tetrazodiphenyl with salicylic acid and aniline), to form a mixed tretrazo coloring matter; rediazotizing this mixed tretrazo coloring matter; and combining the resulting diazo compound with known dyestuff components, as naphthol sulphonic acid gamma.

623,069—April 11, 1899. R. BOHN. *Yellow dye and process of making same.*

A yellow coloring matter produced by treating benzoin with an aromatic oxy-carbonic acid, as gallic acid, in the presence of sulphuric acid; giving a cherry-red to yellowish-red color with caustic soda solution, and with sulphuric acid a red to yellow color with a brown to green fluorescence.

623,219—April 18, 1899. R. E. SCHMIDT. *Chrysazin dye and process of making same.*

An anthraquinone dyestuff, being an acid salt of a disulpho acid of paradihydroxylaminchrysazin, is produced by reducing one molecule of dinitrochrysazin disulpho acid with such quantities of reducing agents as correspond to eight atoms of hydrogen, thereby transforming the nitro groups into hydroxylamin groups; in the form of its acid ammonium salt, soluble in water with a violet color, dyeing wool in acid baths blue shades; and bluish-green on chromium mordants.

623,220—April 18, 1899. R. E. SCHMIDT. *Anthrarufin dye and process of making same.*

An anthraquinone dyestuff, being an acid salt of paradihydroxylamin anthrarufin, is produced by reducing one molecule of dinitro anthrarufindisulpho acid with such quantities of reducing agents as correspond to eight atoms of hydrogen, for which purpose stannous chloride with muriatic acid may be used; dyeing wool in acid baths reddish-blue shades; bluish-green on chromium mordants.

623,346—April 18, 1899. H. WEIL. *Green wool-dye and process of making same.*

Coloring matters are produced from paranitrobenzaldehyde-orthosulphonic acid by first forming a disulpho-leuco compound of the general formula $C_6H_3(NO_2)-(SO_3Na)-C.H.R.R'$, wherein R designates alkylbenzylaniline and R′ monosulphonated alkylbenzylaniline, and then treating this disulpho-leuco compound with an oxidizing agent. They dye wool in an acid bath a green shade.

623,638—April 25, 1899. K. THUN. *Gray-black anthraquinone dye and process of making same.*

Nitro compounds of the anthraquinone series are produced by mixing a concentrated sulphuric acid solution of sulphonic acids of certain bodies, like purpurin-dianilid, with boric acid, adding nitric acid to this mixture and stirring for an hour at from 10° to 20° C., and then pouring into water and separating the precipitated dyestuff; yielding on chrome-mordanted wool from gray to black fast shades.

624,256—May 2, 1899. K. SCHIRMACHER. *Red-brown monoazo dye and process of making same.*

Monoazo dyestuffs produced by combining diazotized picramic acid with alkylated amidonaphtholsulphonic acids, such as 2:5:7 ethylamidonaphthol, 2:5:7 methylamidonaphtholsulphonic acids; dyeing wool in red-brown shades, which become deep black on subsequent treatment with chromates.

624,877—May 9, 1899. J. SCHMID AND H. REY. *Red Sulfo-acid dye.*

Red sulpho-acid dyes, produced by condensing one molecule of a benzaldehyde compound with two molecules of a monobenzylated metamidophenol, heating the product of condensation with a reagent, as concentrated sulphuric acid, whereby dehydration, sulphonation, and partial oxidation are effected, and finally completing the oxidation with an agent such as ferric chloride at a moderate heat; dyeing wool and silk in fast red tints.

625,174—May 16, 1899. I. LEVINSTEIN AND H. PFEIFFER. *Substantive red tetrazo dye and process of making same.*

Tetrazo coloring matters produced by chlorinating diacetbenzidin melting at 317° C., saponifying the product, tetrazotizing the dichlorbenzidin thus formed, and combining the resulting tetrazodichlorbenzidin with a naphthylamin sulphonic acid; dyeing unmordanted cotton bright-red to bluish-red shades fast to organic acids.

625,268—May 16, 1899. R. KNIETSCH AND P. SEIDEL. *Process of making indigo-red.*

A phenylglycocol body is melted with caustic alkali in the presence of a limited quantity of air, and the isatinic body so obtained is then acted upon with an indoxyl body.

625,536—May 23, 1899. J. J. BRACK. *Rhodol derivative.*

A dyestuff of the phthalein series obtained by condensing the methyl ether of dimethylrhodol with formic aldehyde; a vermilion powder; dyeing tannin-mordanted cotton a yellowish red, and on printing with ferrocyanide of potassium and zinc oxide yielding a lake of same color.

625,637—May 23, 1899. H. A. BERNTHSEN. *Oxynaphlindophenolthiosulfonic acid and process of making same.*

An oxy-naphtindophenol-thio-sulphonic body produced by the oxidation of a mixture of unsymmetrical dialkyl-para-phenylene-diamin-thio-sulphonic acid and 1.2-amido-naphthol-sulpho-acid; especially suited for printing on cotton goods with a chromium mordant.

625,641—May 23, 1899. H. CARO. *Rhodamin dye and process of making same.*

An alkylated rhodamin dye is produced by treating chloral hydrate with alkylated-meta-amido-phenol, without the addition of heat. This condensation product is then acted upon with one molecular proportion of a dialkylated-meta-amido-phenol, the same as used in the production of the product of condensation, by grinding them together and gradually heating from 40° to 70° C. in twelve hours, when the resulting leuco base is oxidized into its blue coloring matter and then converted into its red rhodamin dye.

625,717—May 23, 1899. M. BOEHLER. *Process of dyeing dark blue.*

Dyeings produced with the dyestuffs "immedial blacks" (No. 610,541), and which are derived by heating oxydinitrodiphenylamin with sodium sulphide and sulphur, are treated with hydrogen dioxide, and the shades changed to a dark blue.

626,231—June 6, 1899. B. HEYMANN. *Process of making indigo.*

Diacetyl-indoxyl is saponified with caustic alkaline lyes, the product oxidized, and the indigo separated by filtration.

626,897—June 13, 1899. F. FUCHS AND H. GUSSMANN. *Black sulphur dye and process of making same.*

Black direct-dyeing cotton dyestuffs produced by heating dinitranilin 1.2.4 with sulphur and alkaline sulphides at elevated temperatures; dyeing unmordanted cotton even in the cold.

626,913—June 13, 1899. E. KÖNIG. *Brown-yellow azo dye and process of making same.*

Basic azo dyestuffs soluble in water produced by diazotizing aromatic amido-ammonium bases, as amidophenyltrimethylammonium, and treating the resulting compound with substances adapted to unite with diazo bodies to form dyes, as resorcinol; dyeing cotton and leather mordanted with tannin brown-yellow.

626,935—June 13, 1899. F. SCHOLL AND A. HESS. *Disazo dye and process of making same.*

Diazo dyestuffs produced by diazotizing amidobenzylpyridinchloride and combining it first with a primary aromatic amin, as metatoluidin, then further diazotizing and combining it with an azo component, as beta-naphthol; dyeing mordanted cotton or mixed goods with a bluish-red color.

627,679—June 27, 1899. M. BÖNIGER AND J. LAGUTT. *Green trisazo dye and process of making same.*

Green triazo dyestuffs produced by combining in an alkaline solution one molecule of a tetrazotized paradiamin with one molecule of the monoazo dye resulting from the combination in an acid solution of one molecule of diazodichlorbenzene with one molecule 1.8 amidonaphthol 3.6 disulphonic acid, and then coupling the intermediate product thus obtained in an alkaline solution with one molecule of a phenolic compound of the benzene series; dyeing unmordanted cotton green shades.

627,690—June 27, 1899. J. HERBABNY. *Yellow wool-dye and process of making same.*

Yellow dyestuff produced by first forming para-nitro-phenyl-pyrazolone-carboxylic acid by the action of one molecule of para-nitro-phenyl-hydrazin upon one molecule of oxalo-acetic ether, and then combining it with one molecule of diazo-sulphanilic acid; dyeing wool in greenish-yellow tints fast to milling.

627,783—June 27, 1899. K. SCHIRMACHER. *Black azo dye and process of making same.*

Monoazo dyestuff produced by treating diazotized picramic acid with naphtholsulphonic acids containing amido groups, such as 1:8:3:6-amidonaphthol-disulphonic acid "H;" dyeing wool in an acid bath in blue-black shades, which become deep green on treatment with bichromate.

627,896—June 27, 1899. R. BOHN. *Blue dye.*

Blue coloring matter obtained by treating with sulphuric acid the leuco compound of blue naphthazarin, intermediate product, which latter is produced by treating 1.1′-dinitro-naphthalene with sulphuric acid in the presence of a reducing agent, such as zinc or sulphur. This new dye can be applied directly or in the form of its leuco compound.

628,025—July 4, 1899. C. OELSCHLAEGEL. *Blue-black wool-dye and process of making same.*

A diazo dyestuff produced by diazotizing the para-amidophenyl-beta-naphthylaminsulpho acid (derived from para-nitro chlorbenzene-ortho-sulpho acid), combining the diazo compound produced with one molecular proportion of alpha-naphthylamin, rediazotizing the amidoazo compound thus obtained, and combining the diazoazo compound with a naphtholmonosulpho acid.

628,233—July 4, 1899. C. SIMON. *Green trisazo dye and process of making same.*

Green coloring matters produced by combining one molecule of the monoazo color obtained from diazotized orthochloro-paranitranilin and alpha$_1$-alpha$_4$-amidonaphthol-beta$_2$-beta$_3$-disulpho with one molecule of a tetrazo compound, as tetrazodiphenyl, and one molecule of a phenol compound, as salicylic acid; dyeing unmordanted cotton in green shades.

628,243—July 4, 1899. A. HERRMANN. *Green acid dye.*

Green acid dyestuffs of the diphenylnaphthylmethane series; produced by treating the monosulphonic acids of tetralkyldiamidodiphenylnaphthylmethanes with fuming sulphuric acid and oxidizing the leucopolysulphonic acids to dyestuffs; dyeing wool and silk in an acid bath an even green.

628,607—July 11, 1899. B. PRIEBS AND O. KALTWASSER. *Black dye.*

Black dye produced by heating the sodium salt of oxynitrodiphenylamin-sulphonic acid with sulphur and alkali sulphides; dyeing unmordanted cotton in alkaline bath fast and intense black shades.

628,608—July 11, 1899. B. PRIEBS AND O. KALTWASSER. *Black dye.*

Black dye produced by heating the sodium salt of dinitroöxydiphenylamin-carbonic acid with sulphur and alkali sulphides.

628,609—July 11, 1899. B. PRIEBS AND O. KALTWASSER. *Bluish-black dye.*

Bluish-black dye produced by heating the sodium salt of oxydinitrodiphenylaminsulphonic acid with sulphur and alkali sulphides.

628,721—July 11, 1899. C. O. MULLER. *Blue-black dye and process of making same.*

Coloring matters produced by coupling the tetrazo derivative of paraphenylenediamin on the one hand with an orthocarboxylised phenol of the benzene series, and on the other hand with the 1.8.4 dioxynaphthalenesulphonic acid; dyeing chromed wool in blue-black tints.

628,814—July 11, 1899. P. JULIUS. *Brown azo dye.*

Brown monoazo dyestuff obtained by the combination of diazo compounds of nitro-amido-phenol-sulpho acids with meta-phenylene-diamin; dyeing wool from an acid bath in deep-brown shades, darkened to deep brown or black-brown on treatment with chromates.

629,221—July 18, 1899. H. R. VIDAL. *Cresol-sulfur dye and process of making same.*

Coloring matters produced by subjecting benzene-azo-cresol, obtained from meta or ortho cresol, to the action of sulphur in the presence of soda; dyeing animal and vegetable fiber direct without oxidation, and imparting to cotton in the dyeing bath a black color from the outset.

629,666—July 25, 1899. C. DE LA HARPE AND C. VAUCHER. *Gallocyanin-leuco derivative and process of making same.*

A leuco-gallocyanin produced by treating a gallocyanin, in a suitable medium, with a reducing agent, as zinc dust; it contains no sulphur, is more ready soluble in water, and gives in printing more intense and bluer tints than the original gallocyanin.

629,748—July 25, 1899. I. LEVINSTEIN AND R. HERZ. *Blue-black diazo color and process of making same.*

A new product, alpha$_1$ alpha$_2$ naphthylenediamin beta$_3$ (beta$_4$) sulphonic acid, readily soluble in soda solution and almost insoluble in water or dilute acid. The new coloring matters are produced by combining Cleve's acid with a suitable diazo body, reducing, and treating with an acetylating agent, diazotizing, and combining with a rediazotizable aromatic amin, rediazotizing, combining with an aromatic color component, and finally saponifying.

630,199—August 1, 1899. C. DREHER. *Lactic-acid dye.*

Basic artificial dyestuffs are dissolved in lactic acid, forming new dyeing substances.

630,224—August 1, 1899. A. HERRMANN. *Green dye and process of making same.*

Green dyestuffs of the diphenylnaphthylmethane series produced by combining tetralkyldiamidobenzhydrols with naphthalenedisulphonic acids in presence of condensing agents to leucodisulphonic acids and then oxidizing the latter into dyestuffs; dyeing wool in an acid bath.

630,952—August 15, 1899. H. R. VIDAL. *Substantive sulfur dye and process of making same.*

A dihydroxylated azo body, such as those resulting from the copulation of one or two molecules of diazo benzene with resorcin, is heated with sulphur in the presence of an alkaline sulphide; dyeing unmordanted cotton in dark shades.

631,089—August 15, 1899. C. O. MULLER. *Red dye and process of making same.*

Coloring matters produced by coupling one molecule of the diazo derivative of para-amido-benzeneazosalicylic acid with one molecule of a sulphonic acid of a naphtholic compound; dyeing chromed wool in red tints.

631,605—August 22, 1899. O. BALLY. *Green dye and process of making same.*

Green coloring matters of the anthracene series produced by heating at a high temperature the halogen derivatives of No. 631,606 with primary aromatic amins.

631,606—August 22, 1899. O. BALLY. *Halogen derivative of anthraquinone and process of making same.*

Halogen derivatives of alphylated diamidoanthraquinones are obtained by treating them with bromine or chlorine in the presence of a solvent; they are soluble in benzene and are converted into green coloring matters on heating with aniline.

631,607—August 22, 1899. O. BALLY. *Dibrom anthraquinone derivative and process of making same.*

A dibrom-1.5-diamido-anthraquinone is produced by treating 1.5-diamido-anthraquinone in a solvent, such as glacial acetic acid, at ordinary temperature with bromine; valuable for the production of coloring matters of the anthracene series.

631,608—August 22, 1899. O. BALLY. *Anthraquinone derivative and process of making same.*

Tri-brom-1.5-diamido-anthraquinone is obtained by energetically treating 1.5-diamido-anthraquinone with bromine, at a high temperature, in a solvent; it is valuable for the production of coloring matters of the anthracene series.

631,610—August 22, 1899. H. A. BERNTHSEN AND P. JULIUS. *Orange dye and process of making same.*

Substantive orange coloring matter obtained by the combination of the tetrazo compound of a diamido base—benzidin or tolidin—with meta-phenylene-diamin-disulpho acid and then with nitro-meta-phenylene-diamin or nitro-meta-toluylene-diamin; when treated with nitro-diazo-benzene after dyeing on cotton goods it is slightly changed in color to brown orange.

631,611—August 22, 1899. H. A. BERNTHSEN AND P. JULIUS. *Disazo orange dye and process of making same.*

Orange coloring matter obtained by the combination of a tetrazo compound of benzidin, first, with amido-R acid—that is, beta-naphthylamin-3.3′-disulpho acid—or with amido-F acid—that is, beta-naphthylamin-3.2′-disulpho acid—and then combining the resulting intermediate compound with a nitro-meta-diamin.

631,613—August 22, 1899. R. BOHN. *Black dye and process of making same.*

Black coloring matters produced by reacting with naphthazarin upon an aromatic amin, with or without the use of a condensing agent; dyeing chrome-mordanted wool.

631,614—August 22, 1899. R. BOHN. *Naphthazarin intermediate dye and process of making same.*

A coloring matter produced by subjecting the naphthazarin intermediate product, obtained in the manufacture of naphthazarin by heating 1.5-dinitro-naphthalene with fuming sulphuric acid to the action of a reducing agent. It can be used directly or in the form of its bisulphite compound, dyeing greener than naphthazarin.

632,170—August 29, 1899. R. BOHN. *Blue dye and process of making same.*

Blue coloring matter produced from the coloring matters of No. 609,327 (which are obtained from 1.8-dinitro-naphthalene by the reducing action of an alkaline bisulphite on the one hand and of sodium sulphide, grape sugar, etc., on the other) by moderately heating the same with sodium sulphide, with or without the addition of sulphur; dyeing cotton a blue shade directly in a cold bath.

632,621—September 5, 1899. O. BALLY. *Bromanated dye.*

Coloring matters obtained from tri-brominated-amido-anthraquinone, of No. 631,608, by heating same with an aromatic amin, with or without the addition of a diluent or solvent. The sulphonated compounds are soluble, and dye unmordanted and chrome-mordanted wool blue to green-blue shades.

633,245—September 19, 1899. L. P. MARCHLEWSKI. *Process of making dyes.*

The flocculent precipitate of cotton-seed oil is converted into a dye by oxidizing the same with air in the presence of free alkali.

633,883—September 26, 1899. C. O. MULLER. *Yellow basic dye.*

Yellow basic coloring matter produced from the by-product obtained in heating together phthalic anhydride and a mono-alkylated meta-amido-phenol by submitting said by-product to esterification, as by treatment with sulphuric acid and an alcohol.

633,950—September 26, 1899. R. BOHN. *Green-blue dye and process of making same.*

A coloring matter obtained by oxidizing the naphthazarin intermediate product (obtained in the manufacture of naphthazarin by heating 1.5-dinitro-naphthalene with fuming sulphuric acid). It dyes on chrome-mordants fast shades greener than those obtained from naphthazarin.

634,009—October 3, 1899. I. LEVINSTEIN AND R. HERZ. *Blue-black tetrazo dye and process of making same.*

Deep black tetrazo coloring matters produced from the alpha$_1$ alpha$_2$ naphthylenediamin beta$_1$ sulphonic acid by diazotizing the same, combining the resulting sulphonic acid with beta$_1$ naphthol beta$_2$ beta$_3$ disulphonic acid, rediazotizing the thus-produced bluish-violet amidoazo-coloring matter, and finally combining the resulting diazo compound with aromatic dyestuff components, as beta naphthol; dyeing animal and chrome mordanted fibers dark-blue to blue-black shades.

635,168—October 17, 1899. R. KIRCHHOFF AND E. HAUSSMANN. *Black sulfur dye.*

Black dye obtained by heating equimolecular proportions of dinitroöxydiphenylamin and para-amidophenol with sulphur and alkali sulphides; dyeing unmordanted cotton in an alkaline bath intense and fast black shades.

635,169—October 17, 1899. R. KIRCHHOFF AND E. HAUSSMANN. *Black sulfur dye.*

Black dye produced by heating equimolecular proportions of dinitroöxydiphenylamin and meta-phenylenediamin with sulphur and alkali sulphides; dyeing unmordanted cotton in an alkaline bath intense and fast black shades.

636,065—October 31, 1899. C. RIS. *Stilbene azo dye.*

Coloring matters derived from stilbene by the reaction of two molecules of paranitrotoluenesulpho-acid and one molecule of a para compound containing at least one amido group, with caustic-alkali lye; dyeing unmordanted cotton in gold-yellow to orange shades.

636,066—October 31, 1899. C. Ris. *Black cotton dye.*

Black dyestuff obtained by melting a paraämidophenol compound, such as paraämidophenol paraämidocresol (CH_3:OH:NH_2=1:2:5), with acetyl compounds and sulphur at from 200° to 300° C.

637,183—November 14, 1899. H. TERRISSE AND G. DARIER. *Yellow basic dye.*

A new yellow basic coloring matter, obtained from diamido-toluyl-alcohol, beta-naphthylamin, and beta-naphthylamin-hydrochlorate, which is soluble in water and gives a dark-brown-colored diazo compound on treatment with nitrous acid, and which is precipitated from its aqueous solution by common salt, and yields a yellow solution in alcohol possessing a green fluorescence.

638,127—November 28, 1899. G. KOERNER. *Black azo dye.*

Coloring matters derived from amido-naphthol-monosulpho-acid (1.8.4; 1.8.5.) and a tetrazo residue containing one or more basic groups attached to the part of the amido-naphthol-sulpho-acid residue which contains the amido group, and a tetrazo residue containing one or more hydroxyl groups attached to the part of the amido-naphthol-sulpho-acid residue which contains the hydroxyl; characterized by dyeing unmordanted cotton black shades.

638,576—December 5, 1899. C. DE LA HARPE AND C. VAUCHER. *Oxazin dye.*

Coloring matter derived from the oxazin dye resulting from the action of hydrochlorate of nitrosodimethylanilin or of hydrochlorate of dimethylamidoazobenzene upon gallamic acid, by heating the said oxazin dye with sulphurous acid in a free state or as a sulphite or bisulphite in a closed vessel at 90° to 100° C.; dyeing bluer tints than the original oxazin dye.

639,040—December 12, 1899. J. HERBABNY. *Green-blue tetrazo dye.*

A greenish-blue tetrazo substantive dyestuff obtained by the combination of the tetraämido disazo compound derived from a toluylenediaminsulpho-acid and para-nitrodiazobenzene with amidonaphthol-disulpho-acid H.

639,041—December 12, 1899. J. HERBABNY. *Black tetrazo dye.*

A black substantive coloring matter obtained by combining the tetraämido diazo-dyestuff derived from a metadiamin of the benzene series and para-nitro diazo benezene chloride with amidonaphtholsulpho-acid G.

639,042—December 12, 1899. J. HERBABNY. *Claret-red tetrazo dye.*

Direct claret-red coloring matters resulting from the action of a tetrazotized paradiamin, as tetrazoditolyl, upon amido pyrazolone carbonic acid.

639,806—December 26, 1899. W. H. CLAUS, A. RÉE, AND L. MARCHLEWSKI. *Black sulfur dye.*

Dinitroörthohydroxydiphenylamin is heated with sulphur and an alkaline sulphide, producing a black coloring matter dyeing cotton fiber direct.

639,976—December 26, 1899. A. HERRMANN. *Green dye.*

A dyestuff obtained by condensing tetralkyldiamidobenzhydrol with 2.6 naphthalenedisulphonic acid, and oxidizing the resulting leuco compound.

639,977—December 26, 1899. A. HERRMANN. *Green dye.*

A dyestuff obtained by condensing tetralkyldiamidobenzhydrol with 2.7 naphthalenedisulphonic acid, and oxidizing the resulting leuco compound.

640,010—December 26, 1899. C. O. MÜLLER. *Blue-black dye.*

A dyestuff which contains the tetrazo derivative of paraphenylene-diamin, coupled on the one hand with an orthocarboxylized phenol of the benzene series, as salicylic acid, and on the other hand with the 1.8.3.6 dioxynaphthalenedisulphonic acid.

640,559—January 2, 1900. O. HANSMANN. *Brown sulfur dye.*

A brown dye produced by heating with sulphur and sulphides of alkalis the condensation product obtained by the action of paranitrochlorobenzene-ortho-monosulphonic acid upon meta-toluylenediamin; dyeing unmordanted cotton dark-brown shades, which are turned to bronze by treatment with a mixture of copper sulphate and potassium bichromate

640,986—January 9, 1900. O. BALLY. *Green dye.*

Green coloring matter obtained by condensing chlor-substituted diamido-anthraquinone (obtained by treating diamido-anthraquinone with chlorine in the presence of a diluent such as glacial acetic acid) with an aromatic amin and sulphonating the product.

640,989—January 9, 1900. M. BONIGER. *Bluish-red azo dye.*

Azo dyes derived from one molecule of a diazotized aromatic amido compound and one molecule of an 1.8 alphylsulphamidonaphthodisulphonic acid.

641,184—January 9, 1900. H. BOEDEKER. *Rhodamin dye.*

A dyestuff resulting from the simultaneous action of phosphor-oxychloride and monomethylanilin or other aromatic secondary or tertiary base (as mono-ethylamin, dimethyl- and diethyl-anilin, chinolin, monethyl-orthotoluidin or dibenzylanilin) upon symmetric diethylrhodamin; dyeing cotton a fiery pink.

641,587—January 16, 1900. A. G. GREEN AND A. MEYENBERG. *Process of making black sulfur dye.*

A para-diamin together with a base of the benzene series are jointly oxidized in the presence of thiosulphuric acid in aqueous solution, producing a direct dyeing coloring matter, containing sulphur under the influence of the thiosulphuric acid.

641,588—January 16, 1900. A. G. GREEN. *Black sulfur dye.*

Coloring-matter produced by conjoint oxidation of paraphenylene diamin with an amin of the benzene series containing a free para position to the amido group, such as anilin, orthotoluidin, or paraxylidin, in presence of thiosulphuric acid; dyeing unmordanted cotton a deep black from a bath containing sodium sulphide.

641,589—January 16, 1900. A. G. GREEN AND A. MEYENBERG. *Black sulfur dye.*

Coloring matter produced by conjoint oxidation of paratolylenediamin C_6H_3 (CH_3) $(NH_2)_2$ (1:2:5) with an amin of the benzene series containing a free para position to the amido group, in presence of thiosulphuric acid.

651,953—January 23, 1900. A. G. GREEN AND A. MEYENBERG. *Process of making fast brown dyes.*

A polyamin of the benzene series (containing at least two amido groups in para or ortho position to each other) is oxidized in the presence of thiosulphuric acid in aqueous solution.

641,954—January 23, 1900. A. G. GREEN AND A. MEYENBERG. *Fast brown dye.*

A fast brown coloring matter produced by the oxidation of paratolylenediamin $C_6H_3(CH_3)(NH_2)_2$ (1:2:5) in the presence of thiosulphuric acid in aqueous solution; dyeing unmordanted cotton from an alkaline sulphide bath.

642,256—January 30, 1900. B. PRIEBS AND O. KALTWASSER. *Blue sulfur dye.*

Blue dye produced by treating with hot alcohol the sulphur dyes derived by means of sulphur and alkali sulphides from dinitro-oxydiphenylamin derivatives, then removing the alcohol by filtration and drying the residue; dyeing unmordanted cotton in an alkaline bath intense and fast indigo-blue shades.

642,893—February 6, 1900. H. BOEDEKER AND C. HOFFMANN. *Alkylated rhodamin sulfonic acid.*

The sulphonic acids of alkyl derivatives of the metaamidophenol phthaleins (the tetraalkylated rhodamins excepted) are obtained by treating the meta-amidophenolphthaliens with fuming sulphuric acid at a low temperature, so that they are transformed into sulphonic acids and are easily soluble in alkalis and suitable for dyeing purposes. They are completely absorbed by wool in an acid bath and dye with the tint of alkylated metaamidophenolphthaleins with a vivid fluorescence.

643,265—February 13, 1900. C. E. GASSMANN. *Solution of phthalein in phenol.*

For use in printing or dyeing fabrics a phthalein, as a rhodamin and especially a dialkyl rhodamin, is dissolved in a volatile phenol, as cresylic acid.

643,338—February 13, 1900. A. STEINER. *Blue dye from gallocyanin.*

A blue coloring matter obtained by substituting a hydrogen atom in one of the hydroxylic groups of the gallocyanin or its derivatives by an acid radical, especially an alphylsulphon radical XSO_2, where X stands for a benzene, toluene, or xylene group. This esterification can be performed by treating the gallocyanin or its derivatives in alkaline solution with aromatic sulphochlorides.

643,371—February 13, 1900. J. J. BRACK. *Red rhodamin dye.*

Dyestuff obtained by condensing one molecule of formic aldehyde with two molecules of the alkyl ether of the unsymmetrical dimethyl-methylrhodamin of No. 584,119, and which is derived from dimethylamidoöxybenzoylbenzoic acid and metaämidoparacresol (CH_3:NH_2:OH=1:2:4); dyeing tannin-mordanted cotton in fiery-red tints bluer than those obtained from the said ether.

643,451—February 13, 1900. O. BALLY. *Nitroamidoanthraquinone sulfo-acid.*

Coloring matters obtained by treating diamido-anthraquinone sulpho-acids with nitric acid; dyeing chrome-mordanted wool blue-violet to brown-violet shades.

643,502—February 13, 1900. A. H. S. HOLT. *Process of manufacturing indigo-leuco compounds.*

Indigo-leuco compounds produced by melting together a polyhydroxy compound of the fatty series, such as glycerine, with an anthranilic-acid body and an alkali; as, for example, potassium salt of anthranilic acid and potassium glycerate.

643,569—February 13, 1900. F. ULLMANN. *Yellow acridinium dye.*

A dye derived from the acridin series, obtained as a methyl-sulphuric salt by treating an acridin dyestuff as amidotolunaphthacridin, with dimethyl sulphate; dyeing tannin-mordanted cotton orange-yellow shades.

644,233—February 27, 1900. P. JULIUS. *Black disazo dye.*

Disazo coloring matters derived from ortho-nitro-ortho-amido-phenol-sulpho-acid, and which on suitable reduction with ammonium sulphide in ammoniacal solution exhibit a step-by-step reduction, reproducing the nitro-amido-phenol-sulpho-acid.

644,234—February 27, 1900. P. JULIUS. *Black dye.*

A coloring matter derived from ortho-nitro-ortho-amido-phenol-sulpho-acid and having alpha-naphthylamin as both middle and end component.

644,235—February 27, 1900. P. JULIUS. *Black disazo dye.*

Disazo coloring matter derived from ortho-nitro-para-amido-phenol-ortho-sulpho-acid and having Cleve's alpha-naphthylamin-sulpho-acid as middle component, and alpha-naphthol-alpha-sulpho-acid (1.4–1.5) as end component.

644,236—February 27, 1900. P. JULIUS. *Black disazo dye.*

Disazo coloring matter derived from para-nitro-ortho-amido-phenol-ortho-sulpho-acid and having alpha-naphthylamin as middle component, and alpha-naphthol-alpha-sulpho-acid (1.4 or 1.5) as end component.

644,237—February 27, 1900. P. JULIUS. *Black dye.*

Coloring matter derived from ortho-nitro-ortho-amido-phenol-sulpho-acid, alpha-naphthylamin, and beta-naphthol.

644,238—February 27, 1900. P. JULIUS. *Disazo dye from chloramidophenol.*

Disazo coloring matter obtained from para-chloro-ortho-amido-phenol and having Cleve's alpha-naphthylamin-sulpho-acid as middle component, and alpha-naphthylamin as end component.

644,239—February 27, 1900. P. JULIUS. *Black disazo dye.*

Disazo coloring matter obtained from ortho-chlor-ortho-amido-phenol-para-sulpho-acid and having alpha-naphthylamin as middle component, and beta-naphthol-3.6-disulpho-acid (R salt) as end component.

644,240—February 27, 1900. H. A. BERNTHSEN AND P. JULIUS. *Black disazo dye.*

Disazo coloring matter obtained from ortho-amido-para-nitro-phenol, alpha-naphthylamin, and 1.8-dioxynaphthalene-4-sulpho-acid; dyeing wool from an acid bath blue-black shades, turning to green-black on treatment with chromates.

644,291—February 27, 1900. J. HERBABNY. *Black trisazo dye.*

Polyazo coloring matters obtained by the combination of one molecule of a paradiamin first with one molecule of a monoazo coloring matter from 2:8-amido-naphthol-sulphonic acid and toluylene-diamin-sulphonic acid, then with one molecule of an amido-naphthol-sulphonic acid; dyeing cotton without mordants.

644,292—February 27, 1900. J. HERBABNY. *Black polyazo dye.*

Polyazo dyestuffs obtained by the combination of one molecular proportion of a paradiamin with two molecular proportions of a monoazo dye as obtained by combining diazotized 2:8-amido-naphthol-sulphonic acid and toluylene-diamin-sulphonic acid; dyeing cotton without mordants.

644,324—February 27, 1900. P. JULIUS AND W. REESS. *Process of making yellow basic dyes.*

Diamido-toluyl alcohol is treated with beta-naphthol and an oxidizing agent, such as ferric chloride.

644,326—February 27, 1900. R. KNIETSCH AND H. S. A. HOLT. *Process of making indigo products.*

An aromatic glycocoll-carboxy-di-alkyl-ester is heated to above 200° C., and so converted into a piperazine derivative, which intermediate product is then melted with a fixed caustic alkali and lime.

644,333—February 27, 1900. C. SCHRAUBE. *Yellow dye.*

Dyestuffs obtained by the treatment of phenanthrene quinone either with peri-hydroxy-orthó-diamido-naphthalene and subsequent treatment with sulphuric acid or with sulpho-acids of peri-hydroxy-ortho-diamido-naphthalene; dyeing fast yellow shades on wool and silk.

644,334—February 27, 1900. C. SCHRAUBE AND E. SCHLEICHER. *Black trisazo dye.*

Black triazo dye, obtained from oxy-naphthylamin-sulpho acid (NH_2. OH. SO_3H—1.8.4), by combining one molecular proportion of the same with one molecular proportion of diazo-sulphanilic acid in acid solution, and one molecular proportion of diazo-azo-benzene in alkaline solution.

644,462—February 27, 1900. C. RIS. *Disazo dye from stilbene.*

Diazo coloring matters derived from stilbene by diazotizing the product of condensation of two molecules of paranitrotoluene-sulpho acid with one molecule of paraphenylenediamin, and combining the diazo compound with a suitable compound to form an azo dye; dyeing unmordanted cotton orange to brown shades.

644,959—March 6, 1900. J. ABEL. *Green-black dye.*

Coloring matter obtained by treating ortho-hydroxy-dinitro-diphenyl-amin-sulpho-acid with sodium sulphide and sulphur; dyeing unmordanted cotton green-black shades not altered by treatment with chromates and copper salts.

645,738—March 20, 1900. C. RIS. *Black sulfur dye.*

Black coloring matters obtained by melting a paraämidophenol together with an oxyazo compound, as oxyazobenzene, and with sulphur, to which mixture glycerine may be added, at about 200° C. and then dissolving the mass in an alkali and evaporating to dryness; dyeing unmordanted cotton bluish-black shades which are fixed by oxidation into fast deep black.

645,781—March 20, 1900. H. A. BERNTHSEN. *Bluish-red dye and process of making same.*

A coloring matter of the rhodamin series produced by treating the mono-benzylated-di-alkylated rhodamin (obtained by condensation of molecular proportions of dimethyl or diethyl-para-amido-ortho-oxy-benzoyl-benzoic acid with benzyl-meta-amido-phenol) with fuming sulphuric acid; dyeing wool from an acid bath.

646,711—April 3, 1900. O. SOHST. *Black azo dye and process of making same.*

Monoazo-dyestuffs, produced by combining diazotized picramic acid with acetylamidonaphtholsulphonic acids; dyeing wool black and developing to dark olive green on treatment with chrome.

646,794—April 3, 1900. H. A. BERNTHSEN. *Acid rhodamin dye and process of making same.*

An acid dye of the rhodamin series is produced by treating a rhodamin imid with fuming sulphuric acid; it dyes animal fiber from a bath suitable for acid dyes, red shades.

646,795—April 3, 1900. R. BOHN. *Naphthazarin sulfo-acid and process of making same.*

A sulpho-acid of naphthazarin is produced by treating a sulphonated leuco compound of the naphthazarin intermediate product with hydrochloric acid, in aqueous solution; dyeing unmordanted wool from an acid bath brown-red shades, which turn black on treatment with a bichromate.

646,796—April 3, 1900. R. BOHN. *Green dye and process of making same.*

Green coloring matter of the naphthalene series, produced by heating a sulphonated leuco compound of the naphthazarin intermediate product with aniline and aniline hydrochloride and then sulphonating; dyeing unmordanted wool from an acid bath.

646,841—April 3, 1900. R. KNIETSCH, A. H. S. HOLT AND E. OBERREIT. *Process of making aromatic isatin compounds.*

An isatin body of the aromatic series is produced by the direct energetic oxidation (as by a manganic oxidizer) of the corresponding indoxyl compound.

646,873—April 3, 1900. A. F. POIRRIER. *Process of making sulfur dyes.*

Sulphureted coloring matters are produced by treating a simple aromatic substance, as phenol, with sulphur chloride, then heating to a suitable temperature, adding a complex aromatic substance as paraphenylenediamin, increasing the temperature of the mass and maintaining the increased temperature for a suitable period, and finally melting in sodium sulphide and drying.

647,236—April 10, 1900. K. SCHIRMACHER. *Brown dye and process of making same.*

Brown dyestuffs produced by the action of diazotized nitro and sulphonic derivatives of ortho-amidophenol acid—such as 1:2:3:5 and 1:2:5:3 nitroamidophenolsulphonic acids, picramic acid, or amidophenolsulphonic acid—upon metaphenylenediamin or meta-toluylenediamin or their sulphonic acids.

647,260—April 10, 1900. A. HAUSDORFER AND F. REINGRUBER. *Blue diphenylnaphthylmethane dye.*

Diphenylnaphthylmethane dyestuffs produced by first acting with fuming sulphuric acid on basic dyestuffs of the general formula $HO.C.(C_6H_4NR_2)_2.C_{10}H_6NHR'$ (R meaning an alkyl radical such as methyl, ethyl, etc., R' meaning an alkyl radical such as methyl, ethyl, phenyl, paratolyl, etc.) and secondly isolating the dyestuff sulphonic acids thus produced in the form of their alkaline salts: they dye wool in acid baths blue shades.

647,279—April 10, 1900. T. SANDMEYER. *Process of making isatin.*

Chloralhydrate and aniline are caused to react in the presence of chlorhydrate of hydroxylamin; the thus-obtained isonitrosoethenyldiphenylamidin is condensed by means of concentrated sulphuric acid to alpha-isatinanilid, and the latter is decomposed by diluted mineral acids to anilin and isatin.

647,280—April 10, 1900. T. SANDMEYER. *Process of producing indigo.*

Indigo pure and mixed with indigo-red is produced by forming a solution of alpha-isatin-anilid (No. 647,281), and reducing the same by means of ammonium sulphide.

647,281—April 10, 1900. T. SANDMEYER. *Alpha-isatin anilid.*

Alpha-anilid of isatin is obtained by producing a reaction of basic carbonate of lead upon thiocarbanilid in the presence of an alkalicyanid, treating the thus-obtained hydrocyancarbodiphenylimid with a solution of yellow ammonium sulphide, and then transforming the thioamid by hot sulphuric acid; forming dark needles melting at 126° C.

647,370—April 10, 1900. R. BOHN. *Green dye.*

Green coloring matters obtained by treating the naphthazarin intermediate product with an aromatic amin; readily sulphonated to soluble sulpho acids.

647,493—April 17, 1900. E. HÖLKEN. *Process of mordanting.*

Goods dyed black by sulphur substantive dyes are immersed in a warmed bath containing zinc sulphate, chromate of potash, and chromic acid; then the temperature of the bath is raised to the boiling point, and finally the excess of zinc chloride is washed out; white combinations being formed with the sulphur by the metallic salts which do not discolor the wool.

647,834—April 17, 1900. W. HERZBERG AND O. SCHARFENBERG. *Green-blue dye.*

A green-blue dye of the triphenylmethane series, being a salt of the monosulpho acid, produced by subjecting orthotoluidin to condensation with tetraethyldiamidobenzhydrol in the presence of strong sulphuric acid (instead of diluted acid), diazotizing the leuco base thus produced and transforming the oxyleuco product by sulphonation and oxidation.

647,846—April 17, 1900. R. KIRCHHOFF AND E. HAUSSMANN. *Black sulfur dye.*

A black dye produced by melting with sulphur and sulphides of alkali metals an equimolecular mixture of dinitroöxydiphenylamin and dinitrophenol; directly dyeing unmordanted cotton deep-black shades.

647,847—April 17, 1900. R. KIRCHHOFF AND E. HAUSSMANN. *Black sulfur dye.*

A black dye produced by melting together with sulphur and sulphides of alkali metals an equimolecular mixture of picramic acid and dinitroöxydiphenylamin; dyeing unmordanted cotton from a bath containing common salt deep-black shades.

648,271—April 24, 1900. H. LAUBMANN. *Oxyanthraquinone disulfonic acid and process of making same.*

New pentaoxyanthraquinonedisulphonic acids produced by treating the tetraoxyanthraquinonedisulphonic acids dissolved in strong sulphuric acid, with the calculated quantity of an oxidizing agent for the introduction of a hydroxyl group; dyeing wool, in an acid bath, red, the dye yielding, on subsequent treatment with chromium fluoride, pure-blue tints.

648,331—April 24, 1900. O. BALLY. *Blue anthraquinone dye.*

Coloring matter obtained by treating a halogen derivative of alphylidoanthraquinone (as No. 631,606) with sulphuric acid and boracic acid and subsequently sulphonating; dyeing unmordanted wool blue shades and chrome-mordanted wool green-blue shades.

648,332—April 24, 1900. O. BALLY. *Violet anthraquinone dye.*

Coloring matter obtained by treating halogen derivatives of diamido anthraquinone (Nos. 631,607-8) with boracic acid and sulphuric acid and subsequently sulphonating; giving violet-blue shades on chrome-mordanted wool.

648,597—May 1, 1900. A. F. POIRRIER. *Process of making sulfur dyes.*

Substantive coloring matters produced by the reaction of sulphur and sodium sulphide on a mixture of paramidophenol and alphanaphthol; dyeing cotton clear black in an alkaline bath.

648,623—May 1, 1900. A. ISRAEL AND R. KOTHE. *Blue trisazo dye.*

Triazo dyestuffs produced by first combining a diazo derivative of monoacidyl-para-phenylendiamin with one molecule of Cleve's alphanaphthylaminbetasulphonic acid (1.6 or 1.7); then rediazotizing; combining the diazo compound thus obtained with a second molecule of one of Cleve's acids; again diazotizing; coupling the diazo product with a naphtholmono or disulphonic acid; and finally treating the resulting triazo dyestuff with caustic alkalis to split off the acidyl group; dying unmordanted cotton reddish-blue to grayish-blue shades, which can be further diazotized on the fiber.

648,753—May 1, 1900. P. JULIUS. *Blue-black sulfur dye.*

A blue-black coloring matter, directly dyeing unmordanted cotton, obtained from dinitro-di-para-hydroxy-diphenyl-meta-phenylendiamin-di-carboxylic acid by treating same with sulphur and sodium sulphide.

648,754—May 1, 1900. P. JULIUS. *Green-black sulfur dye.*

A green-black coloring matter, dyeing unmordanted cotton, obtained from dinitro-dipara-hydroxy-diphenyl-meta-phenylendiamin-disulpho acid by treating same with sulphur and sodium sulphide.

648,755—May 1, 1900. P. JULIUS. *Black sulfur dye.*

A deep-black dyestuff, dyeing unmordanted cotton, produced from dinitro-di-para-hydroxy-diphenyl-meta-phenylendiamin by treating same with sulphur and sodium sulphide.

649,218—May 8, 1900. C. SCHLEUSSNER. *Process of making black naphthazarin sulfur dye.*

A dyestuff produced from the naphthazarin intermediate product by treating same with sulphides of alkali metals; dyeing cotton directly in blue shades, becoming black when subsequently treated with sulphate of copper.

649,714—May 15, 1900. J. BAMMANN AND W. VORSTER. *Dinaphthylamin sulfo derivative and process of making same.*

A new beta-dioxydinaphthylamin disulphonic acid produced by first dissolving a mixture of beta$_1$-amido-alpha$_3$-naphthol-beta$_4$-monosulphonic acid and water in caustic alkaline lye, heating this solution with a sodium-bisulphite solution, and finally isolating the resulting dinaphthylamin derivative; it is capable of combining with one and also with two molecules of diazo compounds.

649,716—May 15, 1900. H. BOEDEKER. *Sulfonated dichlordiethylrhodamin and process of making same.*

A blue-red dyeing rhodamin dyestuff, obtained from dichlordiethyl-rhodamin by treating same with monoethylamin and anhydrous sulphuric acid.

649,727—May 15, 1900. B. HOMOLKA. *Blue basic dye and process of making same.*

Blue basic saffranin dyestuffs, soluble in water, produced by allowing one molecule of beta-naphthol to act upon two molecules of a diazotized asymmetric dialkyl-saffranin.

649,728—May 15, 1900. B. HOMOLKA. *Blue basic dye and process of making same.*

Blue basic dyestuffs, soluble in water, produced by combining one molecule of beta-naphtol with two molecules of a diazotized saffranin.

650,292—May 22, 1900. J. ABEL AND F. KALKOW. *Brown sulfur dye.*

A brown dyestuff, directly dyeing cotton, produced by treating para-hydroxy-tri-nitro-diphenylamin-meta-sulpho acid with sulphur and sodium sulphide.

650,293—May 22, 1900. J. ABEL AND F. KALKOW. *Black sulfur dye.*

A black coloring matter, with a green cast, directly dyeing cotton, produced by heating with sulphur and an alkaline sulphide certain diphenylamin derivatives, which can be obtained by heating one molecular proportion of para-hydroxy-ortho-para-dinitro-diphenylamin body with one molecular proportion of meta-dinitro-chlorbenzene.

650,326—May 22, 1900. P. JULIUS AND F. REUBOLD. *Brown-black sulfur dye.*

A brown-black coloring matter, directly dyeing unmordanted cotton, obtained from dinitro-ortho-para-dihydroxy-diphenyl-meta-phenylendiamin by treating same with sulphur and sodium sulphide.

650,327—May 22, 1900. P. JULIUS AND F. REUBOLD. *Black sulfur dye.*

A deep-black coloring matter, directly dyeing unmordanted cotton, obtained from dinitro-amido-para-oxy-diphenylamin by treating same with sulphur and sodium sulphide.

650,756—May 29, 1900. M. H. ISLER. *Mordant-dyeing red color and process of making same.*

A mordant-dyeing coloring matter produced from the soluble sulphoacid-like coloring matter which can be obtained from a dinitro-anthraquinone by heating with sulphur, boracic acid, and fuming sulphuric acid, as per No. 617,686, by heating same with concentrated sulphuric acid until it is converted into a comparatively insoluble coloring matter. It dyes alumina-mordanted cotton red shades.

650,757—May 29, 1900. P. JULIUS. *Azo dye for lakes.*

A mono-azo coloring matter obtained by diazotizing 2-naphthyl-amin-1-sulpho acid and combining the diazo compound with beta-naphthol. In the form of its calcium, barium, lead, and alumina salts it is practically insoluble in boiling water.

PROCESSES.

702—April 21, 1838. F. FASSARD. *Improved process of dyeing wool.*

An acid solution of the ferro-cyanide or ferro-sesquicyanide of potassium or sodium is used in conjunction with an acid solution of one of the salts of the black oxide, or of the sesquioxide, or protoxide of iron, which yields a blue precipitate by the interchange of their elements.

703—April 21, 1838. P. MAGENNIS. *Improvement in the art of dyeing.*

The coloring matter and mordants are applied in a concentrated state to the dry cloth or other material to be dyed, which is then immediately passed between rollers, whereby the coloring matter is forced into the material.

746—May 25, 1838. H. HIBBARD. *Improvement in the process of coloring hats, furs, etc.*

A mordant is used of nitric and acetic acids, saturated with copper and tinned iron, and a fixed alkali is added to the dye.

58,591—October 9, 1866. A. C. BRUSH AND G. C. WHITE. *Improvement in dyeing hat bodies.*

The dye or coloring matter is applied to the hat bodies after the sizing has been commenced and before it is completed.

109,341—November 15, 1870. A. PARAF. *Improvement in the manufacture and application of colors for printing and dyeing.*

Colors for printing and dyeing are mixed with soap and so applied.

120,393—October 31, 1871. A. PARAF. *Improvement in dyeing and printing madder colors.*

The madder color is applied to the article in solution with a neutral salt of a fixed alkali and with ammonia; and, second, the coloring matter is precipitated in the article by the mordant adapted to the peculiar color required and the consequent liberation of the ammonia.

147,010—February 3, 1874. A. KELLER. *Improvement in processes of dyeing cotton.*

Cotton is dyed a fast Turkey red, the process involving a series of ten or more steps with a great variety of materials, soda compounds, cows' dung, alum, madder, blood, fish oil, tin salts, etc.

147,887—February 24, 1874. J. B. FREZON. *Improvement in treating mixed fabrics previous to dyeing.*

Woolen and silken fabrics containing vegetable matter or impurities are exposed to a heated acid bath containing a mordant, to simultaneously destroy the vegetable matter and prepare for dyeing or bleaching.

150,427—May 5, 1874. G. MOLT. *Improvement in dyeing with indigo.*

An extract or decoction of hops is added to the indigo solution, to prevent precipitation of the indigo and keep the fabric soft.

163,521—May 18, 1875. J. B. C. H. PETITDIDIER. *Improvement in processes of dyeing silk fabrics.*

The dye solution is in alcohol or similar solvent combined with a fatty and resinous mordant, and the dyed fabric is subsequently passed through a bath of benzine to dissolve the said fatty and resinous mordant.

170,626—November 30, 1875. J. HARLEY. *Improvement in dyeing and printing textile fabrics.*

A fabric is dyed in madder and garancine styles in combination with aniline purples and violets, by first fixing the latter upon the cloth with mordants, and then passing the cloth through the dye bath, whereby it is then dyed up in madder and indigo styles. A fabric having an aniline purple in combination with one or more madder colors is claimed; also the combination of aniline greens and purples upon cloth with mordants suitable for dyeing up in madder colors.

174,891—March 21, 1876. S. BARLOW. *Improvement in processes of manufacturing ornamental textile fabrics.*

A figured fabric is produced by weaving the portions to be stained or printed of vegetable fibers and the portions to be left unstained or unprinted of animal fibers, then printing with aniline-black, suitable for developing in cotton fabrics, and cleansing.

180,628—August 1, 1876. W. PARSONS. *Improvement in processes of ornamenting hosiery and other knit fabrics.*

Hosiery and other knit goods are ornamented by dyeing the ornamentation thereon.

194,392—August 21, 1877. J. WILLIAMS. *Improvement in dyeing and coloring feathers, laces, and other fabrics.*

The material is immersed in a bath consisting of gasoline or naphtha and a mineral pigment ground in oil.

202,910—April 23, 1878. J. WILKINS. *Improvement in treatment of waste from the separation of animal from vegetable fibers.*

The vegetable waste from the separation of animal from vegetable fiber (obtained by treating mixed rags with dilute acid) is converted into dextrine by heating the said material with sulphuric acid, neutralizing with chalk, decanting the solution, decolorizing, if necessary, and evaporating.

223,019—December 30, 1879. H. W. VAUGHAN. *Improvement in methods of coloring fibrous material.*

A dry powder, as infusorial earth, or other suitable vehicle, charged with coloring matter and with an oleaginous constituent, is mechanically incorporated into the fiber in the manufacture of the yarn.

230,753—August 3, 1880. C. P. CULLMANN AND C. A. LORENZ. *Fabrication of onyx from agate.*

One side of the stone is immersed in a bath of dilute nitric acid and iron, and the other side in a bath of potassium carbonate and water; the stones are then dried and burned to fix the color.

235,170—December 7, 1880. G. M. & A. L. RICE. *Art of separating vegetable fibers from animal fibers.*

Chemical disintegrating agents are rendered temporarily inactive during distribution by being absorbed with a suitable comminuted or finely granulated substance, and distributed in a dry or mealy condition through the mixed fibrous material, and the mass is then subjected to heat.

241,661—May 17, 1881. T. & R. HOLLIDAY. *Dyeing colors on cotton or textile fabrics.*

Azo colors are developed in or upon textile fiber, etc., by impregnating the same with a solution of a phenol or phenols, and with a solution of a diazo compound of an aromatic amine or phenol.

242,081—May 24, 1881. H. W. VAUGHAN. *Process of dyeing.*

Dyes of coloring matters in fibrous material which has been superficially colored by impregnation with a dry powder charged with color and an oleaginous constituent (No. 223,019), are fixed by steaming.

253,230—February 7, 1882. A. SANSONE. *Application of coloring matter to fabrics.*

Spotted or stippled effects are produced by scattering upon the mordanted wet fabric a dry insoluble granulous or powdered substance, such as sand, coated or covered with an aniline or other suitable color substance.

262,791—August 15, 1882. M. LANDENBERGER, Jr. *Manufacture of dyed fabrics.*

In the manufacture of mixed cotton and wool fabrics, the cotton is dyed in the yarn with a dye not affected by the dye for the wool, and after weaving, the fabric is dyed with the wool dye.

266,825—October 31, 1882. A. M. JACOBS. *Preparing fabrics for dyeing turkey red.*

Preparatory to dyeing turkey red or alizarine the fabric is treated in a solution of ammonium-aluminum tartrate, whereby the oiling and aluming of the fabric are done in one operation.

272,498—February 20, 1883. H. W. VAUGHAN. *Method of applying dyestuffs to fibrous materials.*

The fiber is sprayed with oleaginous matter, and the coloring matter, combined with a pulverulent vehicle and a mordant, is blown upon the fiber.

283,500—August 21, 1883. J. C. MAGUIRE. *Dyeing and finishing plush fabrics.*

A paste or cementing substance is applied to the nap or face side of the fabric in connection with the dye or color; it is then steamed, and the fabric dried, and finally washed to remove the paste or gum from the nap.

301,344—July 1, 1884. A. N. DUBOIS. *Process of dyeing horse-hair and bristles.*

They are immersed in a boiling bath of water containing salts of lead and salts of soda, boiled for one and a half hours, then washed in cold water, and subsequently in tepid water containing sodium carbonate.

301,475—July 8, 1884. J. BRACEWELL. *Process of printing indigo colors.*

The fabric is saturated with a solution of grape sugar or glucose and dried, and the saccharine crystals over the surface are then broken down, as by passing it through a steam box for a very short time, when the prepared fabric is printed with a mixture of alkali and indigo.

305,057—September 16, 1884. C. ALBERT CONTI DE BARBARAN. *Process of dyeing hair.*

Human hair or the hair or fur of animals is treated first with an ammoniacal solution of nickel and then with pyrogallic acid.

328,465—October 20, 1885. M. CONRAD. *Process of printing textile fabrics.*

Knit or woven fabrics are first printed with a color prepared with laevulinic acid, oil emulsion, acetic acid, and starch, and a solution of dry tannic acid in tragacanth water, and the fabric is afterwards submitted to the action of steam.

331,777—December 8, 1885. A. N. DUBOIS. *Dyeing aniline black.*

The fabric is prepared for dyeing by soaking in a bath of soluble castor oil, then for about three hours in a bath composed of water, aniline oil, hydrochloric acid, nitrate of iron, and bichromate of potash, after which it is finished in a bath of soap.

341,409—May 4, 1886. H. F. DIETZ. *Dyeing hat bodies.*

Hat bodies are dyed while upon the cone or former.

354,223—December 14, 1886. H. R. RANDALL. *Treatment of silk fiber.*

The process consists in treating silk fiber, waste and raw silk and cocoons, before removing the gum, to the action of a solution of acetic acid in water, 1 to 3 ounces in a gallon of water, or a watery solution of acetic acid and sulphuric acid.

355,933—January 11, 1887. T. HOLLIDAY. *Process of napththol dyeing.*

The fiber is passed through a solution of a salt of lead to which an alkali has been added, and then through a soap solution, when the fiber, having on it oxide of lead or lead soap, is impregnated with alpha or beta naphthol, or coloring matter formed with them.

355,934—January 11, 1887. T. HOLLIDAY. *Dyeing textile animal fibers.*

Animal fibers are dyed with the product of oxidation of alpha-naphthol by chromic acid, by acting on the alpha-naphthol with chromic acid in the presence of the fiber.

357,281—February 8, 1887. E. HOLLIDAY AND E. RAU. *Dyeing with basic aniline.*

The material is dyed in a bath composed of the fatty salts of the basic coal-tar colors in a solution of benzine, or other suitable hydrocarbon or like solvent; the surplus color is removed by washing in benzine, and the color is then fixed in a steam box.

362,835—May 10, 1887. T. HOLLIDAY. *Process of dyeing.*

Wool or other animal fiber is impregnated with metallic mordants and immersed in a bath containing one or more nitroso compounds of naphthols.

368,880—August 23, 1887. T. H. DOST. *Dyeing brush stock.*

Vegetable fiber for brushes is dyed in bulk in extract of logwood or other dye producing a black color, then dried, and finally subjected to the fumes of sulphur to fasten the color and also make it lighter.

374,320—December 6, 1887. E. RAU. *Process of dyeing.*

A bath is formed by dissolving the color in water, treating with caustic soda and oleic acid, and then adding oil. The fabric is passed through the dye bath, the surplus color is pressed out, it is dried and steamed, and then washed with hydrocarbons to remove the oil and leave the color only in the fabric.

379,150—March 6, 1888. R. BOHN. *Dyeing animal textile fabrics with naphthazarin.*

Chrome lakes of napthazarin are produced within or upon textile fibers by exposing said fibers to the action of chromium mordants and naphthazarin in dyeing.

385,426—July 3, 1888. J. C. PENNINGTON. *Dyeing.*

Silks, wools, and mixed fabrics are dyed with aniline colors by impregnating them with a solution of the alkaloidal bases of such colors in ether or other equivalent liquids, and afterwards submitting them to the action of steam containing suitable acid to reconstitute the color and to volatilize the residual solvent.

386,247—July 17, 1888. T. HOLLIDAY. *Process of dyeing.*

Cotton or other vegetable fiber is dyed by the formation thereon of the colored products of the combination of the nitroso compounds of alpha or beta naphthol with metallic mordants.

388,703—August 28, 1888. P. P. F. MICHEA. *Treating plants containing indican.*

In the manufacture of indigo ammonia is introduced into the indigo liquor and atmospheric and ozonized air, with agitation to increase the yield.

390,842—October 9, 1888. B. F. CRESSON. *Dyeing aniline-black.*

An aniline-black coloring solution is formed by dissolving and mixing together water, chlorate potash, sal-ammoniac, sulphate of copper, nitrate of iron, and tragacanth gum, then forming another liquor of aniline-oil, muriatic acid, tartaric acid, and water, and finally mixing the two liquors.

394,446—December 11, 1888. V. G. BLOEDE. *Process of tinting fabrics.*

Yarn and fabrics are tinted with insoluble coloring matter by subdividing the color until it is fine enough to permeate the interstices of the yarn and attach itself to the individual fibers thereof, then suspending the color in an aqueous bath, which may contain a gummy or viscous matter, and passing the yarn or fabric through the bath.

394,447—December 11, 1888. V. G. BLOEDE. *Process of dyeing.*

The fabric is first impregnated with, or there is applied thereto, a mixture of soluble fatty matter, such as potash soap, and coloring matter, which may be incorporated with gum, or starch, or glue, and the fatty matter is then rendered insoluble by treating the fabric with chloride of calcium or other equivalent compound.

394,448—December 11, 1888. V. G. BLOEDE. *Tinting or finishing cotton fabrics.*

The interstices of the fabric are filled with starch and coloring matter thoroughly incorporated together, and the paste is then removed from the exposed surface of the threads by scraping.

409,820—August 27, 1889. J. BRACEWELL. *Pigment-resist.*

The process consists in printing the resist compounded of a pigment color and alkali on the cloth in a pattern and drying it; afterwards printing, padding, or blotching over the same the steam aniline-black color, and lastly developing and fixing the aniline-black and pigment-resist colors by steam under pressure.

419,331—January 14, 1890. S. HODGSON. *Process of scouring and dyeing.*

In dyeing, scouring, or washing, the staple is intermittently fed to the operating liquid, and the liquid and the staple are subjected to intermittent forward impulses.

429,131—June 3, 1890. J. J. HART. *Process of printing calico.*

The fabric containing the lake or fixed color is passed through a bath of a solution of a developing reagent maintained at a temperature below the point necessary to effect the chemical reaction between the lake or fixed color and the developing reagent (preferably cold), and then the fabric is exposed to heat to effect the chemical reaction between the lake and fixed color and developing reagent.

433,790—August 5, 1890. T. INGHAM. *Process of dyeing.*

Fabrics of mixed vegetable and animal fibers are submitted to a bath of the required coloring matter or solution without any mordant, then dried, and the coloring matter is then oxidized on the dried fabric by passing the material through a solution that will fix the colors upon both the vegetable and animal fibers at one and the same time.

439,953—November 4, 1890. R. HOLLIDAY. *Process of producing azo colors on cotton or other vegetable fiber.*

The fiber is first subjected to a mixture composed of oil, a phenolic body, and an alkali, dried, and then subjected to an azo compound.

440,414—November 11, 1890. F. ZEMAN. *Process of dyeing.*

Method of dyeing silk consists in first washing the same, subjecting to a dyeing bath, drying, steaming, subjecting to vaporized acetic acid for setting the color, then subjecting to a heated bath of silicate of soda, and washing.

449,104—March 31, 1891. V. G. BLOEDE. *Process of coloring and finishing fabrics.*

Starched fabrics or yarn are treated with a solution of caustic lime or other equivalent compound which has the property of rendering the starch insoluble.

457,488—August 11, 1891. A. FISCHESSER AND J. POKORNY. *Process of dyeing.*

In the direct production of insoluble azo coloring matters upon fabrics, either by dyeing or printing, the fabric is alternately impregnated or coated with diazotized amido substance and with beta-oxynaphthoic acid, the melting point of which is 216° C.

472,267—April 5, 1892. E. MICHAËLIS AND C. HENNING. *Process of dyeing.*

Textile material is immersed in a bath consisting of an acid solution formed by treating zinc with sodium bisulphite mixed with caustic soda and indigo, and then immersed in oxygenated water to oxidize the indigo, to which a percentage of ammonia may be added.

484,080—October 11, 1892. E. ZILLESSEN. *Process of dyeing.*

Silk goods are dyed in contrasting colors, by treating part of the threads to be woven with a mordant before weaving, then weaving in combination with silk not so prepared, to form the desired pattern, and finally dyeing in the piece the fabric thus formed.

491,673—February 14, 1893. W. BROWNING. *Process of printing colors with aniline-black.*

A mordant formed by an astringent solution and a metallic salt is first applied to the material; second, the material is padded with an aniline mixture suitable for producing aniline black; third, a resist for aniline black mixed with coloring matter, which will enter into chemical combination with such mordant, is printed upon the material in any desired design; and, finally, the material so mordanted, padded, and printed, is steamed or aged to develop and fix the colors.

493,286—March 14, 1893. C. F. X. NOROY. *Process of dyeing black.*

The goods (of animal or vegetable fiber or skins) are first submitted to a bath composed of water, logwood, and a copper salt, and then immersed in a fixing bath composed of water, metallic sulphates, bichromate of potash, and neutralized nitrated starch, the solution being rendered slightly alkaline by the addition of soda potash or ammonia.

499,649—June 13, 1893. V. G. BLOEDE. *Process of dyeing and printing.*

The goods are first immersed in a solution composed of a dye and mordant suitable to fix it and a free acid which will hold them both in solution, and the saturated goods are then subjected to the action of a bath of alkaline vapor that will neutralize the acid and allow the mordant and dyestuff to combine.

499,689—June 13, 1893. W. T. WHITEHEAD. *Aniline-black resist.*

The pattern is printed upon the cloth in a resist containing a zinc compound as its essential or active element, with or without a color; it is then suitably dried, and thereafter the cloth is treated with a solution of analine black by blotching, slop-padding, or dyeing.

499,691—June 13, 1893. W. T. WHITEHEAD. *Aniline-black discharge.*

The cloth is first treated with a solution of aniline black, dried sufficiently to keep the color from running, and the pattern is then printed in a discharge containing zinc as its essential or active element (with or without a color), before oxidation of the aniline-black color, thereby producing the pattern on an aniline-black ground.

499,692—June 13, 1893. W. T. WHITEHEAD. *Aniline-black resist.*

The pattern is first printed upon the cloth in a resist containing zinc as its essential or active element (with or without a color), and thereafter the cloth is treated with a solution of aniline black by blotching, slop-padding, or dyeing, producing the pattern on an aniline-black ground.

500,558—July 4, 1893. J. BRACEWELL. *Printing aniline-black.*

The fabric or fiber is first padded or covered with an aniline-black mixture; it is then printed with a color mixture consisting of an aniline-black discharge, a coal-tar color, and an alumina hydrate as mordant for the color, and then steamed or aged to such a degree that the analine black and the color pattern are simultaneously developed and fixed. The said color mixture is claimed, the insoluble salts of which have an affinity for both color and cotton fiber, whereby heat and moisture will cause the mixture to discharge the aniline black on the fiber and deposit the insoluble double salt of the alumina and color.

501,160—July 11, 1893. W. PFITZINGER. *Process of dyeing black.*

Cotton is first dyed by a coloring matter, such as is obtained by the combination of one molecule of tetrazo diphenyl, or analogous compounds thereof, with two molecules of amido naphthol monosulpho acid G; second, the dyestuff on the fiber which contains one or two free amido groups is diazotized; and third, the resulting diazo compound is combined with phenol.

506,966—October 17, 1893. C. BASWITZ. *Method of removing copper from textile parchments (fabrics).*

Copper is removed from textile fabrics and the same rendered uninflammable by dipping them in a solution of vegetable parchment in ammoniacal oxide of copper, then evaporating the ammonia, and finally treating with a mixture of sulphate of ammonia and acetate of alumina to remove the copper.

529,498—November 20, 1894. F. V. KALLAB. *Dyeing aniline-black.*

Aniline black is produced on wool, hair, and other animal substances or mixed textile fabrics by first oxidizing the goods, second padding or printing with a mixture suitable for producing steam-aniline black on cotton, and finally developing the black by steaming.

529,499—November 20, 1894. F. V. KALLAB. *Producing figures on aniline-black.*

White or colored figures are produced on aniline black on fabrics of wool, hair, or other animal substances or mixed fabrics containing such substances, by subjecting the goods to such feeble oxidation that the white of the wool is but little affected, then padding or printing with mixtures suitable for producing steam-aniline black on cotton and for producing discharging white or colors, and finally steaming to develop the black and fix the discharge colors.

542,022—July 2, 1895. E. LAUBER AND L. CABERTI. *Process of dyeing.*

Fabrics are first treated with beta naphthol and antimonious oxide in alkaline solution, and subsequently treated with diazo compounds.

545,420—August 27, 1895. F. BAMFORD. *Process of dyeing pile fabrics.*

The pile fabric is embossed to lay flat portions of the pile; then a mordant, resist, or dye is applied to the erect portions of the pile, and, after steaming and washing, the pile is raised. Two or more colors are produced by applying a dye to the erect portions of the embossed fabric and subsequently, after raising the pile, dyeing the piece.

557,324—March 31, 1896. G. D. BURTON. *Art of electric dyeing.*

See Group X, Electro-chemistry.

558,718—April 21, 1896. H. L. BREVOORT. *Art of fixing dyes in fabrics.*

See Group X, Electro-chemistry.

559,163—April 28, 1896. E. CABIATI. *Process of dyeing with indigo.*

A fine network in aniline black is printed on the fabric before or after treatment in the indigo bath, to economize indigo.

569,392—October 13, 1896. F. STORCK. *Process of producing azo colors on fiber.*

The fiber to be dyed or printed is impregnated with a sodium salt of phenol and subsequently submitted to the action of mixtures of diazo compounds of aromatic bases with cupric chloride.

570,115—October 27, 1896. V. G. BLOEDE. *Process of vapor-dyeing.*

Fibers or fabrics are subjected to the action of the vapors of volatile coloring matters or color-producing compounds.

570,117—October 27, 1896. V. G. BLOEDE. *Process of dyeing aniline-black.*

The fiber is first saturated with a salt of aniline or its homologues (combined in the usual manner with chlorates or metallic salts), then dried, and then, without previous aging, it is brought in contact with an oxidizer, applied in such quantity that the fiber or fabric will not become supercharged with moisture until the color developed has become insoluble.

574,401—January 5, 1897. C. & P. DUPOULLY. *Process of crinkling silk.*

Silk thread or fabric is subjected to the action of an acid of a density sufficient to contract the silk fibers.

577,295—February 16, 1897. W. J. S. GRAWITZ. *Process of dyeing.*

Vegetable fibers, prepared wool, or silk are dyed or printed by first treating the fibers with a mixture of a salt of aniline and a soluble cyanate, such as sulpho-cyanate of barium, capable of forming the sulpho-cyanate of aniline by double decomposition, and then developing the color by oxidizing the chlorate in presence of a salt of vanadium.

580,331—April 6, 1897—J. WEIDMANN. *Process of dyeing silk.*

Unmanufactured silk in the condition of souple is subjected to a bath of bichloride of tin of from 20° to 30° Baumé for an hour, more or less, then washed, then for an added weight of 50 to 300 per cent passed one to five times through the tin bath, then subjected to a solution of phosphate of soda, again washed, passed back and forth in a bath of silicate of soda, again subjected to the tin bath for an hour, and then dyed black, after grounding if desired.

586,865—July 20, 1897. E. VON PORTHEIM. *Process of dyeing black.*

The dyestuff is formed on the fiber by mordanting the same first with betanapthol sodium and then applying thereto a diazo combination of an amidochrysoidin base—formed by diazotizing a base of an amidochrysoidin—adding to the diazotized liquor acetic-starch paste, oxalic acid, and acetate of sodium.

588,203—August 17, 1897. A. WEINBERG. *Process of developing azo colors.*

Dyeings produced by means of those direct-dyeing cotton dyestuffs which contain free primary amido groups are developed by treating the goods in a bath containing diazo compounds. The process appears to be an inversion of the well-known method of diazotizing amidized direct-dyeing coloring matters upon the fiber.

588,387—August 17, 1897. V. G. BLOEDE. *Process of dyeing.*

The fiber or fabric is first treated with a composition of aniline, its homologues or analogues, and then subjected to the action of an oxidizer in gaseous form.

592,022—October 19, 1897. H. N. F. SCHAEFFER. (*Reissue: 11,647—February 1, 1898.*) *Process of dyeing mixed goods.*

Mixed goods composed of wool and cotton are first dyed with a black dye which dyes the wool only and which is unaffected by aniline-black; the cotton is then dyed by padding the goods with an aniline-black liquor, and the black developed in the cotton after it has been padded.

593,192—November 9, 1897. V. G. BLOEDE. *Process of dyeing.*

Colors are developed or modified by diazotization by subjecting the fiber or fabric treated with such colors or color-producing compounds to the action of nitrous acid in gaseous form.

595,894—December 21, 1897. H. SEYBERTH AND M. VON GALLOIS. *Process of producing diazonaphthalene on fiber.*

Process of producing diazonaphthalene for the production of a claret-red color on the fiber consists in applying to the fiber a pasty aqueous solution of pulverized alpha-naphthylamin sulphate, and then diazotizing the same.

601,420—March 29, 1898. H. ZUBLIN AND A. ZINGG. *Process of discharge printing.*

In the art of producing white and color discharge of finished dyed paranitranilin red and similar azo coloring matters, produced directly upon the fiber, the coloring matters are reduced by means of an alkaline solution and of glucose in the presence of a body of the hydroxyl group, as glycerine.

606,776—July 5, 1898. S. F. CARTER. *Process of producing white effects on fabrics.*

The fabric is first subjected to the action of a sulphocarbonate of cellulose, such as viscose, the design is then printed upon the fabric with a suitable pigment, as tungstate of barium, and it is then subjected to heat to decompose the viscose. The design may be first printed with a mixture of viscose and tungstate of soda, and the fabric then heated and afterwards passed through a bath of barium chloride to form upon the fabric tungstate of barium in the form of the design.

606,777—July 5, 1898. S. F CARTER. *Process of producing white effects on fabrics.*

The design is printed upon the fabric with tungstate of barium and albumen, or like binding agent, and then heated to coagulate the albumen, thereby binding the pigment to the fabric.

612,274—October 11, 1898. J. T. REID AND H. THORP. *Dyeing textile fibers, yarns, and fabrics.*

Vegetable fibers are dyed "khaki" shades by passing the material through a bath of olein-oil, drying, impregnating with a mixed solution of alizarin-blue S (or like product of anthracene), chromium and iron salts, then drying, steaming and developing the color by treatment with an alkali.

614,237—November 15, 1898. H. N. F. SCHAEFFER. *Process of printing on mixed goods.*

Printed effects are produced on mixed woven goods of animal and vegetable fibers, by dyeing with a substantive color or colors, rendering the substantive color fast on the vegetable fiber by a substantially colorless compound metallic mordant (as salts of zinc, magnesia, and alumina), and a fixing agent not sufficiently alkaline to affect the animal fiber, and printing in design on both fibers a discharge reagent which reacts on both the animal and vegetable substantive color and produces a colored design on both of said fibers.

615,232—December 6, 1898. H. ALT AND E. CULMANN. *Process of dyeing with quinonoxim colors.*

Process of producing and at the same time fixing nitrosophenols on textile fiber consists in impregnating the goods with a mixture consisting of a phenol, a suitable acid or acid salt, and a mordant adapted for the fixation of nitrosophenols, and subsequently passing the fabric through a hot nitrite solution.

617,772—January 17, 1899. F. RETTIG. *Process of making colored designs on woven fabrics.*

Embroidery-like woven material having a raised and colored portion is produced by weaving such fabric with a raised design on its face, protecting the back by applying a resist thereto, applying a color on the other side, fixing said color on the raised pattern, and subsequently removing the resist and unfixed color. A color may be incorporated with the resist.

620,578—March 7, 1899. J. W. FRIES. *Process of dyeing.*

The dyeing compound consists of starch and caustic soda in semifluid condition, acetic acid, a substance such as acetate of lime capable of precipitating the basic dyes, and a basic dye, the whole forming a viscous material capable of producing insoluble precipitates of the dyes upon the fabric and stiffening of the tetxile material treated on application of heat.

623,697—April 25, 1899. M. BECKE AND A. BEIL. *Process of dyeing unions.*

The wool and cotton in half-woolen goods is simultaneously subjected in one acidulated bath to the action of basic polyazo dyestuffs and saffraninazo dyestuffs.

625,198—May 16, 1899. A. PHILIPS AND M. VON GALLOIS. *Process of dyeing on fiber.*

Azo colors, insoluble in water, are produced on the fiber, from violet-black to black, by grounding the goods with naphthol and combining therewith the tetrazo compounds of diamidodimethylcarbazol by way of printing or dyeing.

630,507—August 8, 1899. F. I. HORROCKS. *Process of dyeing.*

Products made of vegetable fibers are impregnated with a solution of a salt of copper and iron, and the same is precipitated upon the fibers in the form of oxides by a suitable reagent, as a solution of a suitable salt of an alkali metal. Figures or patterns are produced by removing the excess of solution to a greater extent from some portions of the fabric than from others prior to precipitation.

631,806—August 29, 1899. J. T. REID AND H. THORP. *Process of dyeing khaki.*

The fibrous material is impregnated with a mixed solution of alizarin-blue S, chromium and iron salts, dried, steamed, and the color developed by treatment with an alkali. (The preparatory steps of No. 612,274 are omitted.)

632,503—September 5, 1899. A. PHILIPS. *Process of dyeing.*

Brown to brown-black colors are produced on the fiber by treating the naphthol-grounded fabric with the tetrazo solutions of the diamidocarbazols

633,438—September 19, 1899. F. ERBAN. *Process of dyeing.*

To dye with alizarin the fiber is first treated with a soluble modification of alizarin—a solution of the coloring matter mixed with an alkaline medium—then the alizarin color is fixed on the fiber by drying, the fiber is treated with a mordant, and finally steamed.

634,824—October 10, 1899. P. JULIUS AND R. LAIBLIN. *Dyeing wool fast black.*

The wool is dyed from an acid bath with the secondary diazo dyes from ortho-amido-phenol-para-sulpho-acid (those having alphanaphthylamin as middle component and a naphthol or dioxynaphthalene or sulpho-acids thereof as end components), and the dyeings treated with a chrome salt.

646,379—March 27, 1900. G. TAGLIANI. *Process of dyeing fabrics.*

To deepen the shade of color upon one side of fabrics of vegetable fiber a concentrated alkaline solution—as a concentrated caustic solution containing metallic salts—is applied only to the side that is to take the deeper color, then the fabric is dyed, and finally subjected to the washing action of an acid.

647,268—April 10, 1900. F. JUST. *Process of dyeing.*

Colors developed by chromium compounds are produced on wool fiber by dyeing the fiber with an azo dyestuff, oxidizing with chromic acid, and subjecting the dyestuff simultaneously to the action of a reducing agent, such as lactic acid, tartaric acid, etc.

649,227—May 8, 1900. E. ULLRICH. *Process of dyeing quinonimid dyes.*

The tannin-antimony compounds of the quinonimid dyestuffs are produced from their components on the fiber by printing or padding the fiber with a color containing a nitroso compound of aromatic bases, a phenol-like body (as beta-naphthol), an acid, a thickening agent, and tannin, then drying, steaming, and passing the fiber through an antimony bath, and washing and soaping.

649,228—May 8, 1900. E. ULLRICH. *Process of fixing quinonimid dyes.*

The chromium compounds of the quinonimid dyestuffs are produced on the fiber from their components by printing or padding the fiber with a color containing a nitroso compound of aromatic bases, a phenol-like body (such as beta-naphthol), an acid, a thickening agent, and a suitable metallic salt to fix the dyestuff, then drying, steaming, washing, and soaping.

649,486—May 15, 1900. R. E. SCHMIDT. *Process of dyeing.*

Unmordanted wool is dyed with water-soluble amidoöxyanthraquinone sulphonic acids by means of an acid bath, which at the same time contains a sulphurous-acid compound as a reducing agent.

650,752—May 29, 1900. W. ELBERS. *Gray cloth and process of dyeing same.*

A gray-indigo coloring matter is produced on the fiber by printing with a paste of finely divided indigo, a suitable thickening and a quantity of oil on the fiber, and steaming, then freeing from thickening by washing and treating with malt, drying, and again steaming.

MORDANTS.

8,035—April 15, 1851. C. A. BROQUETTE. *Improvement in material for transferring colors in calico printing.*

Extract of fibrine is used to form a mastic to thicken and retain on fibers archil color and such other colors as are incorporated with the mastic. The process is described of preparing and purifying the extract of caseine for use as a mordant.

13,915—December 11, 1855. R. PRINCE AND A. LOVIS. *Improvement in processes for calico printing.*

A compound of silicates of soda or potash with neutral or alkaline salts is used, in lieu of dung, in dunging operations with carbonate of soda and neutral salts.

34,840—April 1, 1862. N. LLOYD AND J. G. DALE. *Improvement in dyeing and printing with aniline colors.*

Tannin and tartarized or other soluble salt of antimony capable of dilution with water, or a soluble salt of lead, mercury, or chromium, are used to fix colors derived from aniline or analogous substances on textile fabrics.

38,686—May 26, 1863. G. H. LEWIS. *Improvement in printing and ornamenting india rubber.*

Printing or engraved matter is impressed or transferred upon vulcanizable india rubber or allied gums, and then fixed by vulcanizing, as by pressure between heated metal plates.

41,066—January 5, 1864. R. H. GRATIX. *Improvement in dyeing and printing with aniline colors.*

A compound of tannin with the aniline color, formed either before or during the process of printing or dyeing, is used in combination with salts of tin or other suitable mordant.

46,200—January 31, 1865. T. CROSSLY. *Improvement in the dyeing, printing, and manufacture of waterproof flocked cloth.*

Before dyeing or printing, the cloth is submitted to a steam heat of 105° to 143° C., then to a bath of muriate of tin of 4° to 12° Twaddle, then to a neutralizing bath of aqua ammonia and salsoda, then to a solution of sulphuric acid and chloride of lime to oxidize the tin deposit, and afterwards to a dilute solution of sulphuric acid to remove the lime. The cloth then dyes and prints in uniform shades.

54,203—April 24, 1866. E. F. PRENTISS. *Improved mordant.*

A triple sulphate of iron, 746 parts; copper, 254 parts; and zinc, 110 parts. It is used for black and any desired shades of mulberry.

60,546—December 18, 1866. A. PARAF. *Improvement in dyeing and printing textile fabrics and yarns.*

Chromic acid is developed in dyeing and printing by the application to the fabric of an insoluble salt of chromium and the subsequent action of a moist atmosphere, or by aging or steaming.

63,084—March 19, 1867. A. PARAF. *Improvement in dyeing and printing textile fabrics, and in compounds therefor.*

The arsenite of glycerine, for fixing aniline colors; also the combination of the same with coal-tar colors and acetate of alumina, magnesia, or other metallic oxide.

69,121—September 24, 1867. A. PARAF. *Improved mode of producing black in dyeing and printing.*

Asphaltum is used and the black coloring matter precipitated in the article to be dyed or printed by means of albumen.

94,581—September 7, 1869. F. S. DUMONT. *Improved compound to be used as a mordant in dyeing and printing.*

A mordant made from the serum of blood, produced by adding arsenic acid, borax, sulphate of zinc, and essence of terebinthine.

99,105—January 25, 1870. A. PARAF. *Improved method of fixing pigments to fibrous and textile materials.*

The coloring matters are fixed by means of albuminous material, as lactarine, and a salt of lime, such as the saccharate of lime or the suchrate of lime.

106,479—August 16, 1870. F. GRAUPNER. *Improvement in composition to be used in dyeing.*

A coloring composition, of the nature of a mordant, consisting of a solution of sulphate of soda, sulphuric acid, and oxalic acid in water, to which is added a mixture of muriatic acid and nitric acid saturated with tin and then diluted with water.

128,302—June 25, 1872. E. A. D. GUICHARD. *Improvement in processes of printing fabrics.*

The colors are mixed with a compound of oil varnish, essence of turpentine, white or yellow wax, and resin and printed direct, without previous preparation of the fabric.

143,449—October 7, 1873. G. A. HAGEMANN. *Improvement in mordants for dyeing.*

Calcined and pulverized acetate of soda and sulphate of alumina are mixed in due proportions ready to be dissolved for the production of the mordant acetate of alumina.

144,952—November 25, 1873. R. O. BURGESS AND S. LA RHETT. *Improvement in mordants for dyeing.*

A compound of sodium chloride and binoxalate of potash.

152,908—July 14, 1874. A. GENDER AND W. THILMANY. *Improvement in treating textile fabrics to prevent mildew and decay.*

Textile fabrics are treated with sulphate of copper and chloride of barium, the salts forming a union with the fabric.

177,987—May 30, 1876. F. J. BIRD. *Improvement in mordants.*

A composition of gallnuts, tannin, alum, tin, and soda, as a mordant for woolen and cotton or other union goods.

186,620—January 23, 1877. J. RAU. *Improvement in processes for dyeing silks.*

Silks and half silks are dyed, without water or steam, by first soaking in a bath of benzine with aniline dissolved therein, and afterwards in a bath of pure benzine.

192,492—June 26, 1877. H. D. DUPEE. *Improvement in printed textile fabrics.*

A textile fabric has coloring matters fixed thereon by means of gelatine combined with chromic acid.

195,826—October 2, 1877. J. KOKESCH. *Improvement in treatment of seal skins.*

The skins are first sheared to the proper length of hair, then subjected to a process of fulling, then mordanted, and finally immersed a number of times in a dye, brushing after each immersion. The mordant consists of quicklime, beech ashes, sumac, and water; and the dye of gallnuts, green copperas, copper scales, litharge, sal ammoniac, verdigris, catechu, rotten stone, cinnabar, and water.

204,130—May 28, 1878. S. CABOT, JR. *Improvement in compositions to be used as mordants and dye stuffs.*

It consists of gallic acid, sodic or potassic hyposulphite, hydrosodic or hydropotassic sulphate, and nutgalls, ground and mixed.

241,398—May 10, 1881. S. MELLOR. *Mordant.*

It consists essentially of stibio-fluorine salts, or any combination of fluorine and antimony by themselves, or in conjunction with any other metal or metalloid.

243,141—June 21, 1881. J. J. LELOIR. *Dyeing mixed fabrics.*

A mordant for mixed fabrics composed of water, muriatic acid, and sulphuric or nitric acid, with zinc or tin, together with bichromate of potash and a sulphate of iron or of copper.

243,378—June 28, 1881. A. M. JACOBS. *Turkey-red mordant.*

Process of preparing a mordant consists in uniting 220 parts of oil or fat and 50 parts of sulphuric acid, the mixture being stirred for three hours until 37° to 56° C. is reached and then settled for twelve hours, then a watery solution of crystallized soda is added and settled for twenty-four hours, when the neutralized oil is drawn off and 26 parts of aqua ammonia is added.

245,633—August 16, 1881. A. M. JACOBS. *Process of manufacturing oleaginous mordants.*

To produce an oxyoleic alkali mordant, for turkey-red dyeing, vegetable and animal oils, fats or oleic acid are treated with sulphuric acid, then double the quantity of cold water added, whereby sulpholeic acid is formed which is settled, separated, and boiled with three to six times the quantity of distilled water until the fatty acids and the sulphuric acid have separated and the former floats on the watery fluid; it is then poured off and the fatty acid is repeatedly boiled with fresh water, separated from the solid parts and mixed with cold water, and alkali added to neutralize or make slightly alkaline.

245,701—August 16, 1881. J. BURTON. *Thickener for mordants and colors.*

Glucose is added to either the mordant or color, or both.

254,713—March 7, 1882. T. SIMPSON. *Chroming fabrics.*

The fabric is passed through a chroming solution, then heated without drying, and then passed, before drying, through a water bath.

255,543—March 28, 1882. T. SIMPSON. *Process of and apparatus for aging fabrics.*

The suspended fabrics, properly prepared, are subjected to the action of currents of moist air directed downward.

263,040—August 22, 1882. T. H. GIBSON. *Mordant.*

A combination of acetate of lead and stannate of soda each one part and alum two parts.

263,366—August 29, 1882. C. TOPPAN. *Process of finishing colored or printed textile fabrics.*

The goods are passed into or through a solution of warm water and sinepetroline No. 2 (No. 186,640), with or without starch, and then calendered upon hot rolls.

270,868—January 16, 1883. F. B. WILKINS. *Finishing woven cotton fabrics.*

Ginghams and other cotton fabrics are wrapped in heavy woolen blankets and subjected to the action of steam under pressure, to render them pliable and improve the texture.

287,112—October 23, 1883. A. N. DUBOIS. *Mordant for aniline-black.*

A compound of water, hydrochloric acid, sulphate of soda, and bichromate of potash.

290,294—December 18, 1883. C. N. WAITE. *Mordant.*

A mixture of lactic acid, 4 parts, with oxalic acid, 1 part. It is specially intended for animal fibers.

309,016—December 9, 1884. G. WITZ. *Process of pattern dyeing.*

To produce figures of the same color as the ground, but of a different shade, the fabric, of vegetable fiber, is dipped in a solution of potassium bichromate, and dried, then printed with a solution of starch at about 50° C., in which is dissolved oxalic acid (whereby the cellulose is converted into oxycellulose) and dried, and then washed and dyed.

320,820—June 23, 1885. R. SILBERBERG. *Process of dyeing.*

Cotton fabric is first immersed in boiling water, then in a solution of oxalate of chromium and a solution of caustic soda, and then washed and dyed with an aniline dye in the usual manner.

320,821—June 23, 1885. R. SILBERBERG. *Mordant.*

A mordant for aniline dyes consisting of a mixture of a solution of oxalate of chromium and a solution of caustic soda.

320,963—June 30, 1885. O. PRINZ. *Mordant.*

Process of producing soluble antimony compounds consists in decomposing sugar or equivalent carbon hydrates by alkaline bodies, with or without the assistance of oxidizing agents such as a current of air and metallic oxides, either or both, acidulating the solution, and then treating the same with an antimony compound.

328,464,—October 20, 1885. M. CONRAD. *Mordant.*

A compound of laevulinic acid (beta-acetyl-propionic acid), oil emulsion, a thickening—such as starch and acetic acid—and a solution of tannic acid.

339,778—April 13, 1886. C. HUGGENBERG. *Process of treating silk fiber.*

Silk threads are subjected to the action of a solution of a suitable tin salt, and then to a solution of tungstate of soda.

341,294—May 4, 1886. C. N. WAITE. *Mordant.*

An antimonious oxide dissolved in lactic acid, wholly or partially neutralized by an alkali, for use on cotton fabrics.

347,315—August 17, 1886. V. G. BLOEDE. *Process of improving the finish and durability of fabrics for window shades, etc.*

Fabrics sized with starch, or a mixture of starch, clay, and pigments, are impregnated, after sizing and coloring, with a solution of waxy or resinous matter in a volatile hydrocarbon.

352,236—November 9, 1886. B. FINKELSTEIN. *Process of mordanting.*

Vegetable fibers and fabrics impregnated or printed with tannin are mordanted with antimony by treating same with antimony oxalate suspended in water.

371,498—October 11, 1887. L. GRAISSOT. *Dressing silk.*

The effect of shrinkage is produced on fabrics containing silk by subjecting them to the action of a bath of chloride of zinc and drying in a tepid chamber. They may be then subjected to the action of a solution of carbonate of potash and finally boiled with soap.

392,659—November 13, 1888. C. T. BAZIN. *Mordant for dyeing.*

For indigo dyeing a preliminary bath is used consisting of carbonaceous material, as 25 pounds of lampblack or charcoal suspended in a saccharine sirup, as 2 gallons of molasses.

398,564—February 26, 1889. W. J. WILLIAMS. *Mordant.*

Fibers and fabrics are subjected to the action of trisodium phosphate to fix colors and prevent rust and crocking.

409,819—August 27, 1889. J. BRACEWELL. *Aniline-black discharge.*

The cloth is treated with the solution of the aniline-black color, dried to a moist state by steam or atmospheric heat above 32° C., the drying completed at a temperature below 32° C., and an alkaline discharge printed in patterns before the oxidation of the aniline color.

418,153—December 31, 1889. F. BAYER. *Process of fixing azo dyes.*

Goods of animal or vegetable fiber, dyed or printed in the usual way with the substantive cotton coloring matters, are fixed by boiling with a solution of a metallic salt.

421,847—February 18, 1890. C. WACHENDORFF. *Mordant.*

Chromium fluoride is used as a fixing agent in dyeing and printing fabrics and fibers.

437,295—September 30, 1890. E. O. FANKHAUSER. *Mordant.*

A mixture of castor oil, sulphuric acid, soda lye, ammonia, white soap, and extract of sumac, as a mordant for cotton or mixed yarns or fabrics.

499,687—June 13, 1893. W. T. WHITEHEAD. *Resist-mordant.*

The pattern or figure is printed in a resist-mordant containing a zinc compound as the essential or active element, with or without a color, and thereafter the cloth is dyed a plain color, thereby producing a pattern contrasting with the ground.

512,264—January 9, 1894. O. P. AMEND. *Process of mordanting fabrics.*

The fiber is first treated with a cold solution of free chromic acid in the presence of another nonoxidizing acid (such as acetic or hydrochloric acid), and the prepared fiber is then treated with a solution containing one or more reducing agents, such as sodium sulphite, when the fiber is ready for the color.

530,202—December 4, 1894. R. H. PICKLES. *Mordant.*

A mordant consisting of a solution of a salt of aluminum derived from sugar hydrated lime and a sulphate of alumina, the sugar and the metal being combined in almost equal proportions, and having the formula $C_{12}H_{22}O_{11}Al_2(OH)_6$. Process of preparing a metallic sucrate (of aluminum, iron, or chromium) consists in adding a sulphate of the metal to a solution of sucrate of an alkaline earth metal, thereby precipitating a sulphate of the alkaline earth metal, and separating the solution of the metallic sucrate.

549,257—November 5, 1895. C. RIS-KUMMER. *Process of treating raw silk.*

Raw silk having an insoluble sericin coating; produced by treating the raw silk with an aldehyde of the fatty series, such as formaldehyde, either in gaseous form or in solution.

568,344—September 29, 1896. A. GANSWINDT. *Mordanting textile fabrics.*

Cotton or other vegetable textile fibers are mordanted with lactate of zinc and subsequently dyed.

583,298—May 25, 1897. V. G. BLOEDE. *Process of dyeing.*

The yarn or fabric is treated with a starch containing a salt or salts, the base of which possesses the power of rendering the starch insoluble when the acid of combination is withdrawn (salts of lime, barium, iron, lead, etc.), then treating with an alkali or otherwise to extract part or all of the acid of combination and make the starch insoluble.

583,725—June 1, 1897. A. BIERMANN. *Process of weighting silks.*

The material is first treated in a stannic-chloride bath of 25° to 30° Baumé, the superfluous chloride of tin being removed; then with a soluble phosphate such as sodium phosphate dissolved in a warm bath and again washed; then treated in a warm bath of aluminum sulphate; then passed through a warm bath containing a solution (3° to 5° Baumé) of a silicate, such as sodium silicate, and finally washed and dried.

586,750—July 20, 1897. J. WEISS. *Printing and mercerizing cotton.*

Crêpe-like patterns or effects are produced on vegetable fibers or fabrics by impregnating the same with a caustic-alkali solution and then printing with a neutralizing substance, such as acetic acid, with or without dyestuffs, before the caustic alkali has commenced to act.

596,464—December 28, 1897. C. TUBBE. *Process of mercerizing.*

Vegetable tissues are padded with a mixture of alkaline lyes and collodial agents (such as British gum, sodium aluminate, etc.), then subjected to pressure, then rolled up to exclude the air, and lastly washed.

597,107—January 11, 1898. C. DREHLER. *Process of mordanting.*

A mordant of antimony oxide combined with acid lactate of calcium, produced by forming a bath of antimony oxide and acid calcium lactate, with which fibers treated with tannin substances are mordanted.

597,401—January 18, 1898. C. DREHER. *Process of mordanting wool.*

Wool and other animal fibers are treated in a lye comprising lactic acid, bichromate of potash, and sulphuric acid, in about the proportions of 2.65 kilos lactic acid, 1.35 kilos bichromate of potash, and 0.9 kilo sulphuric acid, yielding a complete reduction of the potassium bichromate.

600,826—March 15, 1898. R. THOMAS AND E. PREVOST. *Process of mercerizing under tension.*

Vegetable fiber is stretched, then subjected to the action of a mercerizing fluid until it assumes a parchment-like appearance, next subjected to a greater tension while under the action of the mercerizing fluid until a peculiar silky luster appears, and maintained under tension while washing or otherwise removing the mercerizing fluid.

600,827—March 15, 1898. R. THOMAS AND E. PREVOST. *Process of mercerizing under tension.*

The fiber is subjected to the action of s mercerizing fluid without tension, and then during the mercerizing action, after the fiber is wetted and before the removal or neutralization of the fluid, the material is subjected to a stretching action sufficient to produce a silky luster and prevent shrinkage. Vegetable fibers mixed with animal fibers are mercerized at a low temperature, about zero centigrade, in like manner, the fluid being of such a degree of dilution as to be without mercerizing effect on vegetable fiber at ordinary temperature and without deleterious action upon the animal fiber.

601,673—April 5, 1898. F. J. OAKES. *Process of mordanting.*

Fiber or fabric is first subjected to a solution of tannic acid and afterwards to a bichromate or chromic-acid bath, thus fitting it for dyeing with any desired color.

608,231—August 2, 1898. H. SEIDEL. *Mordant from sulfite-cellulose lyes.*

It consists of a solution of a salt of a metal of the alkalis or alkaline earths, with or without a mineral acid, and a sulpho-derivative of lignin- or sulphite-cellulose lye which contains said derivative can be added, either decolored and freed from calcium compounds or otherwise.

609,131—August 16, 1898. G. WENDLER. *Mordant.*

A composition of commercial sulphuric acid, 60 parts; calcined alkaline sulphate, such as sodium sulphate, 100 parts; and boracic acid, 15 parts.

615,045—November 29, 1898. E. PREVOST. *Process of mercerizing.*

Vegetable fibers and fabrics are mercerized, and during the process simultaneously subjected to tension and compression.

621,477—March 21, 1899. J. SCHNEIDER. *Process of mercerizing.*

The material is first treated with benzine to dissolve the oily matters, then with a strong (30 per cent) alkaline solution, then stretched, and washed while stretched.

629,780—August 1, 1899. P. DOSNE. *Process of mercerizing.*

Moiré effects are produced on striped fabrics of vegetable fiber by printing the fabric with a resist in stripes, distorting or pulling the fabric alternately from right to left and left to right during the resist printing, and then mercerizing the fabric.

643,923—February 20, 1900. E. UNGNAD. *Process of treating fibers, etc., to imitate silk.*

Vegetable fibers and fabrics after they have been soaked in an alkaline solution of silk are subjected to the action of carbonic acid, which combines with the alkali of the silk solution, forming an alkaline carbonate, and deposits the silk on the fiber.

646,760—April 3, 1900. A. F. POIRRIER. *Process of mordanting.*

Colors obtained from substantive sulphur coloring matters are fixed by subjecting the dyed material to the action of a bath of chloride of copper, with or without bichromate of potash.

GROUP XII.—TANNING.

NATURAL.

836—July 12, 1838. A. A. HAYES. *Improvement in the process for extracting tannin from bark.*

Bark in water is treated with a solution of alkaline salts of either ammonia, potash, soda, or lithia, with strong agitation, the quantity being sufficient to neutralize four-fifths of the acid naturally contained in the bark.

4,007—April 22, 1845. G. C. CLOSE AND E. FIELD. *Improvement in separating tannin and coloring matter in quercitron bark.*

A decoction of quercitron bark is partially evaporated, the coloring matter settled, and the astringent liquor drawn off and used for tanning or evaporated to an extract.

12,139—January 2, 1855. O. RICH. *Improvement in processes for extracting tannin from leather.*

Leather, washed and chopped into small pieces, is digested in a caustic alkali of ammonia, potash, or soda to extract the tannin, then subjected to pressure and the liquor acidulated with sulphuric, muriatic, or acetic acid, and used for tanning. The scraps are washed, digested in dilute acid to remove coloring matter, the acid neutralized, and are then converted into glue and manure.

34,873—April 8, 1862. J. BRAINERD AND W. H. BURRIDGE. (*Reissue: 2,523—March 19, 1867.*) *Improved process of extracting the strength of bark for tanning and other purposes.*

The material is introduced, in successive charges, into the bottom of a leaching column and the exhausted material is discharged at the top, the water or liquid being introduced at the top and filtering downward: applicable also to filter material.

41,782—March 1, 1864. S. W. PINGREE. (*Reissue: 1,922—March 28, 1865.*) *Improvement in extracting tan bark.*

The bark is first swelled with water or weak tan liquor and heated with steam, and afterwards steeped with cold water or weak tan liquor.

64,321—April 30, 1867. B. IRVING. *Improved process of concentrating the extract of bark for tanning and other purposes.*

The bark solution is concentrated by continuous distillation *in vacuo*, using a flat worm or evaporating tables.

64,323—April 30, 1867. B. IRVING. *Improved process for obtaining the extract of bark for tanning and other purposes.*

The bark fiber is disintegrated by means of heated pressure rollers and water baths, acting alternately, in a continuous operation, in lieu of grinding.

68,335—September 3, 1867. A. APPLEBY. *Improved mode of preparing tan bark for use.*

Bark is prepared for transportation by first steaming it to make it pliable, and then flattening it and removing the ross by running it through a planing machine.

75,608—March 17, 1868. G. WARREN. *Improvement in extracting tannin from bark.*

The bark is subjected to the successive steps of steaming, soaking, and pressing between rolls, the series of steps being repeated several times, and the pressings kept separate from each other.

81,687—September 1, 1868. G. BOSSIÈRE. *Improvement in decolorizing tannin-liquid.*

Tannin juices are decolorized by the addition of a glue made from refuse clippings or scraps, or by all-gelatinc glues dissolved in from fifteen to twenty parts of water. Acetate of lead dissolved in acidulated water and also kaolin decolorize colored tannin.

82,121—September 15, 1868. T. W. JOHNSON. *Improvement in extracting tan bark.*

The bark is softened in chips, passed through rollers into a saturating tank where it is exposed to the action of beaters, then elevated and passed through a series of leaches and repeatedly washed.

96,345—November 2, 1869. J. PICKLES. *Improved solid or dry extract of bark for tanning, etc.*

Dry or powdered tannin extract, the product resulting from concentrating the liquid extract and reducing it to a dry state.

96,365—November 2, 1869. B. C. TILGHMAN. *Improvement in making tanning and dyeing extracts.*

The vegetable material, bark, roots, wood, etc., is digested with a solution of sulphurous acid, in water, with or without the addition of sulphites, as of lime, and either in closed vessels with high temperatures and pressure or in open vessels with temperature not exceeding 100° C.

117,455—July 25, 1871. N. C. PLATT. *Improvement in processes of separating tannin from solutions.*

Tannic acid is obtained by treating a bark infusion or solution with a solution of common salt or other saline crystalline substance.

174,110—February 29, 1876. E. BRADLEY. *Improvement in bleaching extract of hemlock bark.*

Hemlock-bark liquor is bleached by bringing same in intimate contact with sulphurous acid, as by forcing it up through the liquor.

178,919—June 20, 1876. J. FOLEY. *Improvement in processes for treating tannin juices.*

Tannin juices, aqueous solutions of tannin, and concentrated tannin extracts are bleached and prevented from souring by incorporating therewith sulphites, bisulphites, and double sulphites of sodium, calcium, potassium, aluminum, and ammonium, in the form of solid salts or as solutions.

182,965—October 3, 1876. J. SHERMAN, JR. *Improvement in preparing tan bark for transportation.*

The bark is dried, ground, and compressed sufficiently to crush the cells, and also to form it into bricks.

184,638—November 21, 1876. R. LOERCHER. *Improvement in preparing tan bark for transportation.*

A block of compressed ground tan bark coated with a solution of tan bark.

193,443—July 24, 1877. J. FOLEY. *Improvement in tanning solutions.*

Ground bark is leached with water having bisulphite of lime in solution.

198,478—December 25, 1877. I. WELLS. *Improvement in extracts for tanning leather.*

May-weed (*Athemis cotula*) is cut up, ground, and pressed; then steamed and again pressed: the mass is then subjected to air suction, treated with diluted sulphuric acid, and the mass removed from the liquid, which latter is subjected to air exposure to remove trace of acid, and the three liquid products are then mingled.

230,398—July 27, 1880. E. BRADLEY. *Purifying extracts of bark.*

The leached extract is condensed by evaporation to about 10° Baumé, rapidly cooled, and then flowed through a series of tanks overflowing into one another, wherein the matter set free by the action of cooling is precipitated.

231,489—August 24, 1880. J. HOLTZ. *Obtaining tannic acid.*
See Group I, Acids, Tannic.

235,923—December 28, 1880. H. L. WILCOX. *Tanning extract.*

A solid block of the "tannin plant"—the *Polygonum amphibium*—consisting of a mixture—say of 50 pounds—of the freshly ground plant and a concentrated extract from 2,000 pounds of the same plant.

258,573—May 30, 1882. P. GONDOLO. *Process of manufacturing tannin extracts.*

The vegetable matter is macerated in a slightly acidulated bath, a coagulant or absorbent, such as blood, is added, then an alkali or an alkaline salt and a further quantity of coagulant or absorbent, and finally the coagulant or absorbent with the coloring matter and alkaline salts is precipitated by means of sulphuric acid.

258,574—May 30, 1882. P. GONDOLO. *Process of and apparatus for the manufacture of tannin extracts.*

The tannin material is first macerated in a bath containing a salt of sulphurousacid; sulphuric acid is then added to the resulting solution, and it is clarified with blood or other coagulant.

283,881—August 28, 1883. P. GONDOLO. *Process of clarifying tannin extracts.*

Blood, or albumen, is added to the tannin extract at a temperature below that at which it coagulates; the coagulant is diffused through the extract at such temperature, and then the temperature of the mixture is raised and the coloring matter and salts are caught by and precipitated with the coagulant.

284,738—September 11, 1883. B. HOLBROOK. *Preparing tan bark.*

The dry bark is crushed and then passed between rolls under heavy pressure, reducing it to thin flakes.

302,105—July 15, 1884. E. L. P. & G. C. COËZ. *Process of making tanning extracts.*

Tannin extracts are decolorized by first adding oxalic acid, 1 gram to every hundred liters of juice, then introducing alumina in the proportion of about 250 grams per hundred liters of juice and per degree of intensity, with violent agitation and filtration. To produce tannic acid the proportion of alumina is quadrupled.

313,177—March 3, 1885. T. F. COLIN. *Manufacture of tanning extract.*

Bark liquor is evaporated by passing carbonic-acid and sulphurous-acid gases and steam through the liquor in a vacuum pan, then shutting off the steam, and turning it on only at intervals when the liquor becomes too thick to permit the gases to pass freely through it.

351,540—October 26, 1886. E. TAVERNIER. *Process of extracting tannin from wood.*

The heavier and lighter portions of a tannin extract are separated by centrifugal action.

357,129—February 1, 1887. A. MORAND. *Manufacture of tannin extract from wood.*

The wood is cut into thin slices across the grain, broken into granules by a pneumatic blast in a conduit, and leached by percolation. Weaker solutions at successive higher temperatures are used as the wood becomes spent.

365,087—June 21, 1887. A. MORAND. *Process of and apparatus for clarifying extracts.*

Crude tannin extracts have mingled therewith a purifying agent or color absorbent, as caseine, and heated, and then pumped, with the substance in suspension, through a dense filtering fabric.

376,345—January 10, 1888. H. M. RAU. *Manufacture of tannin extracts.*

Tannin liquors are clarified and decolorized by treating with hydrosulphurous acid—which may be produced by the addition of zinc dust and a concentrated solution of bisulphite of soda with agitation in a closed vessel—and filtering.

404,440—June 4, 1889. L. SAARBACH. *Process of purifying tannic extracts.*

The extract, heated to about 60° C., is mixed with acetate of lead without the addition of any acid—125 grams per 100 liters of juice and per degree of density—the precipitate separated, and the solution then treated with acids, preferably oxalic acid, 10 grams per 100 liters per degree Baumé, thereby obtaining a further precipitate.

409,876—August 27, 1889. E. F. SMITH. *Process of leaching tan bark.*

Ground bark is delivered into a tank of fluid and intermixed, the intermixed bark and fluid conveyed into and through a steam box, and thence to the top of the leach.

462,694—November 10, 1891. A. FOELSING. *Process of purifying tannin solutions by electrolysis.*

See Group X, Electro-chemistry.

480,376—August 9, 1892. W. C. TIFFANY. *Process of making tannin extracts.*

Canaigre root, *Rumex hymenosepalum torr*, is comminuted or macerated, subjected to a bath of water at 60° C. or less, and the extract evaporated.

483,141—September 27, 1892. G. DELVAUX. *Process of purifying tannic extracts.*

Tannic extracts are decolored and clarified by the addition of a compound of strontium, as 6 kilograms of crystalline hydrate of strontium to 1,000 liters of tanning liquor marking above 2.5° Baumé.

495,768—April 18, 1893. P. T. AUSTEN. *Process of making solid extract of sumac, hemlock, and other tanning agents.*

A brittle solid extract of sumac, produced by adding an alkaline nitrite to a liquid extract of sumacs, heated to about 50° C.—say 5 per cent of sodium nitrite—allowing the reaction to take place, and evaporating to dryness.

510,132—December 5, 1893. O. C. HAGEMANN. *Process of separating tannin from other bodies.*

Tannin is separated from other bodies by the use of amyl alcohol as a solvent, the tannin being subsequently separated from the solvent by the addition of benzine or an equivalent body.

517,626—April 3, 1894. B. REINUS. *Process of purifying tannic acid.*

A solution of tannic acid is treated with acetate of lead to precipitate the impurities, the precipitate separated by filtration, the filtered solution again treated with acetate of lead in excess to precipitate tannate of lead, and then the tannate of lead is subjected to the action of oxalic acid which forms an insoluble compound with lead, and the pure and concentrated tannic acid is filtered off.

531,752—January 1, 1895. H. SCHWEITZER. *Process of extracting tannin.*

Raw material containing tannin is treated with acetate of amyl, and the tannin then precipitated from the solvent by the action of benzine or other organic solvent.

571,635—November 17, 1896. J. S. ADRIANCE. *Process of decolorizing tannin extract.*

A solution of basic acetate of lead—acetate of lead, litharge, and water—is added to liquid extracts to precipitate the coloring matter and the clear liquid is drawn off after settling, and evaporated.

578,334—March 9, 1897. M. HÖNIG. *Making tannin extracts.*

Tannin is extracted from sulphite cellulose lyes by neutralizing with lime, clarifying, concentrating to from 15° to 16° Baumé, converting the lime into an insoluble compound by means of sulphuric acid, eliminating from the lye the free volatile acids by heat, filtering, and concentrating the filtrate to from 28° to 30° Baumé.

601,170—March 22, 1898. H. M. RAU. *Process of extracting tannic acid.*

Tannic acid, with other ingredients, is extracted from sumac leaves by acetone at low temperatures, that is, below the boiling point of acetone; then the acetone solution is evaporated, the extract secured in a dry mass, and the pure tannic acid extracted therefrom by water.

614,929—November 29, 1898. G. D. BURTON. *Process of tanning hides or skins of animals.*

See Group X, Electro-chemistry.

616,882—January 3, 1899. J. BLAIR. *Process of making tannin extracts.*

Leaves of coniferous trees are steamed in a weak solution of potassium permanganate and an alkali, the resulting solution is clarified by a weak acidulated solution precipitating the resinous matters, and then evaporated.

626,100—May 30, 1899. P. G. SANFORD. *Method of making tanning extracts.*

To clarify, bleach, or decolorize tanning liquids, albuminous matter is subjected to the action of alkaline fluoride and dialyzed; the tanning liquid is then subjected to the action of this product and dialyzed, and the albumen finally coagulated.

642,081—January 30, 1900. G. D. BURTON. *Process of unhairing animal hides or skins.*

See Group X, Electro-chemistry.

ARTIFICIAL, INORGANIC.

219,637—September 16, 1879. C. S. GORMAN. *Improvement in the manufacture of chromates of potash and soda.*

Chrome ore mixed with lime and carbonate of potash is calcined, the charge cooled and a further quantity added, say from 10 to 20 per cent of carbonate of potash, or its equivalent alkaline carbonate, and the mass reheated at from 425° to 650° C.

234,145—November 9, 1880. H. PEMBERTON. *Manufacture of bichromates.*

Carbonic acid gas is passed into a calcined mixture of chrome ore, bases, and salts to convert the insoluble compounds of chromic acid into soluble chromates.

279,431—June 12, 1883. E. P. POTTER AND W. H. HIGGIN. *Manufacture of bichromate of soda.*

A mixture of sulphate of soda, chrome ore, and lime, in proper proportions, is furnaced, lixiviated, and the monochromate of soda solution formed treated with hydrochloric acid in exactly sufficient quantity to change the chromate into a bichromate. The sodic sulphate present is separated by precipitating with calcic or baric chloride, the solution evaporated to a pasty mass, the sodic chloride crystals removed and washed, adding the resulting liquor to the original mass, and finally drying the mass at a temperature a little above that of boiling water. The monochromate of soda solution may be treated with sulphuric acid and the sodic sulphate formed converted into chloride by the addition of chloride of calcium, strontium, or barium. The removed sodic chloride crystals are decomposed with sulphuric acid in a salt-cake furnace and the product used for the decomposition of the chrome ore in place of sodium sulphate.

307,994—November 11, 1884. W. SIMON. *Manufacture of bichromate of soda.*

A solution of neutral chromate of soda is evaporated to dryness, decomposed in this condition by a mineral acid, as sulphuric acid, and the concentrated solution of bichromate of soda is then mechanically separated from the anhydrous lye product in a centrifugal machine.

329,138—October 27, 1885. W. J. CHRYSTAL. *Manufacture of chromates and bichromates.*

Chromates and bichromates of potash and ammonia are produced from the chromate or bichromate of soda by decomposition with the sulphate of potash or the sulphate of ammonia, respectively.

342,578—May 25, 1886. W. J. CHRYSTAL. *Manufacture of bichromate of soda.*

Chrome ore is furnaced with lime and a soda salt, the mass lixiviated with an acid solution of a soda salt and washed with water, and the solution and washings treated with an acid to convert the neutral or monochromate into bichromate of soda. The solution is then concentrated to 150° to 180° Twaddle to eliminate the sulphate of soda, which is separated, and the concentration continued and the pure bichromate obtained.

342,646—May 25, 1886. W. SIMON. *Manufacture of bichromate of potash.*

Bichromate of sodium is decomposed by chloride of potassium, or chromate of sodium by chloride of potassium and hydrochloric acid.

342,647—May 25, 1886. W. SIMON. *Process of manufacturing ammonium bichromate.*

Sodium bichromate is converted into ammonium-sodium chromate by the addition of ammonia to a solution of the same, and this salt is decomposed into sodium chloride and ammonium bichromate by the addition of hydrochloric acid.

366,036—July 5, 1887. W. SIMON. *Process of making potassium bichromate.*

Bichromate of sodium is decomposed by sulphate of potassium.

442,109—December 9, 1890. W. J. A. DONALD. *Process of making chromates.*

The insoluble residue resulting from the ordinary manufacture of chromates is calcined, pulverized, and mixed with chrome ore, lime, and an aqueous solution of the salt to be produced, oxidized in a furnace, and lixiviated to extract the soluble chromates, and the residue again used as before.

463,841—November 24, 1891. J. MASSIGNON AND E. WATEL. *Manufacture of chromates and bichromates.*

A mixture of pulverized chrome mineral with carbonate of lime and chloride of calcium is heated to convert the carbonate of lime into caustic lime, and the mineral oxidized at a low temperature. This oxidated mixture can serve for the manufacture of chromates and bichromates, and of chromic and chlorochromic acids. To make chromate of lead the chloride of calcium is first washed out and subsequently the chromate of lime, which latter is precipitated by a lead salt.

527,563—October 16, 1894. E. A. STARKE. *Process of making ammonium bichromate.*

See Group XIV, Explosives, Nitro-substitution Compounds.

539,029—May 14, 1895. M. W. BEYLIKGY. *Process of making alkaline bichromates.*

A double chromate of lime and the alkali formed by calcining a mixture of chrome ore, lime, and an oxygenated compound of the alkali metal, is lixiviated and the liquor passed through a filter saturated with an insoluble fatty acid, such as oleic acid, to remove the lime and leave the alkaline bicarbonate in solution. The lime is removed from the filter by dilute hydrochloric acid.

574,391—January 5, 1897. G. H. CLAMER. *Process of making bichromates.*

To make alkaline chromates, powdered chrome ore and an alkaline nitrate are fused together, cooled and powdered, then mixed with a caustic alkali and sufficient alkali nitrate to complete the oxidation of the ore, the caustic alkali and alkali nitrate being first fused together, and the powdered ore and nitrate gradually added to the fused mass with stirring.

599,197—February 15, 1898. S. P. SADTLER. *Process of making chromates.*

Bichromates or chromates are regenerated from waste liquors—as those of primary batteries—by neutralizing the free acid with milk of lime and oxidizing with bleaching powder. The solution may then be filtered, concentrated, and crystallized.

620,935—March 14, 1899. H. J. KREBS. *Method of recovering chromates from tan liquor.*

The dissolved impurities are first precipitated, as by caustic lime, and removed, and the chromic acid is then precipitated as a chromate of lead or barium. The dissolved lime may be precipitated as a sulphate, oxalate, or carbonate prior to filtration or decantation.

GROUP XIII—PAINTS, COLORS, AND VARNISHES.

PIGMENTS.

2,910—January 16, 1843. R. A. TILGHMAN. *Improvement in making chromic yellow.*

Carbonate of lead is mixed or ground in a solution of chromate or bichromate of potassa, or other soluble chromate or bichromate, the solution being in excess.

6,327—April 17, 1849. T. SCHWARTZ. *Improvement in the manufacture of paris green.*

A hot saturated solution is formed of white arsenic, and sodium carbonate, and blue vitriol is dissolved therein, the compound solution being then cooled with constant stirring in a shallow vat, and reduced to a homogeneous arsenite of copper. Strong vinegar is then added and the liquor cooled to 37° C., water being added to keep the sulphate of soda in solution. After successive settlings and stirrings the product is collected and dried. The vitriol may be dissolved with the arsenic instead of the soda.

62,097—February 12, 1867. P. H. VANDER WEYDE. *Improvement in the manufacture of white lead.*

See Group VII, Wood Distillation.

75,861—March 24, 1868. W. W. CHIPMAN. *Improvement in the manufacture of whiting and paris-white.*

Limestone is burned, slacked, and recarbonized with carbonic-acid gas.

87,270—February 23, 1869. A. LEYKAUF. *Improvement in the manufacture of colors.*

See Group XI, Dyestuffs, Artificial, Inorganic.

88,291—March 30, 1869. E. HARRSCH. *Improvement in the manufacture of colors and pigments.*

See Group XI, Dyestuffs, Artificial, Inorganic.

90,359—May 25, 1869. E. HARRSCH. *Improvement in the manufacture of colors.*

Ores of zinc are dissolved in nitric, nitro-muriatic, or muriatic acids, and the solution mixed with soluble salts of baryta, or carbonate of baryta, or the same of strontia, or lime, or equivalents. Colors are then precipitated with various reagents.

93,817—August 17, 1869. L. D. GALE AND I. M. CATTMAN. *Improvement in the manufacture of sugar of lead and acetic acid.*

See Group VII, Wood Distillation.

138,685—May 6, 1873. F. OSGOOD. *Improvement in treating zinc dross and skimmings for the manufacture of pigments.*

Oxide of zinc or other pigments are produced from galvanizing dross or skimmings, by roasting at a nonfluxing heat, mixing with coal and subjecting to heat with a blast of air.

292,119—January 15, 1884. J. K. KESSLER. *Process of making white lead.*

See Group X, Electro-chemistry.

292,753—January 29, 1884. J. K. KESSLER. *Process of making sponge-lead.*

See Group X, Electro-chemistry.

305,389—September 16, 1884. C. E. HORE. *Process of making chrome red.*

Chrome red is produced by boiling a mixture of sublimed lead, 500 pounds, a solution of 90 pounds of bichromate of potash, and an alkali, such as soda ash, 38 pounds. A deeper red is produced by doubling the quantity of bichromate and alkali.

305,390—September 16, 1884. C. E. HORE. *Process of making lemon chrome.*

Lemon chrome is produced by mixing sublimed lead with an acid, such as nitric acid, then adding bichromate or a neutral chromate of potash.

305,391—September 16, 1884. C. E. HORE. *Process of making chrome yellow.*

Sublimed lead is mixed with a solution of bichromate of potash, boiled, and the insoluble coloring matter separated from the soluble products.

414,935—November 12, 1889. T. D. BOTTOME. *Manufacture of white lead.*

See Group X, Electro-chemistry.

431,026—July 1, 1890. M. ALSBERG. *Process of manufacturing red lead.*

Lead nitrate is incorporated into the oxide or carbonate of lead and the mixture heated sufficiently high to drive off any contained water and then decompose the lead nitrate and produce minium.

442,661—December 16, 1890. T. D. BOTTOME. *Process of desilverizing lead by electrolysis.*

See Group X, Electro-chemistry.

451,487—May 5, 1891. J. C. JESSUP. *Process of making paris green.*

A solution of sulphate of copper is first prepared by subjecting copper residue, or other crude material containing copper, to the action of sulphuric acid, and the proper quantities of arsenite of soda and acetic acid are then introduced directly into the solution.

457,028—August 4, 1891. F. W. IHNE. *Process of making chrome yellow.*

Pulverized galena is dissolved with nitric acid, the sulphur removed, and a solution of bichromate of potassa, neutral chromate of potassa or chromate of soda added, whereby chrome yellow is precipitated and a saltpeter-lye is formed, which is drawn off and condensed to form nitrate of potassium or saltpeter.

459,946—September 22, 1891. D. V. KYTE. *Manufacture of white lead.*

See Group X, Electro-chemistry.

477,733—June 28, 1892. J. BLAIR. *Process of making white pigments.*

See Group X, Electro-chemistry.

496,109—April 25, 1893. A. B. BROWNE. *Process of manufacturing white lead.*

See Group X, Electro-chemistry.

503,429—August 15, 1893. F. M. & C. H. M. LYTE. *Process of producing chlorine and purifying lead.*

See Group X, Electro-chemistry.

524,470—August 14, 1894. F. L. SLOCUM. *Process of making green oxid of chromium.*

A powdered chromate is moistened with hydrochloric acid and then 10 per cent of powdered carbon is mixed therewith and the mass again wet with hydrochloric acid and brought to a paste (an explosive mixture results if mixed dry), subjected to heat without air, and then further moistened with hydrochloric acid. The resultant chloride and any remaining chromate is dissolved out with boiling water.

538,998—May 7, 1895. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing chromate of lead.*

See Group X, Electro-chemistry.

554,718—February 18, 1896. R. McKENZIE. *Process of producing lakes or coloring compounds by electrolysis.*

See Group X, Electro-chemistry.

555,232—February 25, 1896. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing white lead by electrolysis.*

See Group X, Electro-chemistry.

560,518—May 19, 1896. J. METRUEIS. *Treatment of sodium chloride.*

See Group X, Electro-chemistry.

563,553—July 7, 1896. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing white lead.*

See Group X, Electro-chemistry.

563,554—July 7, 1896. A. B. BROWNE AND E. D. CHAPLIN. *Process of manufacturing oxids of lead.*

See Group X, Electro-chemistry.

563,555—July 7, 1896. A. B. BROWNE. *Manufacture of white lead.*

See Group X, Electro-chemistry.

588,883—August 24, 1897. P. G. SALOM. *Process of making litharge or protoxid of lead from lead ore.*

See Group X, Electro-chemistry.

589,801—September 7, 1897. H. C. WOLTERECK. *Process of manufacturing white lead.*

See Group X, Electro-chemistry.

602,872—April 26, 1898. J. W. RICHARDS AND C. W. ROEPPER. *Process of producing chemical compounds by electrolysis.*

See Group X, Electro-chemistry.

602,873—April 26, 1898. J. W. RICHARDS AND C. W. ROEPPER. *Process of electrolytically manufacturing metallic sulfids.*

See Group X, Electro-chemistry.

625,918—May 30, 1899. E. BAILEY, G. R. COX, AND W. T. HEY. *Process of and apparatus for producing white lead.*

See Group X, Electro-chemistry.

626,331—June 6, 1899. C. LUCKOW. *Process of producing neutral chromate of lead.*

See Group X, Electro-chemistry.

627,002—June 13, 1899. C. LUCKOW. *Process of producing white lead by means of electrolysis.*

See Group X, Electro-chemistry.

627,266—June 20, 1899. C. LUCKOW. *Process of producing acid chromate of lead.*

See Group X, Electro-chemistry.

631,939—August 29, 1899. H. C. WOLTERECK. *Process of manufacturing white lead or other pigments by electrolysis.*

See Group X, Electro-chemistry.

644,779—March 6, 1900. J. W. RICHARDS AND C. W. ROEPPER. *Process of manufacturing metallic carbonates by electrolysis.*

See Group X, Electro-chemistry.

651,306—June 12, 1900. E. A. G. STREET. *Production of chromium oxid.*

See Group X, Electro-chemistry.

PAINTS.

1,676—July 10, 1840. F. G. SPILSBURY, M. F. C. D. CORBAUX, AND A. S. BYRNE. *Improvement in the mode of applying distemper colors having albumen or gelatine for their vehicle, so as to render the same more durable, and preserving the same when not wanted for immediate use.*

Soluble vehicles, as gelatine or albumen, are used for paints, which vehicles, by an after application of chemical agents, as alum, are rendered insoluble in water. Soluble salts of zinc, manganese, and lead are combined with gelatine to preserve it. Pigments may be prepared with resinous matters or wax dissolved in an alkaline lye or solution of borax. Vegetable products, as flour, may form the base mixed with pigments, the paint to be fixed after application with a solution of silicate of potassa or of soda.

2,252—September 11, 1841. J. RAND. *Improvement in preserving paints and other fluids.*

They are confined in closed metallic vessels constructed to collapse with slight pressure and force out the material.

10,714—April 20, 1886. A. KISSEL. *Hardening resins.*

See Group XV, Rubber and Rubber Substitutes.

197,433—November 20, 1877. J. F. WALTER, Jr. *Improvement in putting up calcimining materials.*

The liquid material, in a bottle, is placed within and surrounded by the pulverized pigment or body material.

200,228—February 12, 1878. G. I. STEVENS. *Improvement in distemper paints.*

The base, glue, and coloring pigment are ground together with as little water as possible, compressed into a cake, and dried; ready for use by the addition of water.

221,882—November 18, 1879. W. H. P. WEBB. *Improvement in paint for filling the seams of vessels.*

244,788—July 26, 1881. L. BECKERS. *Treating caoutchouc with hydrocarbon oils.*

See Group XV, Rubber and Rubber Substitutes.

A compound consisting of a quick-drying liquid-gum vehicle composed of resin and naphtha, combined with an earthy base, as red oxide of iron, and a hydraulic cement.

250,302—November 29, 1881. H. R. TOYE. *Process of preparing colors for ornamenting fabrics.*

Colors in the form of powders, for ornamenting fabrics, are produced by forming a pasty mixture of pulverized starch, powdered talc, and acid, adding colors to form the tint desired, drying by a moderate heat, and sifting or pulverzing.

391,927—October 30, 1888. J. A. TITZEL. *Rubber compound or mixture.*

See Group XV, Rubber and Rubber Substitutes.

VARNISHES.

146,387—January 13, 1874. P. FINDLEY. *Improvement in the preparation and treatment of india-rubber varnish.*

See Group XV, Rubber and Rubber Substitutes.

501,578—July 18, 1893. H. PFANNE. *Method of manufacturing varnish and apparatus therefor.*

See Group X, Electro-chemistry.

GROUP XIV—EXPLOSIVES.

GUNPOWDER, INCLUDING BLASTING POWDER.

669—April 2, 1838. R. I. L. WITTY. *Improvement in the manufacture of gunpowder.*

Bituminous coal is used in the place of charcoal, with sulphur and niter.

8,734—February 17, 1852. E. CALLOW. *Improvement in explosive compounds.*

The compound consists of 5 parts of chlorate or oxymuriate of potash, 2 parts of orpiment or red sulphuret of arsenic, and 1 part of ferrocyanuret or prussiate of potash.

10,260—November 22, 1853. W. SILVER, Jr. *Improvement in blasting powder.*

Unglazed powder, composed of charcoal, niter, and sulphur, is treated with potassium chlorate, as by moistening the granulated powder with a saturated solution and drying.

15,257—July 1, 1856. W. SILVER, Jr. *Improvement in blasting powder.*

The explosive compound consists of rags or paper saturated and coated with a mixture of gunpowder, potassium chlorate, and powdered calcined cork.

15,551—August 19, 1856. L. BUCHHOLTZ. *Improved blasting compound.*

A composition of saltpeter, 45 to 80 parts; charcoal, 20 to 10 parts; lycopodium, 20 to 5 parts; and white sugar, 15 to 5 parts.

16,580—February 10, 1857. E. B. DOBSON. *Improved gunpowder.*

Anthracite coal or coke, to prepare it for use in the manufacture of gunpowder, is ground to fine dust and exposed to the air, in a dry place, for twelve months.

17,291—May 12, 1857. A. MURTINEDDU. *Improved blasting powder.*

A composition of sulphur, 100 parts; saltpeter, 100 parts; sawdust. 50 parts; horse dung, 50 parts; and sodium chloride, 10 parts. Molasses, 4 parts, is added as a binder.

17,321—May 19, 1857. L. DU PONT. *Improvement in gunpowder.*

Sodium nitrate is used in the manufacture of gunpowder, which is glazed to prevent deliquescence, by rolling it in a barrel with black lead.

26,602—December 27, 1859. V. L. MAXWELL. *Improvement in the manufacture of gunpowder.*

Alcohol is employed, in the place of water, as the vehicle for uniting the particles.

32,016—April 9, 1861. W. R. THOMAS AND M. EMANUEL, Jr. *Improvement in compositions for blasting powder.*

A composition of sodium nitrate, $3\frac{1}{2}$ pounds; flower of sulphur, $1\frac{1}{2}$ pounds; ground bark, $4\frac{1}{2}$ pounds; and water, 3 quarts. The composition is well dried.

33,069—August 20, 1861. J. H. BROWN. *Improvement in preparation of granulated gunpowder to serve as charges for firearms.*

A charge is made by combining and pressing grains of gunpowder with an adhesive solution into a solid form.

34,233—January 28, 1862. T. K. ANDERSON. *Improved composition for fuse or slow-match for igniting powder under water.*

A compound consisting of niter, 8 parts; charcoal, 10 parts; sulphur, 2 parts; and sodium chloride, 1 part.

34,654—March 11, 1862. W. R. THOMAS AND M. EMANUEL, Jr. *Improved blasting powder.*

Potassium chlorate (2 pounds) is added to the composition of No. 32,016.

34,724—March 18, 1862. R. O. DOREMUS AND B. L. BUDD. *Improvement in treating gunpowder to form cartridges.*

Granulated gunpowder is compressed dry into solid shapes suitable for use as cartridges in molds. A cartridge of powder in strata of different degrees of combustibility is formed by introducing the powder into the mold in successive portions, and successively applying a diminished amount of pressure.

36,599—October 7, 1862. H. BIEBUYCK. *Improved blasting powder.*

Barium nitrate is employed in the manufacture of blasting powder, with or without potassium nitrate.

37,117—December 9, 1862. W. R. THOMAS AND M. EMANUEL, Jr. *Improved composition for blasting powder.*

A composition of sodium nitrate, sulphur, potassium chlorate, starch, and ground bark, or other absorbent carbonaceous material.

37,296—January 6, 1863. H. LEIBERT. *Improved composition for gunpowder.*

A mixture of prussiate of potash, 2 pounds; chlorate of potash, 1 pound; sodium nitrate or its equivalent, 10 pounds; sawdust or charcoal, 4 pounds; sulphate of soda, 1 pound; and sulphur, 4 pounds.

40,070—September 22, 1863. G. B. WIESTLING. *Improved gun and blasting powder.*

A composition of charcoal, sulphur, sodium nitrate, and potassium chlorate, either with or without potassium nitrate.

41,576—February 9, 1864. E. HARRISON. *Improved composition for gunpowder, etc.*

A mixture of ordinary gunpowder, $12\frac{1}{2}$ parts, and amorphous phosphorus, 1 part.

41,578—February 9, 1864. E. HARRISON. *Improved explosive composition.*

A compound of potassium chlorate, charcoal, prussiate of potash, and flour starch, with or without cyanuret of zinc.

42,037—March 22, 1864. H. HOCHSTÄTTER. *Improved gunpowder, mining powder, etc.*

A composition of charcoal, potassium chlorate, half-calcined sea grass, stone coal, and sawdust, or certain named substitutes, is formed in boiling water and dried; or mixtures of wheat flour and potassium chlorate, and stone coal and charcoal, are made in mortars, intermixed in water, pressed into blocks, rubbed through a sieve and dried.

42,056—March 22, 1864. C. M. WETHERILL. *Improvement in gunpowder, etc.*

A mixture of a suitable oxygen compound of chlorine with carbonaceous material is to be used in the proportion of 8 to 16 parts by weight of the former to 6 parts of the latter, to form either carbonic oxide or carbonic acid or a mixture of the said gases. Dextrine or other gum is to be added to form a grained powder. Peroxide of manganese facilitates the liberation of oxygen from the chlorates, and oil of vitriol is designed to act on the chlorine compound, by appropriate means, to effect the explosion of the powder in shells as on striking an object.

42,869—May 24, 1864. M. NOWAK. *Improved blasting compound.*

A composition of manganese binoxide, 23 grams (or carbon 15 grams instead); potassium chlorate, 62 grams; potassium nitrate, 31 grams; and potassium ferrocyanide, 15 grams; applied to any vegetable material, as paper, cotton waste, or sawdust.

42,913—May 24, 1864. F. A. JAECKEL. *Improved blasting powder.*

It consists of potassium nitrate, sodium nitrate, sulphur, charcoal, mineral coal, and potassio-tartrate of soda.

43,021—June 7, 1864. H. HALVORSON. *Improved explosive compound.*

An organic sulphide and a cyanide or ferrocyanide is combined with an organic deflagrating ammoniacal salt and a chloric or perchloric salts of potassa and ammonia.

44,269—September 13, 1864. H. E. DRAYSON. *Improvement in the manufacture of gunpowder.*

The saltpeter is treated to the direct and quick action of a heavy volume of steam until it is dissolved, when the sulphur and charcoal are added and thoroughly mixed, when it is ready for the incorporating mill. The mill cake, after manipulation in the incorporating mill, is passed through sieves before it becomes dry, set, or hard, and then dried and glazed.

46,275—February 7, 1865. W. G. BATES AND C. S. SMITH, EXECUTORS OF J. S. SMITH, DECEASED. *Improvement in drying and glazing gunpowder.*

Heat is applied to the drum or cylinder during the process of glazing to glaze and dry at one operation.

48,303—June 20, 1865. F. G. MURRAY. *Improvement in the manufacture of gunpowder.*

A compound of potassium chlorate, 45 parts; saltpeter, 15 parts; ground bark, 30 parts; charcoal, 8 parts; and lampblack, 2 parts; mixed in boiling water, evaporated, and dried.

50,104—September 26, 1865. L. DU PONT. *Improvement in plates for pressing gunpowder.*

The plates are made of hard or indurated rubber.

50,313—October 3, 1865. J. GALE, Jr. *Improved mode of keeping gunpowder.*

Gunpowder is mixed with a fine, dry, inexplosive powder, finer than the grains of the gunpowder. It is separated from the gunpowder, for use, by sifting or winnowing.

50,568—October 24, 1865. L. DU PONT. *Improvement in presses for pressing gunpowder.*

Powder dust is compressed into cakes by horizontally applied pressure.

55,795—June 19, 1866. L. H. G. EHRHARDT. *Improved gunpowder.*

A safety powder formed of mineral carbon, mixed with cutch, tannin, or gambier, to be mixed with a mixture of potassium chlorate and nitrate for use, in the proportion of five parts of the cutch mixture to three parts of the potassium mixture.

58,567—October 9, 1866. F. S. ALLEN. *Improvement in the manufacture of gunpowder.*

Paper or other fibrous material is saturated with an explosive compound, as a mixture of manganese binoxide, potassium chlorate, potassium nitrate, and potassium ferrocyanide, by boiling them together in a solution and evaporating the liquid wholly or partially.

58,656—October 9, 1866. H. S. LUCAS. *Improved blasting cartridge.*

A cartridge of solidly compressed gunpowder, with a central perforation extending partially or wholly through, for interior ignition.

61,659—January 29, 1867. W. & E. FEHLEISEN. *Improved blasting powder.*

It is composed of sawdust or other finely divided cellulose material, 9 parts; potassium nitrate, 45 parts; charcoal or carbon, 3 parts; and postassium ferrocyanide, 1 part.

61,957—February 12, 1867. C. SEIDEL. *Improved chemical composition for blasting rocks.*

A powder and fluid to be combined when used; the powder consisting of sulphuret of antimony, 1 part, and potassium chlorate, 2 parts; the fluid of phosphorus, 1 part, dissolved in bisulphuret of carbon, 4 parts. It is exploded by friction or a fuse.

66,378—July 2, 1867. G. A. NEUMEYER. *Improved powder for firearms and for blasting.*

Blasting powder is made of saltpeter, flower of sulphur and charcoal (from freshly cut wood), gunpowder of saltpeter, flower of sulphur and brown coal. The mixing is made with the addition of water, and the mass is subsequently dried.

70,359—October 29, 1867. A. T. RAND. *Improved compound for blasting powder.*

It consists of sodium nitrate, 60 parts, and charcoal, 40 parts.

71,004—November 19, 1867. E. E. HENDRICK. *Improved method of drying gunpowder.*

Gunpowder is dried by exposing it *in vacuo.*

73,786—January 28, 1868. L. H. G. EHRHARDT. *Improvement in gunpowder.*

A finely pulverized mixture of potassium chlorate, 1 part; potassium nitrate, 2 to 4 parts; and mineral coal, 3 to 5 parts.

76,133—March 31, 1868. E. H. ASHCROFT. *Improved compound for use in safes and powder magazines.*

Bicarbonate of soda, carbonates of ammonia, or other volatile salts, with or without a liquid acid, are placed in the inner compartments of safes and around the chambers of powder magazines, to develop incombustible gases, in case of undue heating.

79,010—June 16, 1868. F. M. RUSCHHAUPT. *Improved explosive powder.*

A mixture of chlorate of potassa, say 75 parts, and naphthalene 25 parts.

79,229—June 23, 1868. W. H. JACKSON. *Improvement in the manufacture of gun powder.*

A solution of potassium nitrate, or equivalent thereof, is mixed with a soluble vegetable extract, as of logwood or other soluble vegetable matter, and evaporated to dryness, with or without the addition of sulphur or pulverized charcoal.

80,004—July 14, 1868. P. A. OLIVER. *Improved powder for blasting and other purposes.*

A powder made from peat, instead of charcoal, with saltpeter, sulphur, and chlorate of potash.

81,670—August 25, 1868. G. A. NEUMEYER. *Improvement in the manufacture of gunpowder and blasting powder.*

A mixture of saltpeter, flowers of sulphur, and brown coal, or brown coal and charcoal, is made in the dry state, then ground in water for one and a half to two and a half hours, and grained and dried.

81,894—September 8, 1868. J. HAFENEGGER. *Improvement in explosive compounds.*

The powder may consist of mixtures of potassium chlorate, sulphur, and light charcoal; or potassium chlorate, white sugar, and potassium ferrocyanide; or potassium chlorate, powdered charcoal, sulphur or sugar, and potassium ferrocyanide; or potassium chlorate, sugar, charcoal, and sulphur. A self-igniting fluid therefor consists of 1 to 2 parts of phosphorus dissolved in 2 parts of bisulphuret of carbon, its effect being more or less instantaneous according to the degree of saturation.

85,482—December 29, 1868. W. SCHMITZ. *Improvement in explosive cartridges.*

A waterproof cartridge of special construction charged with a mixture of amorphous phosphorus, 1 part; potassium chlorate, 2 parts; gum arabic, 3 parts; and water, 1 part; which assumes a solidified form. The compound may be used for percussion caps.

85,576—January 5, 1869. L. H. G. EHRHARDT. *Improvement in the manufacture of gunpowder.*

A finely pulverized mixture of potassium chlorate with a vegetable extract, such as cutch, gambier, logwood, or of tannin.

86,980—February 16, 1869. E. GOMEZ. *Improved explosive compound.*

A solution of sugar of lead is added to a solution of prussiate of potash, and the ferrocyanide deposited; also a nitrate of iron is prepared with 2 pounds of nitric acid and 1 pound of iron in 1 gallon of water. The substances are mixed in the proportion of 1 pound of nitrate of iron to 3 pounds of ferrocyanide of potassium and the precipitate washed and dried and mixed with equal proportions of potassium chlorate.

87,382—March 2, 1869. P. H. VANDER WEYDE. *Improved application of Grahamite in the manufacture of gunpowder and lampblack.*

Grahamite is used as an ingredient in the manufacture of gunpowder; also for the production of lampblack, chlorine gas being introduced into the furnace.

88,171—March 23, 1869. W. H. JACKSON. *Improved powder for blasting and other purposes.*

Vegetable fiber, as tan bark, saturated with a niter salt or a chlorine salt in water, is combined with gunpowder or other explosive compounds.

97,566—December 19, 1869. T. TAYLOR. *Improved explosive compound for use in firearms, blasting, etc.*

A mixture of potassium chlorate and the yellow prussiate of potash with paraffine, say, in equal parts of the potash compounds with one thirty-second part by weight of paraffine.

97,567—December 7, 1869. T. TAYLOR. *Improved gunpowder.*

Paraffine is mixed with ordinary gunpowder in all proportions.

110,355—December 20, 1870. J. HAFENEGGER. *Improvement in explosive compounds.*

Fatty or oily substances, as Venice turpentine, are mixed with explosive compounds to prevent spontaneous explosion.

111,642—February 7, 1871. J. HAFENEGGER. *Improvement in explosive compounds.*

A mineral oxide, as an oxide of lead or manganese, and oily, fatty, or resinous substances are mixed with explosive compounds.

118,040—August 15, 1871. A. MOLFINO. *Improvement in gunpowders.*

It is composed of potassium chlorate, 772 parts; wheat starch, 228 parts, and charcoal, 150 parts.

120,862—November 14, 1871. C. W. CURTIS. *Improvement in the manufacture of gunpowder.*

The grains of "pellet" powder, for heavy ordnance, are split into halves, and afterwards stoved and glazed, thereby presenting one rough face.

122,245—December 26, 1871. E. GOMEZ. *Improvement in explosive compounds.*

Acetate of lead is mixed with prussiate of potash and the ferrocyanide deposit in a dry state is mixed with chlorate of potash; mucilage or other adhesive material may be added.

130,123—August 6, 1872. C. F. FUCHS AND A. CLEMENT. *Improvement in gun and blasting powders.*

A compound of potassium chlorate and ground tortoise or turtle shell, in addition to saltpeter, sulphur, and charcoal.

133,522—December 3, 1872. L. & E. DU PONT. *Improvement in the manufacture of gunpowder.*

Dampened powder is compressed in sheets between ribbed plates, to form indented lines, by which the cake is broken into uniform shapes or sizes.

145,149—December 2, 1873. F. BURNEY. (*Reissue: 5,773—February 24, 1874.*) *Improvement in the manufacture of gunpowder.*

Gunpowder is molded into pebbles or grains of large size by pressure between plates having cellular surfaces.

148,536—March 10, 1874. B. WEINER. *Improvement in the manufacture of gunpowder.*

Gunpowder, after mixture of the ingredients, in a dry state, is subjected to a sufficiently high temperature to liquefy the sulphur and agglutinate the mass.

150,543—May 5, 1874. J. H. DOLDE. *Improvement in explosive compounds.*

A mixture of prussiate of potash, white sugar, lime or soapstone, chlorate of potash, and tannin.

160,053—February 23, 1875. E. GREENE. *Improvement in the manufacture of gunpowder.*

The saltpeter or sodium nitrate is dissolved in hot water, and the other ingredients mixed with the heated solution, the heat being maintained during the mixing operation in a complete or partial vacuum.

161,325—March 30, 1875. R. CAHUC. (*Reissue: 6,601—August 17, 1875.*) *Improvement in explosive compounds.*

A mining powder, incombustible at low temperature and nonexplosive except when under pressure, produced by heating potassium nitrate, carbon, and sulphur, in the presence of sawdust or tanning bark and a solution of sulphate of iron, till a homogeneous liquid mass is produced, then cooling and drying.

172,547—January 18, 1876. C. FELHOEN. *Improvement in explosive compounds.*

It consists of sodium nitrate, 36 parts; potassium carbonate, 3 parts; potassium nitrate, crude, 24 parts, and refined, 9 parts; sulphur, 15 parts; and charcoal, 13 parts; combined in a dry powder with granulation.

177,818—May 23, 1876. J. H. DOLDE. *Improvement in explosive compounds.*

A sporting powder consisting of potassium chlorate, 9 ounces; gall, 3 ounces; and yellow prussiate of potash, one-half ounce.

177,819—May 23, 1876. J. H. DOLDE. *Improvement in blasting powder.*

A compound of silica, potassium nitrate, potassium chlorate, sodium nitrate, water, sawdust, sugar, and tannin.

182,421—September 19, 1876. L. DE SOULAGES AND R. CAHUC. *Improvement in explosive compositions.*

Same as No. 161,325.

184,020—November 7, 1876. J. P. R. POCH. *Improvement in explosive compounds.*

A blasting compound of spent tan, wood sawdust, sodium nitrate, barium nitrate, charcoal, sulphur, and saltpeter.

186,211—January 16, 1877. A. E. MILTIMORE AND C. A. L. TOTTEN. *Improvement in compensating powder.*

The grains are made up of concentric layers of different explosive substances of varying force and expansive intensity.

188,124—March 6, 1877. J. GOETZ. *Improvement in explosive compounds.*

A dry gas-producing or explosive base is mixed with glucose, uncrystallizable sugar, or sirupy solution to prevent premature or accidental discharge.

199,723—January 29, 1878. T. T. S. LAIDLEY. *Improvement in powder for cannons.*

Gunpowder is formed in cubical grains with rounded angles and perforated centrally through two opposite sides.

200,272—February 12, 1878. S. J. FOWLER. *Improvement in explosive compounds.*

It consists of the combination of nitrate of ammonia and sulphate of soda with an explosive.

201,520—March 19, 1878. W. GRAHAM AND E. WARD. *Improvement in blasting powder.*

A mixture of yellow prussiate of potash, potassium chlorate, white sugar, and red lead.

210,197—November 26, 1878. P. M. GALLAHER, W. LLOYD, AND G. S. WALKER. *Improvement in blasting powder.*

A combination of nitrate of soda or potash, sulphur, charcoal, ground bark, and sulphate of iron and sulphate of copper.

212,726—February 25, 1879. W. MILLER. *Improvement in explosive compounds.*

A blasting powder composed of complementary mixtures of sodium nitrate, 35 parts; potassium nitrate, crude, 25 parts, and refined, 10 parts; and starch, 2 parts; constituting one mixture; and potassium bichromate, 3 parts; sulphur, 13 parts; and charcoal, 12 parts, constituting the other mixture.

213,762—August 19, 1879. A. MONNIER. (*Reissue: 9,173—April 27, 1880.*) *Explosive compound.*

Coal tar or other tarry matter is mixed with explosive compounds containing potassium chlorate to cushion and segregate the particles of chlorate. The potassium chlorate and other soluble ingredients are dissolved in water, the insoluble ingredients which absorb the soluble substances are added, the dissolved salts crystallized by evaporation and agitation, the mass ground, and the coal tar added with heating and kneading.

220,304—October 7, 1879. J. PATTISON. *Improvement in explosive compounds.*

An oleaginous flour or meal is combined with an explosive compound having for its base chlorate of potash to prevent premature and spontaneous explosion.

220,534—October 14, 1879. O. B. HARDY. *Improvement in blasting powder.*

It is composed of crude nitrate of soda, 75 pounds; sulphur, 20 pounds; charcoal, 20 pounds; common salt, 10 pounds; sugar, 5 pounds; and paraffine, 3 pounds.

222,169—December 2, 1879. E. J. WILLIAMS. *Improvement in explosive compounds.*

It consists of potassium chlorate, 3 pounds; prussiate of potash, 1 pound; bichromate of potash, 2 ounces; nutgalls, 5 ounces; cannel coal, 2 ounces; starch, 6 ounces; and crude coal oil, 5 ounces.

241,163—May 10, 1881. T. P. SLEEPER. *Blasting powder.*

It consists of potassium chlorate, 8 parts; sugar, 7 parts; and charcoal, 1 part.

268,518—December 5, 1882. C. F. MOHRIG. *Explosive compound.*

It consists of potassium chlorate, 50 to 70 parts; sugar, 12 to 15 parts; charcoal, 5 parts; black oxide of manganese, 5 parts; metallic zinc, 10 to 20 parts; water and wax, 10 parts.

273,209—February 27, 1883. N. WIARD. *Manufacture of gunpowder*

It is formed in perforated pellets or grains with tapering perforations, the exterior surface being of greater density than its interior surface.

281,565—July 17, 1883. M. E. SANLAVILLE AND R. LALIGANT. *Manufacture of explosive compounds.*

A composition consisting of carbonaceous matter, alkaline chlorate and nitrate, alkaline bisulphate, and glycerine.

289,756—December 4, 1883. S. R. DIVINE. *Explosive compound.*

It consists of a solid ingredient, as potassium chlorate, about 7½ parts, and a liquid ingredient, as the heavy oil of coal tar (dead oil), 1 part; mechanically united.

289,760—December 4, 1883. S. R. DIVINE. *Explosive compound.*

It consists of potassium chlorate, about 8½ parts and turpentine, 1 part; mechanically mixed.

289,762—December 4, 1883. S. R. DIVINE. *Explosive compound.*

From 1 to 3 per cent of sulphur is combined with the moist mass of No. 289,756 (potassium chlorate and dead oil).

289,765—December 4, 1883. S. R. DIVINE. *Composition for preparing explosive compounds.*

A fluid mixture constituting the liquid ingredient of an explosive consists of the liquid ingredient of the explosive—as dead oil—and a volatile fluid, such as bisulphide of carbon having finely divided sulphur dissolved in the volatile fluid.

312,010—February 10, 1885. R. S. PENNIMAN. *Protected nitrate of ammonia for use in explosive compounds.*

Granulated or finely divided nitrate of ammonia is protected against deliquescence by a coating of petroleum or its soft and viscous products.

314,824—March 31, 1885. A. GACON. *Blasting powder.*

A mixture of nitrate of potash (or soda), 69 parts; flowers of sulphur, 19 parts; ashes, 12 parts; and tannin, 2 parts; all by weight.

320,583—June 23, 1885. R. S. PENNIMAN. *Explosive compound.*

A high explosive consisting of nitrate of ammonia coated with petroleum or its soft products—No. 312,010—combined with potassium chlorate as a detonator.

333,152—December 29, 1885. R. S. PENNIMAN. *Explosive compound.*

It is composed of protected grains of nitrate of ammonia—No. 312,010—and grains of potassium chlorate mixed with a dry powdered material—as carbonate of magnesia—to prevent the latter from caking.

352,611—November 16, 1886. E. DU PONT. *Explosive compound.*

It consists of a nitrate and sulphur combined with charcoal retaining its fibrous structure (baked wood).

362,899—May 10, 1887. T. NORDENFELT AND V. A. MEURLING. *Manufacture of gunpowder.*

Sulphur is incorporated with carbonaceous matter, by dissolving the sulphur in bisulphide of carbon, impregnating the carbonaceous matter with the solution, and evaporating the bisulphide. It is then impregnated with saltpeter or equivalent salt in solution, and the solvent evaporated. Cotton or other vegetable fiber is treated with hydrochloric acid (gaseous or liquid) to obtain carbonaceous matter.

363,887—May 31, 1887. E. DU PONT. *Explosive compound.*

A compound of a nitrate, sulphur, charcoal retaining its fibrous structure, and a carbohydrate, as sugar.

370,025—September 13, 1887. K. J. SUNDSTRÖM. *Blasting powder.*

A mixture of sodium nitrate, say 370 parts; wood tar, 70 parts; resin, 38 parts; and sulphur, 50 parts; produced by moistening the nitrate with a solution of the wood tar and resin, and then mixing with the coated nitrate a solution of the sulphur in a volatile solvent, as bisulphide of carbon.

374,740—December 13, 1887. L. G. HEUSSCHEN. *Explosive compound.*

It consists of coal oil and glycerine, together with potassium or sodium nitrate, sulphate of iron and sulphuric acid, carbonaceous matter and sulphur.

376,849—January 24, 1888. C. E. BICHEL. *Manufacture of explosives.*

Sulphur and a hydrocarbon are distilled in the presence of one another, and potassium nitrate, or equivalent oxygen-bearing substance, is added to the resultant body.

381,507—April 17, 1888. C. J. OLDS. *Gunpowder.*

It consists of carbonized peas, combined with saltpeter, sulphur, and charcoal from willow or other trees.

393,634—November 27, 1888. A. FAVIER. *Explosive and method of making same.*

An explosive consisting of a highly compressed intermixture of a nitrate and a hydrocarbon, produced by mixing a pulverized nitrate, as ammonium nitrate, and a waterproof hydrocarbon fusible at a low temperature, and agglomerating the mixture under high pressure.

397,095—January 29, 1889. R. SJOBERG. *Blasting compound.*

It consists of ammonium oxalate, a nonnitrated hydrocarbon, as naphthalene, and potassium chlorate, with or without a liquid nonvolatile hydrocarbon, as astral oil.

418,635—December 31, 1889. A. F. WOODS. *Gunpowder.*

A mixture of potassium chlorate, 4 parts; yellow prussiate of potash, 1 part; and a carbohydrate, such as sugar, 1 part.

448,361—March 17, 1891. R. S. PENNIMAN. *Process of manufacturing nitrate of ammonia.*

Protected nitrate of ammonia is produced by mixing the protecting medium with the nitrate while in a melted condition, cooling, and graining by agitation. Nitric acid is mixed with ammoniacal liquor, settled, and concentrated by evaporating the main portion of the water, dehydrated, and then mixed, while in its initially melted condition, with the grain-protecting medium.

474,529—May 10, 1892. F. ROLLER. *Manufacture of explosives.*

A compound consisting of nitrate grains coated with colophony, with or without a solid, fatty substance, such as spermaceti, and an oil in which the colophony is dissolved, such as cottonseed oil.

483,125—September 27, 1892. F. AUCHMAN. *Blasting-powder.*

It consists of malt germs or cooms, ammonium nitrate, and potassium chlorate.

512,042—January 2, 1894. H. MAXIM. *Process of making chlorate blasting-powder.*

Potassium chlorate and sodium, or potassium nitrate, are combined in a state of fusion and reduced to a fine state of division prior to the admixture of combustible elements. The oxygen-bearing salt is first fused and the potassium chlorate then added.

542,723—July 16, 1895. F. G. A. BROBERG. *Blasting-powder.*

A free running powder consisting of particles of nitrate of soda coated with a mixture of resin and sulphur; produced by adding dry pulverized nitrate of soda to melted sulphur and resin and agitating the mixture.

546,552—September 17, 1895. B. C. PETTINGELL. *Blasting-powder.*

Process of manufacture consists in first immersing the powdered carbon singly and alone in an aqueous solution of niter, and afterwards adding and mechanically mixing the other ingredients, as sulphur and woodpulp.

565,593—August 11, 1896. M. BIELEFELDT. *Safety explosive.*

Formed of from 90 to 92 parts of ammonium nitrate, 5 parts of resin, and from 3 to 5 parts of a chromium compound, such as chromous hydroxid.

593,568—November 16, 1897. H. R. VON DAHMEN. *Blasting powder.*

It is composed of ammonium nitrate, phenanthrene, and potassium bichromate; produces a low explosion temperature.

598,096—February 1, 1898. T. IEVLEY. *Explosive.*

A compound consisting of potassium chlorate; a metallic oxid or oxides, as sesquioxid of iron and oxid of manganese; petroleum, and turpentine; with or without a moderator, such as an oil of the fatty-acid series, as oil of almonds.

608,316—August 2, 1898. G. BENEKE. *Explosive and method of making same.*

A compound of ammonium nitrate, resin, and an alkaline carbonate, with or without an oxidizing material such as alkaline chromate; produced by incorporating the alkaline carbonate (and the oxidizing material) with the resin when the latter is in a liquid state, cooling and pulverizing, and then incorporating with the ammonium nitrate.

647,606—April 17, 1900. R. S. PENNIMAN AND J. C. SCHRADER. *Resinous dope and method of making same.*

Vulcanized resin, adapted for use in explosive-compound dopes, produced by mixing resin and sulphur, highly heating for vulcanizing the resin, then cooling, breaking up, and pulverizing.

650,225—May 22, 1900. M. BIELEFELDT. *Explosive.*

A compressed mixture of sodium nitrate, potassium nitrate, sulphur, coal tar, and potassium bichromate, the proportion of sodium nitrate being greater than the aggregate of the other ingredients.

655,832—August 14, 1900. J. ROSS AND W. D. CAIRNEY. *Blasting powder.*

A mixture of potassium chlorate, 75 per cent; black oxide of manganese, 6 per cent; charcoal, 6 per cent; wax, 9 per cent; and vaseline, 4 per cent. Process of manufacture consists in granulating the potassium chlorate, mixing therewith the granulated charcoal and black oxide of manganese, then mixing in the wax, and heating until moist with the melted wax, then adding the vaseline to fill all crevices and supplement the coating.

656,048—August 14, 1900. J. ROSS AND W. D. CAIRNEY. *Explosive and process of making same.*

A mixture of potassium chlorate, 87 per cent; charcoal, 3 per cent; wax, 7 per cent; and vaseline, 3 per cent; the process being the same as No. 655,832.

656,678—August 28, 1900. J. A. STRANSKY. *Smokeless powder.*

A compound of potassium chlorate, 20 ounces; sugar, 16 ounces; alum, 1 dram; sulphur, 1 dram; and alcohol.

NITROGLYCERINE.

50,617—October 24, 1865. A. NOBEL. (*Reissues: Div. A, 3,377—April 13, 1869; 4,815, March 19, 1872; 5,621, October 21, 1873; 5,798, March 17, 1874. Div. B, 3,378—April 13, 1869; 4,816, March 19, 1872; 5,620, October 21, 1873; 5,800, March 17, 1874. Div. C, 3,379—April 13, 1869; 4,817, March 19, 1872. Div. D, 3,380—April 13, 1869; 4,818, March 19, 1872.*) *Improved substitute for gunpowder.*

Nitroglycerine is exploded, throughout its entire mass, by confining same and subjecting it to excessive pressure, or to an impulse of explosion, as by means of an auxiliary explosive, an electric spark or heat, or other means.

It is placed either within or around an exploding charge or igniter.

In the manufacture of nitroglycerine streams of acids and of glycerine are poured together into a mixing tube and discharged into water maintained at a low temperature.

57,175—August 14, 1866. A. NOBEL. (*Reissues: A 2,537—April 2, 1867, product; B 2,538—April 2, 1867, process; B, Div. 1, 3,381—April 13, 1869, process; B, Div. 2, 3,382—April 13, 1869, apparatus.*) *Improved explosive compound.*

Nitrine or crystallizing nitroglycerine, produced by the admixture of glycerine, sulphuric acid, and nitric acid, free, or nearly free, from hyponitric acid.

60,573—December 18, 1866. T. P. SHAFFNER. *Improvement in methods of blasting with nitroleum.*

The nitroglycerine may be mixed with sand, for blasting; or the charge is poured into the hole, tamped with water, and fired with a tamping charge near the top; or the water tamping may be omitted and the firing canister suspended near the top of the hole, with the blasting charge in the bottom, and space between, there being sand tamping above the former.

76,499—April 7, 1868. G. M. MOWBRAY. *Improvement in the manufacture of nitroglycerine.*

Compressed air, dried and cooled, is introduced during the process of manufacture, to preserve a low temperature, and convert any hyponitrous acid produced.

85,906—January 19, 1869. S. CHESTER AND O. BÜRSTENBINDER. *Improved method of preparing nitroglycerine.*

The ingredients are mixed under an atmosphere which will not support combustion, as carbonic-acid gas. The mixture is cooled by the ebullition of cool compressed carbonic-acid gas through it and caused to rotate by means of jets of escaping gas.

86,701—February 9, 1869. T. P. SHAFFNER. *Improvement in preserving nitroglycerine, etc.*

Water is placed in a vessel containing nitroglycerine for transportation or storage.

93,756—August 17, 1869. T. P. SHAFFNER. *Improvement in the manufacture of nitro-glycerine.*

A cold water jacketed tank is used, having curved agitating arms.

98,425—December 28, 1869. T. P. SHAFFNER. *Improvement in the manufacture of nitro-glycerine.*

It is washed and agitated by forcing water and air into it by means of a perforated pipe at the bottom of a tank.

98,426—December 28, 1869. T. P. SHAFFNER. *Improved process of preserving nitroleum and other explosive liquids.*

Sponge, or like elastic porous substance, is used to hold nitroglycerine in suspension for storage or transportation. It is released by immersing charged sponge in warm water—say 60° F.

112,848—March 21, 1871. E. A. L. ROBERTS. *Improvement in the manufacture of nitro-glycerine.*

The amount of sulphuric acid in the acid bath is gradually increased simultaneously with the pouring in of the glycerine. The proportionate amount of sulphuric acid used in the first instance is reduced.

112,849—March 21, 1871. E. A. L. ROBERTS. *Improvement in the manufacture of nitro-glycerine.*

The glycerine is introduced in a bath of mixed acids in which a rapid circulation of the fluid contents of the bath is maintained.

121,898—December 12, 1871. E. A. L. ROBERTS. *Improvement in the manufacture of nitro-glycerine.*

The acids and glycerine are mixed in a water-cooled tube so constructed as to produce the tumbling or cascading of the liquids within.

137,440—April 1, 1873. A. HAMAR. *Impovement in the manufacture of nitroglycerine.*

The acid and glycerine flow through a trough and discharge upon a cooling-coil, into a solution of sodium chloride.

164,260—June 8, 1875. P. CASTELLANOS. *Improvement in the manufacture of nitro-sulphuric acid for manufacturing nitro-glycerine.*

See Group I, Mixed Acids.

164,261—June 8, 1875. P. CASTELLANOS. *Improvement in recovering acids from residuum of nitro-glycerine manufacture.*

See Group I, Mixed Acids.

226,867—April 27, 1880. F. MANN. *Process of manufacturing nitro-glycerine.*

Nitroglycerine is separated from its acid mother liquor by freezing the mixed acids and nitroglycerine and then separating the crystallized nitroglycerine by a centrifugal machine.

240,516—April 26, 1881. L. HINCKLEY. *Method of handling nitro-glycerine.*

Nitroglycerine is confined in closed vessels, tubes, cartridges, or shells under pressure, to render it nonexplosive by ordinary shocks or jars. It can be thus fired from a gun with ordinary gunpowder.

241,941—May 24, 1881. G. S. DEAN. *Method of preparing nitro-glycerine compounds.*

Nitroglycerine is mixed with a pulverulent nitro-compound and water (say 2 to 3 per cent of water) to increase the safety in handling and transportation.

262,769—August 15, 1882. W. N. HILL. *Process of and apparatus for the production of nitro-glycerine.*

Glycerine is mixed with a portion only of the acid, the reaction taking place with agitation by air or otherwise, then the partially converted mixture is passed into another and larger vessel, and the necessary quantity of acid added to complete the conversion.

413,070—October 15, 1889. E. LIEBERT. *Manufacture of explosives.*

Isoamyl nitrate is added to nitroglycerine, or a mixture of glycerine with isoamyl nitrate or isoamyl alcohol is nitrated, to lower the freezing point and make the nitroglycerine less sensitive to shocks.

432,336—July 15, 1890. S. D. SMOLIANINOFF. *Explosive compound.*

A mixture of nitroglycerine and an alcohol, as methyl alcohol, with or without an absorbent and a fulminate.

449,687—April 7, 1891. H. S. MAXIM. *Process of and apparatus for making explosives.*

The glycerine and the nitrating agent are separately atomized and then intermingled as spray, and the mixture quenched with water. Also claims for the apparatus.

457,002—August 4, 1891. E. K. MITTING. *Process of making nitro-glycerine.*

A charge of glycerine is nitrated, the spent acid drawn off and the product treated anew with a fresh charge of nitrating acid in excess, and finally the nitroglycerine separated from the fresh excess charge of acid, which is used to nitrate a second charge of glycerine, repeating the operation in the same nitrating vessel.

482,372—September 13, 1892. J. LAWRENCE. *Process of recovering nitro-glycerine from waste acids.*

The glycerine is nitrated and the nitroglycerine separated from the waste acids, then sulphuric acid may be added to the waste acids, and they are cooled to a temperature below the freezing point of nitroglycerine and above the freezing point of the acids, and the remaining nitroglycerine recovered.

CELLULOSE NITRATES AND OTHER ORGANIC NITRATES.

4,874—December 5, 1846. C. F. SCHÖNBEIN. *Improvement in preparation of cotton-wool and other substances as substitutes for gunpowder.*

Vegetable fibrous substances are treated with a mixture of nitric acid and sulphuric acid, or with pure nitric acid of greatest specific gravity. The explosive cotton may be impregnated with potassium nitrate or other chemical substitutes.

43,166—June 14, 1864. W. LENK. *Improved gun-cotton.*

Gun-cotton is produced by a process involving a specific series of steps, including, among others, the immersion of the gun-cotton in a solution of water-glass.

47,316—April 18, 1865. J. P. McLEAN. *Improvement in the manufacture of gun-cotton and lint.*

The fibers of the *Asclepias syriaca*, or milkweed, are used, either as fiber or in the form of yarn or fabric made thereof.

50,082—September 19, 1865. J. J. RÉVY. *Improvement in the manufacture of gun-cotton.*

The process calls for a specified series of steps, the acid mixture being formed of monhydrated nitric acid of a specific gravity not under 1.52 and monohydrated sulphuric acid of a specific gravity not under 1.84. It is spun into a lightly twisted yarn. The cotton yarn is boiled in a weak solution of water glass. The yarn is wound into the form of cartridges, or spun into ropes, woven into cloth, and then made up into cartridges.

50,083—September 19, 1865. J. J. RÉVY. *Improvement in the manufacture of gun cotton.*

The cotton is prepared by washing in an alkaline solution. In treating with acid, small and regular quantities are dipped in a considerable quantity of acid, fresh acid being added after each dipping to compensate for that removed. The acid is removed from the exterior of the fiber by saturating with water and treating in a centrifugal machine, and from the interior of the fiber by placing the fiber on perforated shelves and percolating water therethrough. Water glass is applied by means of a centrifugal machine, the solution being applied cool.

59,888—November 20, 1866. F. A. ABEL. *Improvement in the manufacture of gun-cotton.*

Gun-cotton is reduced to a pulp and consolidated, with or without pressure, into solid forms, with or without the admixture of binding materials. Soluble and insoluble gun-cotton may be combined, pulp mixed with fibrous cotton, and the compressed forms coated with soluble gun-cotton, or shellac.

60,571—December 18, 1866. T. P. SHAFFNER. *Improvement in the manufacture of gun-cotton.*

Saturation and washing are performed under pressure, to compel the fluids to thoroughly permeate the fiber.

93,757—August 17, 1869. T. P. SHAFFNER. *Improved method of blasting with gunpowder and other explosive substances.*

Non or partially explosive materials are interposed between the fibers of gun-cotton, grains of powder, or nitrated or explosive materials to spread the action of the gases.

124,510—March 12, 1872. R. PUNSHON. *Improvement in explosive compounds from gun-cotton.*

Sugar is mixed with gun-cotton; as by dissolving sugar equal to one-third of the weight of the cotton in a minimum quantity of boiling water, thoroughly mixing finely cut gun-cotton therewith, and drying.

128,450—June 25, 1872. J. B. MUSCHAMP. *Improvement in explosive substances and processes of manufacturing the same.*

Comminuted cellulose woody fiber, purified of sap and mineral salts by treatment in strong caustic soda under pressure and washed, is treated with the acid bath, washed, and steeped in an alkaline solution, washed, and dried; the first dip producing the strongest explosive. A second quantity of fiber is treated in the same bath (second dip) to produce a weaker explosive; and a third for a still weaker explosive. To retard the rapidity of explosion it is steeped in a solution of starch.

139,738—June 10, 1873. T. P. SHAFFNER. *Improvement in explosive compounds.*

Gun-cotton, or other nitrated fibrous substance, is combined with nitrated water, or liquids, or paraffine, or beeswax, or any oleaginous or resinous matter.

141,654—August 12, 1873. S. J. MACKIE. *Improvement in the manufacture of gun-cotton.*

Gun-cotton is crushed to destroy its capillary structure and reduce it to an impalpable mass, and then granulated. It is dried *in vacuo*.

143,865—October 21, 1873. H. T. ANTHONY. *Improvement in preparing soluble cotton for the manufacture of collodion.*

After the ordinary acid treatment and washing, soluble cotton is subjected to volatilized alkali, as ammonia, to remove traces of acid.

210,611—December 10, 1878. J. W. HYATT. *Improvement in apparatus and processes for the manufacture of nitro-cellulose.*

Soluble fiber is made from paper by successive steps of "disintegration" into minute flakes; "conversion" in an acid bath (with centrifugal and centripetal swirls); "desiccation" by drying in a centrifugal machine; and "ablution." Claims are made for the apparatus.

230,216—July 20, 1880. J. A. ARRAULT, J. AND C. SCHMERBER. *Process for manufacturing nitro-derivatives from cellulose, etc.*

Nitro-derivatives are produced by treating the cellulose, starch, glucose, etc., with the fumes of nitric acid or nitric acid in a gaseous state.

238,916—March 15, 1881. F. C. KEIL. *Explosive compound.*

It is composed of nitroglucose (dextro-glucose made from starch) dissolved in a volatile solvent, such as alcohol, and mixed with potassium nitrate, potassium chlorate, and prepared vegetable fiber.

242,893—June 14, 1881. G. S. DEAN. *Process of making nitro-dextrine.*

Vegetable fiber is treated with dilute sulphuric acid, whereby its structure is destroyed and dextrination commenced, and afterwards it is nitrated with concentrated nitro-sulphuric acid.

244,575—July 19, 1881. C. A. FAURE AND G. TRENCH. *Explosive blasting material.*

It consists of intimately mixed carbonaceous and oxidizing materials in granular form, with finely divided nitrocellulose distributed around the granules.

249,490—November 15, 1881. C. W. VOLNEY. *Explosive compound.*

A mixture of monochlordinitrin or chlorpropenyldinitrate, and a nitrate of potassium, sodium, barium, or other suitable alkaline metal, in equivalent quantities to effect a mutual decomposition, with or without chlorates of the said metals, vegetable fiber, or charcoal.

251,145—December 20, 1881. G. VON PLANITZ. *Explosive compound.*

A base for explosives formed by the combination of nitric acid and resin, produced by spreading pulverized resin on a bath of nitric acid and water heated to the boiling point, and skimming off the resulting soft foamy product.

252,600—January 24, 1882. C. DITTMAR. *Explosive compound.*

"Chlornitrosaccharose," or nitro-sugar, produced by dissolving sucrose in chlorhydrin and then converting it into a nitro compound.

274,335—March 20, 1883. J. W. HYATT AND F. V. POOL. *Manufacture of pyroxyline.*

The fiber is treated with acid; the residual acid is then freed from matter in suspension by use of barium sulphate or otherwise, and the spent acid is analyzed and its strength restored according to the original formula.

276,833—May 1, 1883. A. J. LANFREY. *Manufacture of explosive compounds.*

An explosive compound consisting of nitrocellulose made from straw and oxidating substances, such as nitroglycerine, niter, or mixture of niter and carbonaceous matter. The straw is disintegrated, triturated, washed, treated with acid, washed, and disacidulated. It is formed into sheets or leaves and the paper converted into nitrocellulose.

299,857—June 3, 1884. E. SCHERING. *Preparation of collodion.*

Pure collodion cotton (free from acid), is dissolved in ether and alcohol, and distilled, after filtration, to an extent to permit of the mass being cast into forms. It is nonexplosive.

304,361—September 2, 1884. J. SCHULHOF. *Explosive preparation made from gun-cotton.*

Gun-cotton is impregnated with fat, compressed, and coated with collodion.

306,519—October 14, 1884. F. V. POOL. *Manufacture of soluble nitro-cellulose.*

The strength of the spent acids is restored in bulk by introducing the proper quantity of a nitrate.

309,787—December 23, 1884. E. JUDSON. *Explosive compound.*

A mixture of nitrocellulose or other equivalent detonating or fulminating compound with a dope prepared by pulverizing, drying, and mixing sodium nitrate, 70 parts; and anthracite coal, 10 parts; and mixing same in a melted mixture of sulphur, 15 parts; resin, 3 parts; and asphalt, 2 parts; stirring and cooling the dope until the grains cease to adhere.

315,357—April 7, 1885. M. VON FÖRSTER. *Coating gun-cotton.*

Pure gun-cotton is compressed and then treated with a solvent, as ethylic acetate, which will dissolve part of the gun-cotton, and on drying leave a hard film or coating of gun-cotton.

333,872—January 5, 1886. M. F. LINDSLEY. *Explosive compound.*

A mixture of nitrocellulose, 50 pounds; saltpeter, 38 pounds; charcoal, 5 pounds; potassium chlorate, 3 pounds; starch, 2 pounds; and potassium carbonate, 2 pounds.

336,822—February 23, 1886. F. V. POOL. *Art of manufacturing nitro-cellulose.*

In the manufacture of nitrocellulose a spent bath is restored and purified by introducing a suitable quantity of sulphuric acid and a nitrate, according to the requirements as shown by an analysis, and effecting the crystallization and removal of the resulting by-product.

340,276—April 20, 1886. M. BIELEFELDT. *Explosive compound.*

It consists of nitrocellulose, with or without nitroglycerine, with nitrate of ammonia in water of ammonia.

341,155—May 4, 1886. M. F. LINDSLEY. *Process of making explosive compounds:*

A mixture of wood fiber, charcoal, bituminous coal, and starch is formed into fine powder and then into grains, treated with acids, the free acid removed, and the grains then treated in a solution of potassium carbonate and saltpeter.

343,850—June 15, 1886. F. V. POOL. *Art of making nitro-cellulose.*

Spent acids are restored and purified by adding a suitable quantity of a nitrate, which is decomposed, the liberated nitric acid strengthening the bath, while the base forms, with sulphuric acid present, an insoluble compound which acts as a settling agent. Fresh sulphuric acid may be introduced with the nitrate or afterwards.

350,497—October 12, 1886. G. M. MOWBRAY. *Manufacture of pyroxyline.*

The spent acid is restored in strength and bulk without precipitation and analysis by fortifying and adding to the drained spent acid of a previous nitration a mixture of concentrated sulphuric and nitric acids.

350,498—October 12, 1886. G. M. MOWBRAY. *Manufacture of pyroxyline.*

The use of steeled cast-iron pots is claimed for holding the mixed acids, and "Bessemer process steel" for tanks; also structural details of apparatus.

359,289—March 15, 1887. E. SCHULTZE. *Gunpowder.*

A composition of a nitro-hydrocarburet (such as nitro-colophony, tar, turpentine, or turpentine-oil), pyroxyline, and nitrates or salts furnishing oxygen in combination with nitrogen; as colophony, 12 parts; pyroxyline, 60 to 80 parts; barium nitrate, 60 to 80 parts; and potassium nitrate, 8 to 10 parts.

363,197—May 17, 1887. R. BERNSTEIN. *Granular nitro-cellulose.*

Prepared from the pulverized nuts, fruits, or shells of nuts of the *Phytelephas macrocarpa*, or "vegetable ivory" and kindred plants, and forming smooth grains that pack without cohesion.

366,281—July 12, 1887. C. W. VOLNEY. *Explosive compound.*

A solution of nitro-starch in nitroglycerine; also the same with oxidants, as chlorates and nitrates.

371,376—October 11, 1887. H. SCHÖNEWEG. *Explosive.*

Consisting in nitrated carburets of hydrogen and nitrated cellulose with an oxalate or oxalic acid.

417,577—December 17, 1889. J. F. A. MUMM. *Explosive compound.*

A mixture of potassium chlorate, 1 pound; antimony, 8 ounces; charcoal, 1 ounce; flowers of sulphur, 2 ounces; glycerine, 1 ounce; collodion, 1 ounce; sulphuric acid, 4 drops; nitric acid, 2 drops; alcohol, 3 ounces; and water, 2 to 3 ounces.

420,445—February 4, 1890. J. R. FRANCE. *Soluble nitro-cellulose and process of manufacture.*

Soluble nitrocellulose composed of pure mechanically comminuted cotton fiber nitrated, produced by mechanically reducing cotton to a uniform and homogeneous dust-like condition and then treating with a bath of nitric and sulphuric acids, in the proportions, say, of nitric acid, 42° Baumé, 8 parts, and sulphuric acid, 66° Baumé, 12 parts.

420,446—February 4, 1890. J. R. FRANCE. *Insoluble nitrocellulose and preparing the same.*

Insoluble nitrocellulose consisting of pure mechanically comminuted cotton nitrated, produced by mechanically reducing cotton to a uniform homogeneous dust-like condition, treating it in a bath of nitric and sulphuric acids in the usual proportions and strength, at about 75° F., for about fifteen minutes, and pressing out the superabundant acids, and washing.

420,477—February 4, 1890. J. R. FRANCE. *Cotton-fiber dust and preparing the same.*

Mechanically comminuted cotton-fiber dust for the manufacture of nitrocellulose, produced by forming the cotton into a card or lap and cutting or otherwise reducing the fibers in their natural state to cotton dust by mechanical means.

430,215—June 17, 1890. H. S. MAXIM. *Recovering solvents from explosives.*

In the manufacture of explosive material, the dissolved material is exposed in receptacles in a drying chamber and a constant circulation of air or gas maintained through the drying chamber and a communicating condensing chamber, the air or gas being heated before entering the drying chamber.

434,287—August 12, 1890. G. M. MOWBRAY. *Process of manufacturing nitrocellulose.*

A continuous web of cellulose paper is moved through an acid bath, compressed, then through a washing fluid, dried, and a solvent is then distributed upon the continuously moving web, and it is formed into a roll to diffuse the solvent.

443,105—December 23, 1890. G. M. MOWBRAY. *Method of preparing nitrocellulose.*

Cellulose material, whether fibrous, felted, or textile, is impregnated by crystallizing a salt, preferably sodic nitrate, in the interstices of the material; the dry saline-impregnated cellulose material is then immersed in a bath of sulphuric and nitric acids, and then removed, washed, and dried.

454, 281—June 16, 1891. H. S. MAXIM. *Method of making gun-cotton.*

Charges of cotton are treated in a given order in each of a series of acid vats, the excess of acid expressed from the cotton and returned to the vat from which it was taken, and as the acid in said vats becomes spent the weakest acid of the first vat of the series is replaced with fresh acid and the order of immersion changed in accordance with the relative strength of the acid in the several vats.

455,245—June 30, 1891. H. DE CHARDONNET. *Manufacture of pyroxyline.*

Process consists in the successive steps of nitration, centrifugal extraction of spent acids, washing of the pyroxyline, and neutralization of the wash water by an alkaline or basic material to recover the residue of nitric acid left in the pyroxyline by the centrifugal action, and reuse of the water with successive quantities of pyroxyline.

465,280—December 15, 1891. H. MAXIM. *Method of making nitrocellulose.*

Pyroxyline of a high grade is produced by immersing the cellulose for a short time in a bath of strong-acids mixture, then conveying said cellulose with contained acids (amounting to, say, six or more times the weight of cellulose) to a second bath containing many times the weight of the cellulose of a weaker acids mixture, and there completing the conversion by digesting for a considerable time.

474,778—May 10, 1892. H. MAXIM. *Process of making nitrocellulose.*

Cellulose is first converted into a lower nitro compound, such as dinitrocellulose, in a preliminary bath of suitable acids, the excess of acid removed by mechanical means and washing, then dried, and then immersed in a stronger bath of acids suitable to convert it into trinitrocellulose, or pyroxyline. The adhering strong acids are washed therefrom into the first bath by passing the weaker acids mixture through it and back into the bath.

479,988—August 2, 1892. H. MAXIM. *Method of restoring nitrating acids.*

A quantity of dry nitrate is added to the weakened mixture, the acid sulphate allowed to crystallize, the liquor is removed from the crystals by a centrifugal machine, and the crystals further washed by a portion of the weakened mixture.

487,080—November 29, 1892. J. V. SKOGLUND. *Explosive powder.*

It consists of dried grains of nitrated cellulose gelatinized by means of a solvent containing a fat or fatty acid, with or without saltpeter.

514,830—February 13, 1894. R. C. SCHÜPPHAUS. *Nitro compound and process of making same.*

A pyroxyline composition having urea incorporated therewith, to secure stability.

516,295—March 13, 1894. H. M. CHAPMAN. *Explosive.*

The combination with a nitro-explosive as an agglomerating agent of formic ether.

516,924—March 20, 1894. F. G. DU PONT. *Process of drying nitrocellulose.*

Wet nitrocellulose is placed in a hydrocarbon oil, as kerosene, and the oil vaporized, thereby removing the water from the fiber.

526,752—October 2, 1894. R. C. SCHÜPPHAUS. *Process of nitrating cellulose.*

The weakened acid bath is restored by adding sulphuric anhydrid and nitric acid; with oil of vitriol in certain cases.

541,899—July 2, 1895. B. THIEME. *Process of making nitropentaerythrit.*

Nitropentaerythrit, suitable for use as a smokeless explosive, is produced by treating pentaerythrit, which is produced by the condensation of acetyldehyde and formaldehyde in the presence of lime, with concentrated nitric and sulphuric acids.

544,924—August 20, 1895. H. MAXIM. *High explosive.*

An intimate mechanical mixture, in a fine state of division, of an explosive colloid of gun-cotton and nitroglycerine and wet fibrous gun-cotton; the latter may hold in suspension in its pores a solution of an oxygen bearing salt, such as nitrate of ammonia.

640,160—December 26, 1899. C. F. HENGST. *Explosive compound.*

Esparto grass is mechanically disintegrated, macerated in a sulphuric-acid and nitric-acid bath, the liquor expressed and the pulp washed, boiled in an aqueous solution of potassium bicarbonate, the product colored with hydrochloride of triamidoazobenzene, washed and strained, dried, ground with starch, charcoal, and potassium nitrate, dried, sifted, molded, and the grains waterproofed.

647,420—April 10, 1900. A. LUCK AND C. F. CROSS. *Process of increasing stability of nitrocellulose.*

The nitrocellulose is freed from the nitrating acid, treated with a solution of acetone and metallic salts and alcohol, and washed in successive washes to remove the acetone.

667,759—February 12, 1901. D. BACHRACH. *Nitrocellulose or similar substance and process of making same.*

A nitrocellulose containing a sulphate, as sulphate of lime, constituting 30 per cent or more by weight of the solid constituents of the compound, forming a noncombustible cellulose, may be formed by adding to the other constituents thereof carbonate of lime and sulphuric acid in proper proportions.

DYNAMITES.

78,317—May 26, 1868. A. NOBEL. (*Reissues: 5,619—October 21, 1873; 5,799—March 17, 1874; and 10,267—January 9, 1883.*) *Explosive compound.*

A combination of nitroglycerine with infusorial earth.

93,752—August 17, 1869. T. P. SHAFFNER. *Improved explosive compound for use in firearms, blasting, etc.*

Nitroglycerine is mixed with granulated plaster of paris.

93,753—August 17, 1869. T. P. SHAFFNER. *Improved explosive compound.*

A mixture of nitroglycerine with comminuted sponge or other vegetable fiber, with or without the admixture of plaster of paris.

93,754—August 17, 1869. T. P. SHAFFNER. *Improved explosive compound.*

Nitroglycerine is mixed with metallic powder, such as red lead, with or without an admixture of plaster of paris or any alkaline substance.

98,382—December 28, 1869. J. HORSLEY. *Improved nitro-glycerine compound for blasting.*

From 20 to 25 per cent of nitroglycerine is incorporated with a powdered mixture of Aleppo or other foreign gallnuts and potassium chlorate; or with galls, charcoal, and potassium chlorate; or galls, cream of tartar, and potassium chlorate; or galls, hard sugar, and potassium chlorate.

98,427—December 28, 1869. T. P. SCHAFFNER. *Improved explosive compound.*

Gun cotton is treated with nitroglycerine.

98,854—January 18, 1870. C. DITTMAR. *Improvement in explosive compounds.*

"Dualin," consisting of cellulose, nitrocellulose, nitro-starch, nitro-mannite, and nitroglycerine, mixed in different combinations, according to the strength desired.

99,069—January 25, 1870. C. DITTMAR. *Improved explosive agent, called "xyloglodine."*

It consists of glycerine-starch, or glycerine-cellulose, or glycerine-mannite, or glycerine-benzole, or analogous substances, treated with a mixture of nitric and sulphuric acids. It is a milky reddish or white fluid and may be mixed with cellulose or other porous substances.

120,776—November 7, 1871. E. A. L. ROBERTS. *Improvement in explosive compounds.*

Asbestos is combined with nitroglycerine, or other explosives, with or without infusorial earth or silica.

138,841—May 13, 1873. T. S. BEACH. *Improvement in explosive compounds.*

A compound formed of an alkaline nitrate, nitroglycerine or equivalent nitro-substitution product, wood-fiber or other material containing cellulose, and paraffine or equivalent wax-like material.

139,468—June 3, 1873. E. JUDSON. *Improvement in explosive compounds, or giant powder.*

A mixture of nitroglycerine with infusorial earth, sodium nitrate, resin and sulphur, or their equivalents.

139,746—June 10, 1873. T. VARNEY. *Improvement in explosive compounds.*

Dynamite is granulated while it is freezing or when frozen, and can then be used in its frozen state.

141,455—August 5, 1873. A. NOBEL. *Improvement in explosive compounds.*

A mixture of sodium nitrate and resin, or their equivalents, with or without sulphur, with nitroglycerine.

141,585—August 5, 1873. J. H. NORRBIN AND J. OHLSSON. *Improvement in explosive compounds.*

Nitrate or nitrite of ammonia is combined with a fulminate, as nitroglycerine.

146,530—January 20, 1874. W. N. HILL. *Improvement in blasting compounds or dynamites.*

A mixture of nitroglycerine and a silicious powder, prepared by precipitation from solutions of the silicates.

150,428—May 5, 1874. G. M. MOWBRAY. *Improvement in blasting powders.*

A mixture of nitroglycerine with finely divided mica.

153,086—July 14, 1874. C. L. KALMBACH. *Improvement in explosive compounds or dynamites.*

A mixture of a coarsely-ground farinaceous substance, such as corn meal, and nitroglycerine. Nitroglycerine is packed for shipment in nonmetallic vessels, holding, with the nitroglycerine, an equal amount in bulk of atmospheric air; when not in transit it is stored in perpendicular or flaring-sided nonmetallic open vessels, covered only with a film of water.

157,054—November 17, 1874. J. W. WILLARD. *Improvement in explosive compounds.*

It is composed of carbonate of magnesia, nitrate of potash, chlorate of potash, sugar, and nitroglycerine.

164,263—June 8, 1875. P. CASTELLANOS. *Improvement in explosive compounds.*

It consists of nitroglycerine, nitrobenzole, or benzine (to reduce the point of congelation), fibrous material, and pulverized earth.

164,264—June 8, 1875. P. CASTELLANOS. *Improvement in explosive compounds.*

It consists of nitroglycerine, potassium, or sodium nitrate, picrate, sulphur, carbon, and a salt insoluble and incombustible in nitroglycerine, such as the silicates of zinc, magnesia, and lime, carbonate of zinc, etc.

167,503—September 7, 1875. H. COURTEILLE. (*Reissue: 7,068—April 18, 1876.*) *Improvement in blasting powder.*

A safety blasting powder containing the elements of common gunpowder and also the uncombined elements of nitroglycerine; produced by treating the components of ordinary gunpowder in the presence of oleaginous or tarry matters, peat, and metallic sulphates.

173,961—February 22, 1876. W. F. JOHNSTON. *Improvement in explosive mixtures.*

An explosive containing salts which contain nitric acid and ammonia (as a mixture of sodium nitrate and ammonium sulphate), that by their decomposition at the time of the explosion will produce nitrate of ammonia; as a compound of salts containing nitric acid and ammonia, and a small percentage of gunpowder, nitroglycerine, or other common explosive, to produce a primary combustion.

175,735—April 4, 1876. A. NOBEL. *Improvement in gelatinated explosive compounds.*

Gelatinated nitroglycerine, produced by dissolving in nitroglycerine a substance capable of gelatinating it, such as nitrated cotton. The process is applicable to other explosive fluids, such as the nitrates of methyl and ethyl.

175,929—April 11, 1876. J. COAD. *Improvement in blasting compounds.*

A mixture of nitroglycerine and decayed wood.

177,988—May 30, 1876. C. G. BJORKMAN. *Improvement in explosive compounds.*

A mixture of potassium nitrate, 20 parts; potassium chlorate, 20 parts; cellulosa, 10 parts; pea-meal, 10 parts; sawdust, 10 parts; and nitroline, 30 parts.

183,764—October 31, 1876. E. JUDSON. (*Reissue: 7,481—January 30, 1877.*) *Improvement in explosive compositions.*

A powder consisting of particles or grains of a gas-producing material, rendered nonabsorbent by a coating of varnish or cement, as by mixing and stirring the sodium nitrate and the coal into a mixture of molten sulphur, resin, and asphalt, the powder then being rendered explosive by the admixture or incorporation of nitroglycerine.

184,762—November 28, 1876. C. DE LACY. *Improvement in explosive compositions.*

It consists of pyroxyline, sawdust, potassium nitrate and chlorate, and nitroleum. (Nitroleum is obtained by adding stearic oil mixed with honey, or coarse glycerine, to a mixture of nitric and sulphuric acids; the oleic mixture being removed, washed, and impregnated with soda.)

190,954—May 22, 1877. O. BÜRSTENBINDER. *Improvement in explosive compounds.*

Vegetable substances are inspissated with glycocole or chondrin and saltpeter, then soaked in nitroglycerine, and granulated and dried.

203,482—May 7, 1878. E. MONAKAY. *Improvement in explosive compounds.*

An explosive compound containing nitroglycerine and a liquid hydrocarbon, diluent, such as kerosene oil.

227,601—May 11, 1880. R. W. WARREN. *Explosive compound.*

It is composed of gunpowder mixed with a powder made of nitroglycerine, nitrocellulose, and trinitrocellulose, formed by first reducing nitrocellulose and nitroglycerine to a coagulated mass, then adding trinitrocellulose until a dry powder is produced, and finally combining therewith gunpowder.

234,489—November 16, 1880. C. A. MORSE. *Explosive compound.*

Nitroglycerine and a resinous or equivalent substance in a solid, granulated, or pulverized mass; produced by dissolving nitroglycerine and resin in a common solvent, as methyl alcohol, and then evaporating the solvent. The mass may be stirred during distillation to break down the mass and discharge it in a pulverized form.

235,871—December 28, 1880. W. HEICK. *Explosive compound.*

It is composed of honey and glycerine treated with nitric and sulphuric acid and then mixed with chlorate of potash, prepared sawdust, and prepared chalk.

236,714—January 18, 1881. C. A. MORSE. *Manufacture of explosive compounds.*

A compound composed of nitroglycerine, resinous substance, and oxidizing agents, as niter, produced as in No. 234,489, with the addition of the oxidizing agents to the solution.

242,783—June 14, 1881. J. M. LEWIS. *Explosive compound.*

"Forcite," a plastic gelatinized nitroglycerine compound, comprising an inexplosive gelatinizing material, such as cellulose (unnitrated), and an oxidizing salt, as niter, combined with nitroglycerine.

249,701—November 15, 1881. T. VARNEY. *Explosive compound.*

An absorbent for nitroglycerine is prepared by mingling with the fine particles of the powder a small proportion of a fusible, soluble, or paste-producing material, and causing the same to melt, dissolve, or become paste while in the mixture, so that each particle of such material becomes an adhesive nucleous to which the surrounding particles attach themselves, and are held in aggregations when hardened by cooling, drying, or crystallizing.

252,250—January 10, 1882. W. R. QUINAN. *Blasting-powder.*

A high explosive composed of nitroglycerine, nitrocellulose, and potassium chlorate (or nitrate).

260,786—July 11, 1882. W. R. QUINAN. *Explosive powder.*

A low explosive, consisting of an untriturated nitrate—such as sodium nitrate—in the form of small masses or grains of determinate size, sulphur, pulverized or grained, carbonaceous material, either pulverized or in small nonporous grains of determinate size, the unpulverized ingredients remaining as separate grains, and a small proportion of nitroglycerine which forms a coating in contact with said small grains, whereby the surfaces of the ingredients are so limited in extent to retain the small proportion of nitroglycerine susceptible to detonation by the ordinary blasting-cap.

288,516—November 13, 1883. H. D. VAN CAMPEN. *Explosive compound.*

It consists of tan-bark, dextrine, cryolite, potassium nitrate, and nitroglycerine.

289,759—December 4, 1883. S. R. DIVINE. *Explosive compound.*

It consists of a solid ingredient—potassium chlorate, 5 parts—and a liquid ingredient, consisting of a mixture of dead-oil and nitroglycerine (in the proportion of 2 to 1) 1 part, mechanically mixed.

300,281—June 10, 1884. W. R. QUINAN. *Explosive compound.*

A low-explosive powder composed of a small proportion of nitroglycerine, carbonaceous material, pulverized or in nonporous grains, and an explosive salt in the form of nonporous untriturated grains or crystals, the unpulverized ingredients remaining as separate grains in the mixture.

307,988—November 11, 1884. J. H. ROBERTSON. *Dynamite.*

A compound of an anhydrous salt and nitroglycerine, produced by expelling the water of crystallization from the salt, reducing it to a powder, and mixing with it nitroglycerine, whereby the latter takes the place of the water of crystallization and a granular compound is produced.

307,989—November 11, 1884. J. H. ROBERTSON. *Explosive compound.*

Anhydrous sodium sulphate is combined with nitroglycerine.

312,010—February 10, 1885. R. S. PENNIMAN. *Protected nitrate of ammonia for use in explosive compounds.*

Nitrate of ammonia in a finely divided or granulated condition is protected against deliquescence by a coating of petroleum or its soft and viscous educts or products.

323,088—July 28, 1885. R. W. WARREN. *Dynamite.*

A compound of nitroglycerine, sodium nitrate, and ground peat, with or without calcic hydrate.

333,149—December 29, 1885. R. S. PENNIMAN AND J. C. SCHRADER. *Dynamite.*

An explosive compound containing finely comminuted solid matter charged with nitroglycerine and protected grains of ammonium nitrate, the protecting coating being petroleum or its soft educts, as cosmoline, for which nitroglycerine has no affinity.

333,150—December 29, 1885. R. S. PENNIMAN AND J. C. SCHRADER. *Dynamite.*

An explosive compound composed of composite absorbent grains charged with nitroglycerine, and jacketed grains of an explosive salt.

333,151—December 29, 1885. R. S. PENNIMAN AND J. C. SCHRADER. *Gelatinated explosive.*

Composed of gelatinated nitroglycerine and grains of protected nitrate of ammonia.

333,344—December 29, 1885. J. C. SCHRADER. *Explosive compound.*

Porous-grained dope, embodying in each grain a cellular mass of sulphur and combustible or noncombustible matter (such as vegetable or woody fiber, coal, asbestus, furnace slag, or nitrates), produced, for example, by mixing wood pulp and finely ground sulphur, beating the mass until the sulphur is softened to an adhesive condition, cooling and graining.

333,345—December 29, 1885. J. C. SCHRADER. *Process of making explosive compounds.*

A dry-grained, free-running, high-explosive powder is produced by mixing with combustible ingredients, as wood pulp, powdered sulphur sufficient to adhesively control the mass when melted, heating, cooling, and graining into porous grains, and charging with the liquid explosive not greater than their capacity to receive and retain by capillary attraction.

333,346—December 29, 1885. J. C. SCHRADER. *Dynamite.*

A dry-grained explosive containing nitroglycerine housed and retained within hard cellular grains, composed in whole or in part of a cellular mass of sulphur and fibrous vegetable matter capable of resisting the softening influence of the liquid explosive.

333,347—December 29, 1885. J. C. SCHRADER. *Dynamite.*

An explosive compound containing nitroglycerine housed and retained within hard cellular grains composed in part of particles of solid carbonaceous matter held by a porous structure of suphur; formed, say, by heating a mixture of pulverized bituminous coal, sulphur, and sodium nitrate until the sulphur melts, cooling and graining.

333,348—December 29, 1885. J. C. SCHRADER. *Dynamite and process of making the same.*

A low-grade, dry-grained, free-running powder composed of absorbent grains charged with nitroglycerine and dry combustible uncharged grains.

335,006—January 26, 1886. C. W. A. ZADEK. *Explosive compound.*

A mixture of resinate of calcium or magnesium with trinitro-glycerine.

347,424—August 17, 1886. M. EISSLER. *Dynamite.*

It comprises coated nonabsorbent granules of nitrate salts, nitrocellulose, and nitroglycerine, first chemically amalgamated, and rye flour as a binding agent.

354,345—December 14, 1886. T. PRICE. *Composition for neutralizing fumes of explosives.*

It consists of carbonate of ammonia, urate of ammonia, lime, and sulphate of iron, in equal proportions.

372,330—November 1, 1887. S. D. SMOLIANINOFF. *Dynamite.*

A combination of asbestos, potassium nitrate and potassium chloride, and nitroglycerine.

382,229—May 1, 1888. J. W. GRAYDON. *Explosive charge.*

It consists of a number of rounded pellets, each made of a small portion of explosive inclosed in a flexible envelope impervious to nitroglycerine.

383,420—May 22, 1888. C. W. VOLNEY. *Explosive compound.*

A mixture of charcoal and an oxidant, as sodium nitrate, combined with starch, and forming an absorbent granular powder, with nitroglycerine absorbed by the powder, the granules retaining their granular form.

397,285—February 5, 1889. G. E. F. GRÜNE. *Preparing dynamite.*

Kieselguhr (infusorial earth) is pressed into the form of cartridges, carbonized by heating to a red heat, either with or without the admixture of vegetable or animal carbon, and saturated with nitroglycerine. Water will not expel the nitroglycerine.

398,559—February 26, 1889. J. WAFFEN. *Dynamite.*

It consists of sodium nitrate, 22.5 parts; decayed wood, 36 parts; picric acid, 0.25 part; sulphur, 1 part ;and carbonate of soda, 0.25 part; combined with 40 per cent of nitroglycerine prepared with collodion.

420,626—February 4, 1890. E. JUDSON. *Dynamite.*

A protected powder consisting of a base of nitrate or equivalent gas-producing material, with the grains coated with a paste of barley meal combined with nitroglycerine.

427,679—May 13, 1890. P. GERMAIN. *Dynamite.*

Spongy cellular vegetable tissue, as pith, is compressed and used as an absorbent for nitroglycerine or other liquid explosive; it may be cut into small pieces.

437,499—September 30, 1890. D. MINDELEFF. *Explosive compound.*

A combination of nitro-glycerine, an alcohol, as methyl alcohol, and a soluble explosive, as pyroxyline.

438,816—October 21, 1890. C. O. LUNDHOLM AND J. SAYERS. *Manufacture of explosives.*

Cellulose nitro derivatives are mixed and incorporated with nitroglycerine by suspending or diffusing the ingredients in a liquid that is a nonsolvent, such as water, agitating them together in the liquid, and then separating the liquid.

440,921—November 18, 1890. D. MINDELEFF. *Explosive.*

A compound consisting of ethyl nitrate, methyl nitrate pyroxyline, nitroglycerine, and a nonsensitizing mixture, as nitro-benzene and methyl alcohol.

443,035—December 16, 1890. W. D. BORLAND. *Dynamite.*

Nitroglycerine and carbonized or charred cork.

466,900—January 12, 1892. L. BROWN. *Absorbent of nitro-glycerine.*

A mixture of sodium nitrate, wood pulp, glue, and magnesia.

478,366—July 5, 1892. S. ROGERS. *Explosive compound.*

A mixture of ammonium picrate, 4 parts; ammonium nitrate, 6 parts; and nitroglycerine, 6 parts.

478,844—July 12, 1892. L. BROWN. *Nitro-glycerine blasting-powder.*

A grading and coating mixture, consisting of sodium nitrate, 73 parts; wood pulp, 1 part; sulphur, 12 parts; resin, 11 parts; and paraffine, 3 parts; all by weight.

506,784—October 17, 1893. A. KRANZ. *Dynamite.*

A composition of nitroglycerine, camphor, and gun-cotton dissolved in acetone and sulphuric ether, combined with a composition of linseed oil and oil of turpentine treated with nitrate of ammonia and sulphuric ether.

517,396—March 27, 1894. W. Y. ROCHESTER AND J. McARTHUR. *Dynamite and process of making same.*

A composition of nitroglycerine, whiting, coal, slacked lime, pulverized copperas, sodium nitrate, gum camphor, alcohol, carbonate of ammonia, and water, in specified proportions. It produces no obnoxious gases.

524,776—August 21, 1894. G. J. BUECHERT. *Explosive compound.*

A compound consisting of a protectively coated salt of ammonia, as the sulphate or chloride, and sodium nitrate, with wood pulp and nitroglycerine.

525,188—August 28, 1894. H. A. CALLAHAN. *Dynamite.*

A mixture of nitroglycerine and acetate of lime, with or without pulverized coke.

525,996—September 11, 1894. B. C. PETTINGELL. *Explosive compound.*

Composed of nitroglycerine combined with nitrated coal dust as an absorbent base.

542,724—July 16, 1895. F. G. A. BROBERG. *High explosive.*

It consists essentially of nitroglycerine, nitronaphthalenes, wood-pulp, and sodium nitrate, with or without sulphur or nitro-cellulose.

612,707—October 18, 1898. R. CROWE. *Composition for preventing fumes in mining powders.*

A mixture of unbolted wheat flour, 50 per cent; common salt, 25 per cent; and bicarbonate of soda, 25 per cent; the salt and soda to be finely ground; to be used contiguous to but not mixed with the high explosive.

625,380—May 23, 1899. E. S. CLARK. *Tamping plug and process of and apparatus for making same.*

A new article of manufacture, a tamping plug, designed to neutralize the deleterious fumes of explosives and lessen the heat of the explosion, consists of a perforated cylinder of solid hydrated salt, as mono-carbonate of soda with a small amount of ferric oxide and mono-sulphate of soda, formed by pressing the salt into molds, filling the interstices with a hot saturated solution, cooling and then temporarily heating the mold to form a film of fused salt and admit of the discharge of the block.

644,403—February 27, 1900. E. CALLENBERG. *Explosive.*

It is composed of turpentine oil, 4 parts; collodion cotton, 1 part; and nitroglycerine, 30 parts; heated together to form a gelatine, and mixed with 27 parts of Epsom salts, and 1 part of soda.

647,607—April 17, 1900. R. S. PENNIMAN AND J. C. SCHRADER. *High-explosive compound.*

A mixture of nitroglycerine and a dope containing vulcanized resin—No. 647,606—(homogeneously united resin and sulphur in a pulverized condition).

648,222—April 24, 1900. H. E. STÜRCKE. *Explosive.*

An explosive consisting of an explosive organic nitro compound, as nitroglycerine, an oxygen-consuming absorbent material, ammonium nitrate, and an additional oxidizing material, as sodium nitrate, the oxidizing materials being combined in such proportions that the ammoniun nitrate will furnish from 5 to 20 per cent of the available oxygen.

649,852—May 15, 1900. A. LUCK. *Explosive.*

An explosive containing an explosive organic nitrate, as nitroglycerine and a nonexplosive ester of cellulose, as acetate of cellulose.

SMOKELESS POWDER.

38,789—June 2, 1863. J. F. E. SCHULTZE. *Improved gunpowder.*

Wood grains, formed by punching or cutting veneers, are successively treated to remove acids and easily soluble material, the proteine, albumen, etc., and bleached; then treated with nitric and sulphuric acid mixture, drained, and washed; and finally saturated with a salt or salts containing oxygen and nitrogen, as potassium nitrate with or without barium nitrate. The dust produced is made into a paste, formed into sheets, and then punched or cut into grains and dried, and powder produced therefrom.

89,910—May 11, 1869. O. H. BANDISCH. *Improved explosive compound.*

Schultze gunpowder, No. 38,789, is treated to bath of pure alcohol and ether (one of alcohol to five of ether), dried at 21° to 27° C., and then compressed.

145,403—December 9, 1873. C. DITTMAR. *Improvement in explosive compounds.*

Vegetable fiber is prepared with a solution of sugar, or mannite, or amylum, or inuline, or other described substances, and rendered explosive by nitric acid. The fiber is reduced to a pulp, compressed in a sheet or other compact form, and then reduced to a granulated or powdered condition and treated with acid to render it explosive.

145,403—December 9, 1873. C. DITTMAR. (*Reissues: 5,759—February 10, 1874; 6,645—September 14, 1875.*) *Improvement in explosive compounds.*

Vegetable fiber is converted into a pulp, desiccated and reduced to powder, grains or compact forms, and then treated with nitric or nitric and sulphuric acids. The acid bath may be preceded by a soaking in a starchy or saccharine solution and followed by an alkaline solution. Potassium nitrate or chlorate or nitroglycerine may be added.

179,688—July 11, 1876. C. DITTMAR. *Improvement in explosive compounds.*

An explosive compound having its grains parchmented, whereby they are smooth and nonadhesive, produced by forming grains of vegetable fiber, parchmenting same by sulphuric acid, and then treating with nitric and sulphuric acid bath.

187,155—February 6, 1877. S. J. MACKIE, C. A. FAURE, AND G. FRENCH. *Improvement in explosive compounds.*

It consists of a mixture of nitro cellulose, say 25 parts, reduced to an impalpable powder, nitrate of baryta 18½ parts, and nitrate of potassium 6½ parts.

267,108—November 7, 1882. W. F. REID AND D. JOHNSON. *Hardening explosive granulated powders containing nitro-cellulose, etc.*

The granulated powder is moistened with a spirit, which is then evaporated.

376,000—January 3, 1888. D. JOHNSON. *Process of preparing explosives.*

Dinitro cellulose is incorporated with barium and potassium nitrates and carbon, the mixture treated with a solution of camphor in a volatile liquid not a solvent of dinitro cellulose—such as light petroleum or benzoline—the solvent evaporated at a low temperature, the camphorized material then subjected to a temperature high enough to change the mechanical state of the dinitro cellulose, and finally the camphor expelled.

409,549—August 20, 1889. F. A. ABEL AND J. DEWAR. *Nitro-gelatine explosive.*

Blasting gelatine or compounds thereof is pressed through holes and formed into wires, cut into lengths, and packed in cartridge cases.

411,127—September 17, 1889. H. MAXIM. *Method of producing high explosives.*

Gun-cotton or nitro cellulose is dissolved in a suitable solvent, such as acetone or ethylic acetate, the solution added to nitroglycerine, and the solvent evaporated from the mixture.

423,230—March 11, 1890. S. H. EMMENS. *Explosive.*

It consists of paper or paper stock converted into a nitro compound and impregnated with ammonia and picric acid.

425,648—April 15, 1890. F. A. ABEL AND J. DEWAR. *Gelatinous explosive.*

A gelatinous explosive consisting of nitroglycerine and nitro cellulose to which tannin is added (from 10 to 20 per cent).

429,516—June 3, 1890. R. VON FREEDEN. *Manufacture of gunpowder.*

Nitro cellulose, or a compound thereof with other substances, is gelatinized and granulated by adding a solvent of the nitro cellulose, kneading until it has become plastic and thoroughly gelatinized, and then introducing a liquid or vapor chemically indifferent to the constituents of the mass, as water or steam, and stirring until complete granulation.

430,212—June 17, 1890. H. S. MAXIM. *Manufacture of explosives.*

Gun-cotton is reduced to a pulp, washed and dried, confined in a receiver and the air exhausted therefrom, when the vapor of acetone or its equivalent is admitted to the receiver, and the dissolved gun-cotton is then expelled by pressure.

434,049—August 12, 1890. H. S. MAXIM. *Explosive compound.*

It consists essentially of gun-cotton or pyroxyline mixed with nitroglycerine and an oil such as castor oil; produced by mixing and agitating the same with a proportion of a solvent, such as acetone, insufficient to entirely dissolve the gun-cotton, and subjecting the product in a partial vacuum to the action of vaporized acetone, and then to pressure.

436,898—September 23, 1890. H. S. MAXIM. *Manufacture of explosives.*

Gun-cotton is reduced to pulp, dried, and subjected in a receiver to the action of a vaporized solvent, as acetone, until it is partially dissolved, when it is compressed by a high pressure—20 to 40 tons per square inch—and the sheet cut into pieces or grains.

456,508—July 21, 1891. A. NOBEL. *Celluloid explosive and process of making the same.*

Hard, horny grains, containing nitro cellulose and nitroglycerine, solid at ordinary temperatures; produced by uniting nitro cellulose and nitroglycerine by means of a volatile solvent, as acetone, camphor, or the like—say in the proportions of equal parts of nitro cellulose and nitroglycerine plus camphor—removing the volatile solvent, passing between steam heated rolls, and cutting the sheets into grains.

489,684—January 10, 1893. C. E. MUNROE. *Explosive powder and process of making same.*

It consists wholly of cellulose nitrate of high nitration in a colloidized and indurated condition; produced by first extracting from gun-cotton the lower products of nitration, then mixing and incorporating with it a liquid colloidizing agent capable of converting at ordinary temperatures the higher cellulose nitrates into viscous form, as nitro-benzene, then forming the material into strips or grains, and finally indurating it by the action of heated liquids or vapors, as water or steam, or both.

503,583—August 22, 1893. F. G. & P. S. DU PONT. *Process of making smokeless explosives.*

Nitro cellulose is suspended in a liquid, such as water, which is not a solvent of the same, and in which may be dissolved a suitable salt; granulated by agitating therewith in proper proportions a suitable solvent, as nitro-benzole, not miscible in the suspending liquid, with or without the injection of steam; the grains being hardened and rounded by rotation, and further solidified by rotation in an atmosphere of steam.

503,585—August 22, 1893. F. G. & P. S. DU PONT. *Process of making smokeless powder.*

As a modification of process No. 503,583, the grains are solidified by subjecting them to a heat ranging from 49° to 82° C., to remove the water contained in the grains, but not high enough to vaporize the solvent, and then to a heat sufficient to vaporize the solvent for removal of the excess of solvent.

503,587—August 22, 1893. F. G. DU PONT. *Process of making smokeless explosive.*

Process No. 503,583 is modified by forming an emulsion of the solvent, nitrobenzole, with water in proper proportions, and then adding it to the nitrocellulose suspended in water.

507,279—October 24, 1893. M. E. LEONARD. *Smokeless powder.*

Composed of nitroglycerine, gun-cotton, lycopodium, and a neutralizer of free acid, such as urea crystals or dinitrobenzol, with or without an oil, as cottonseed oil.

513,737—January 30, 1894. E. A. STARKE. *Smokeless powder.*

A combination of an ammonium chromate, potassium picrate, and ammonium picrate.

519,702—May 15, 1894. F. G. DU PONT. *Manufacture of smokeless powder.*

A volatile oil, and preferably a hydrocarbon oil, as benzine, is mixed with the solvent emulsion of processes No. 503,587 and 503,583. The excess of solvent and the oil is removed from the grains by distillation, after hardening.

522,987—July 17, 1894. F. G. DU PONT. *Smokeless explosive.*

Nitro cellulose is suspended in an oil, as hydro-carbon oil; granulated by agitating therewith in suitable proportions a solvent which, though soluble in the suspending oil, has a solvent action on the nitro cellulose, as acetone; the grains hardened by rotation; the excess of solvent removed; and finally the oil removed from the grains.

541,909—July 2, 1895. G. N. WHISTLER AND H. C. ASPINWALL. *Smokeless powder.*

A mixture of nitroglycerine, gun-cotton, a nitrate such as barium nitrate, petrolatum, and urea crystals.

541,910—July 2, 1895. G. N. WHISTLER AND H. C. ASPINWALL. *Smokeless gunpowder.*

Composed of nitroglycerine, trinitrocellulose, a nitrate and a neutralizer of free acid, such as urea crystals, the proportion of nitrate to the trinitrocellulose being about 45 to 100, so that the combustion of the gun cotton shall be substantially similar to that of the nitroglycerine.

541,911—July 2, 1895. G. N. WHISTLER AND H. C. ASPINWALL. *Smokeless powder.*

A compound of nitroglycerine, gun-cotton, a nitrate as barium nitrate, a resin and urea crystals. The fossilized or mineral gum kauri is claimed as a deterrent in a nitroglycerine, gun-cotton, and a nitrate mixture.

542,812—July 16, 1895. J. V. SKOGLUND. *Method of making smokeless powder.*

The drying of grains of powder containing nitrated cellulose is insured by combining with the solvent, water and a vehicle such as alcohol, and dissolving the nitrated cellulose in the liquid, rendering the material porous by the presence of the water as the solvent evaporates.

544,517—August 13, 1895. W. C. PEYTON. *Process and apparatus for making gunpowder.*

The plastic mass is forced through a die and formed into a tube, split, and spread into a flat sheet; passed between grooved rollers and formed into strips or rods connected by films, and then beneath a vertically reciprocating cutter, whereby the strips are cut into grains.

550,472—November 26, 1895. J. B. BERNADOU AND G. A. CONVERSE. *Process of making nitrocellulose powders.*

Two or more nitrocelluloses of known nitration strength are mixed in such proportions as to give a product of desired nitration strength, an oxidizing agent and camphor are added, the mass is colloided with a solvent capable of dissolving the highest form of nitrocellulose present, and it is made into regular forms of uniform least dimension.

552,919—January 14, 1896. H. MAXIM. *Cellular explosive charge.*

An amorphous explosive charge having a multiplicity of interior cells, formed by rolling a sheet of the colloid material, having regular cells or depressions, into a cylinder form. The cells may be filled with granular powder, and the charge exteriorly coated with celluloid or varnish difficult of ignition with respect to the interior of the mass.

559,638—May 5, 1896. M. VON FÖRSTER. *Process of making smokeless powder.*

Flakes having a corrugated or wavy surface are produced by forming a paste of incompletely-gelatinized nitrocellulose into thin bands, cutting these bands into flakes, and rapidly drying the flakes.

568,902—October 6, 1896. F. A. HALSEY. *Smokeless powder.*

A compound of strontium nitrate, ammonium picrate, potassium bichromate and potassium permanganate.

570,705—November 3, 1896. F. A. HALSEY. *Smokeless powder.*

A compound of an ammonium picrate, potassium bichromate, and potassium permanganate.

575,765—January 26, 1897. G. G. ANDRÉ. *Manufacture of gunpowder.*

A compound of dinitro and trinitro cellulose is granulated or reduced to pellets in a wet state, and then subjected to the action of a solvent capable of dissolving the dinitrocellulose only, whereby the trinitrocellulose particles are coated with and cemented together by the dissolved dinitrocellulose, and the granules are then hardened by removal of the solvent.

576,532—February 9, 1897. G. G. ANDRÉ. *Manufacture of gunpowder.*

A base consists of 2 parts of trinitrocellulose and 1 part of dinitrocellulose; the same is combined with nitroglycerine, forming a tough, leathery, and translucent explosive.

583,489—June 1, 1897. H. KOLF. *Process of making smokeless powder.*

A carbohydrate is nitrated, then treated with an alkaline sulphide, then saturated with an alkaline nitrate, then a nitro product as nitro-molasses (or nitro-sugar or nitro-glycerine) is mixed therewith and the compound is converted into a gelatinous body by means of a suitable solvent.

586,586—July 20, 1897. J. B. BERNADOU. *Smokeless powder and process of making same.*

An ether-alcohol colloid of nitrocellulose of substantially uniform nitration, or 12.45 per cent nitrogen and corresponding to the formula $C_{30}H_{38}(NO_2)_{12}O_{25}$, with which nitrates of metallic bases and insoluble nitrocellulose, either or both, may be incorporated. It may be in form of strips or grains. It is insoluble in ethyl alcohol alone, soluble in 3 parts ethyl alcohol and 1 part ethylic ether, and is produced by immersing cellulose in a mixture of nitric and sulphuric acids and heating to between 42° and 46° C., freeing the product from excess of acid by washing and pulping in water below 71° C., dehydrating and washing in excess of alcohol, and then colloiding in a mixture of ethylic alcohol and ethylic ether.

590,931—September 21, 1897. F. G. DU PONT. (*Reissue: 11,651—February 15, 1898.*) *Process of and apparatus for making smokeless powder.*

Wet gun cotton is compressed until of equal porosity throughout, when the water is displaced with alcohol by percolation under pressure, the gun-cotton is compressed until only the alcohol desired to combine with a colloidizing solvent remains, which solvent, such as ether, is then mixed with the alcoholized gun-cotton.

592,485—October 26, 1897. C. W. VOLNEY. *Process of making gunpowder.*

Grains containing trinitrocellulose are given a surface coating of dinitrocellulose by reducing the trinitrocellulose upon such surface to dinitrocellulose by reducing agents, as by the sulphites or hyposulphites of potassium, sodium, or ammonium.

596,324—December 28, 1897. F. A. HALSEY. *Smokeless powder.*

A compound consisting of an alkaline-metal chromate, an alkaline earth metal nitrate, ammonium picrate, an alkaline-metal permanganate, and an alkaline-metal silicate.

597,565—January 18, 1898. C. QUINAN. *Process of making gun cotton.*

An essentially ash-free hydrocellulose is produced by steeping fiber in a bath of heated mineral acid capable of dissolving the mineral matter, washing out the mineral matter with a weak acid bath, and finally heating the same to complete the conversion. It is then pulverized and nitrated.

599,589—February 22, 1898. J. E. BLOMÉN. *Process of making explosives.*

Process consists in dissolving nitro, and nitrohydroxyl, hydrocarbon derivatives, preferably nitronaphthalene, with a volatile organic solvent, such as amyl acetate; then adding to the composite solvent thus obtained cellulose nitrates and an oxidizing agent; and finally drying and granulating the compound.

617,766—January 17, 1899. G. M. PETERS. *Explosive and process of making same.*

A powder composed of pulverized nitrated wood-pulp, 20 per cent; saltpeter, 60 per cent; charcoal, 12 per cent; and brimstone, 8 per cent; produced by separately reducing the ingredients to powder, nitrating, washing, and drying the cellulose dust, mixing the dust of the four ingredients, thoroughly incorporating the mass until it is worked into a single substance, and granulating.

622,777—April 11, 1899. F. H. McGAHIE. *Powder-grain.*

A multiperforated powder grain, designed to have powder partitions of equal thicknesses; as a central perforation and a surrounding concentric row of segmental-shaped perforations.

625,365—May 23, 1899. E. A. G. STREET. *Process of making explosives.*

Pitch or tar, with or without an azo or nitro derivative, is dissolved in oil, while heating the latter, and chlorate powder added while maintaining the solution fluid by heat.

625,682—May 23, 1899. F. W. JONES. *Process of making explosives.*

In the manufacture of a gelatinized smokeless powder of a nitrocellulose base the grains are swelled to regulate rate of combustion by acting on them with an aqueous solution of a nitrocellulose solvent, as a ketone; the same is saturated with any ingredients of the grain soluble therein which would otherwise dissolve out of the powder.

625,684—May 23, 1899. J. KARSTAIRS. *Explosive and method of making same.*

A compound, $CH_3N_3O_5$, consisting of a crystalline body soluble in water, sp. gr. 1.8, produced by slowly nitrating a mixture of urea and alcohol. It is combined with gum to form a protecting coating, and with nitrated cellulose.

625,685—May 23, 1889. J. KARSTAIRS. *Explosive.*

The combination of a chlorate with the crystalline body $CH_3N_3O_5$ (No. 625,684), the latter having a protective coating.

625,908—May 30, 1899. E. A. G. STREET. *Explosive and method of making same.*

A compound of a chlorate powder mixed with a solution of a nitric ether, as nitroglycerine, an analogous combustible substance wherein the former is soluble, as nitronaphthaline, and an oil derived from organic substance, as castor oil; produced by forming at an elevated temperature a solution of the nitroglycerine, nitronaphthaline, and castor oil, and adding thereto the chlorate powder.

627,436—June 20, 1899. A. MOFFATT. *Process of making nitro-explosives.*

Nitrate of starch is produced by drying until practically free from moisture, cooling, nitrating in a bath at or below 4° C., diluting the mixture with water sufficient to lower its sp. gr. to below 1.30, washing, neutralizing, and drying, whereby the product consists of unruptured granules, and its stability is insured.

633,611—September 26, 1899. F. G. & F. I. DU PONT. *Process of making explosives.*

Alcohol is mixed with nitrocellulose (displacing the water of wet cotton by percolation), and a solution of nitroglycerine in ether is then mixed with the alcoholized nitrocellulose.

640,213—January 2, 1900. H. MAXIM AND R. C. SCHUPPHAUS. *Process of making smokeless powder.*

Pyroxyline, preferably of varying degrees of nitration, pulped or reduced to a fine state of division, is treated with a solvent, and before it is completely freed from the solvent it is treated with a size, and then granulated and dried.

648,147—April 24, 1900. F. I. DU PONT. *Process of making gun-cotton.*

Acid is removed from gun-cotton by applying pressure, and then, while under pressure, replacing the acid with water by percolation, which, in turn, may be replaced with an alkaline fluid by percolation.

652,455—June 26, 1900. J. B. BERNADOU. *Process of making smokeless powder.*

A colloid powder is formed by subjecting soluble nitrocellulose and a colloiding agent, as ether, in a closed vessel to a temperature equal to or below that of freezing water, mechanically agitating or kneading the cooled mixture, and then forming it into shapes and drying.

652,505—June 26, 1900. J. B. BERNADOU. *Smokeless powder.*

An ether colloid of ether-alcohol-soluble nitrocellulose of high nitration; produced by immersing ether-alcohol-soluble nitrocellulose in ethyl ether and exposing to a temperature of 0° C, or lower.

654,471—July 24, 1900. H. S. MAXIM. *Powder-grain.*

A nitro-compound explosive block or tablet (in part of a slow-burning and in part of a quick-burning character), has concentric annular depressions in each face, with tapered cavities in the walls, the cavities on opposite sides breaking joint.

NITRO-SUBSTITUTION COMPOUNDS.

76,173—March 31, 1868. G. DESIGNOBLE AND J. CASTHELAZ. *Improvement in explosive-powders.*

The use of picrate or carbazotate of potassa, as well as the salts formed from picric or carbazotic acid, the derivatives from such acid, and the acid itself, is claimed in the manufacture of powder; as 55 parts of carbazotate of potassa with 45 parts of azotate of potassa, for the greatest effect.

96,248—October 26, 1869. W. MILLS. *Improved explosive compound.*

The use of carbolic acid and aloes in explosive compounds; and an explosive formed of carbolic acid, nitric acid, potassa, and aloes.

112,163—February 28, 1871. W. MILLS. *Improvement in explosive compounds.*

"Oxidized carbolic acid," a wax-like product, produced by treating carbolic or cresylic acid with nitric acid, alone or combined with metal or metallic or earthy oxides or their carbonates, also with sawdust or other ligneous substances treated with niter. Combined with alcohol, spirits, or ether, and metal or metallic oxides it forms an explosive varnish.

124,397—March 5, 1872. C. W. VOLNEY. *Improvement in explosive compounds.*

A mixture of nitroglycerine and nitrotoluol or nitrobenzole, as by dissolving 3 parts of nitrotoluol in 7 parts of nitroglycerine.

178,277—June 6, 1876. A. DIECKERHOFF. *Improvement in explosive compounds.*

It is composed of sawdust which has been saturated with a solution of picric acid and potassium nitrate dissolved in boiling water and then desiccated, mixed with potassium nitrate, sodium nitrate, and sulphur. It is granulated while damp or formed into sticks.

215,199—May 6, 1879. A. DIECKERHOFF. *Improvement in explosive compounds.*

It consists of gunpowder, or the essential elements thereof—the charcoal not being essential—mixed with a small proportion (not over 15 per cent) of a precipitated alkaline picrate or picrates.

216,949—July 1, 1879. C. FELHOEN. *Improvement in blasting powder.*

A composition of niter, sulphur, and charcoal, in the usual proportions of gunpowder, mixed with nitro-naphthaline; 10 per cent or more should be used.

232,381—September 21, 1880. M. TSCHIRNER. *Explosive compound.*

It consists of picric acid and potassium chlorate, say in the proportion of 57 parts of the former to 43 of the latter. They are incorporated with the aid of 5 per cent of resin dissolved in a volatile solvent.

243,432—June 28, 1881. S. R. DIVINE. *Explosive compound.*

It consists of a solid ingredient, such as potassium chlorate, 3 to $4\frac{1}{2}$ parts, and a liquid ingredient, such as nitro-benzole, 1 part, mechanically united.

263,824—September 5, 1882. E. TURPIN. *Explosive compound.*

A compound of peroxide of nitrogen or hyponitric anhydride with sulphuret of carbon, or its equivalent. If slowly ignited it produces an intense light, without explosion, and the flame instantly melts platinum.

289,755—December 4, 1883. S. R. DIVINE. *Process of preparing explosive compounds.*

An explosive composed of two ingredients, one a solid—such as potassium chlorate—and the other a liquid—such as nitro-benzole—is prepared by saturating the powdered potassium chlorate with a mixture of the nitro-benzole and a volatile fluid, such as carbon bisulphide, and then allowing the volatile fluid to evaporate; the proportions being such as to give the proper proportion of nitro-benzole for the mass.

289,757—December 4, 1883. S. R. DIVINE. *Explosive compound.*

From 1 to 3 per cent of sulphur is combined with the moist mass of No. 243,432 (potassium chlorate and nitro-benzene).

289,758—December 4, 1883. S. R. DIVINE. *Explosive compound.*

It is composed of a solid ingredient—4 or 5 parts—such as potassium chlorate, and a liquid ingredient—1 part—consisting of a mixture of nitro-benzole and dead-oil, the latter being mixed in about equal proportions.

289,763—December 4, 1883. S. R. DIVINE. *Explosive compound.*

From 1 to 3 per cent of sulphur is combined with the moist mass of No. 289,758 (potassium chlorate with nitro-benzole and dead-oil).

374,921—December 20, 1887. G. ANTHEUNIS. *Blasting powder.*

It consists of mahogany sawdust, 8 per cent; potassium nitrate, 50 per cent; sodium nitrate, 16 per cent; charcoal, 1.5 per cent; sublimated sulphur, 18 per cent; potassium ferrocyanide, 3 per cent; and ammonium picrate, 3.5 per cent. (Potassium nitrate is omitted in the claim.)

375,651—December 27, 1887. C. ROTH. *Explosive.*

The combination of a chlornitro-hydrocarburet of the aromatic series, as chlornitro-benzol, with an oxidant, such as ammonium nitrate.

376,145—January 10, 1888. S. H. EMMENS. *Explosive derived from phenol.*

A crystalline acid compound is produced by the action of heated concentrated or fuming nitric acid, of sp. gr. 1.52 or higher, upon picric acid in excess, and the crystallization of the liquid. Explosive compositions or pastes are produced by dissolving 2 parts of the same in 1 part of concentrated nitric acid.

403,749—May 21, 1889. J. A. HALBMAYR. *Manufacturing explosives.*

In the manufacture of explosives from tar oils the oils are introduced in a state of division below the surface of a body of nitrating acid, as by a perforated pipe, and cold air under pressure is introduced at the same point, to cool the liquid.

417,429—December 17, 1889. W. E. LIARDÊT. *Manufacture of explosives.*

In the manufacture of explosives containing picric acid and potassium nitrate, or its equivalents, the picric acid is mixed with boiling-hot glycerine, potassium nitrate is added and the mixture cooled, ground wood is then added to the cooled mass, boiling-hot potassium nitrate is added to the mixture, and finally flowers of sulphur.

421,662—February 18, 1890. B. BRONCS. *Explosive compound.*

It is composed of a double salt combination of sodium picrate with other picrates (No. 421,753), potassium nitrate, saccharine matter, a gummy or resinous substance, and soot, with or without nitrated naphthaline.

421,753—February 18, 1890. B. BRONCS, H. ORTH, ADM'R. *Explosive compound.*

A double picrate consisting of sodium picrate combined with barium or lead picrate.

422,514—March 4, 1890. S. H. EMMENS. *Manufacture of explosives.*

A suitable hydrocarbon substitution derivative, as trinitrophenol, is fused; a suitable alkaline nitrate, as sodium nitrate, is added thereto; and the heat gently raised until actual liquefaction of the mixture is attained, when it is allowed to cool.

422,515—March 4, 1890. S. H. EMMENS. *Manufacture of explosives.*

The crystalline acid of No. 376,145 is heated with an allied nitro-hydrocarbon, as dinitrobenzene, which reduces the fusing point of the acid; a pulverized oxidant is then mixed therewith, and the mixture is cooled.

435,142—September 2, 1890. C. LAMM. *Manufacturing explosive charges.*

Pulverized partially-fusible explosive material is introduced, into molds surrounded by a heating chamber, then a heating medium is passed through said chamber to melt the contents of the molds, then cold water is passed through said chamber to solidify the explosive material, and finally the charges or cartridges are ejected.

455,217—June 30, 1891. C. LAMM. *Explosive compound.*

Composed of a nitrate salt, as ammonium nitrate, and dinitro-benzene or dinitro-benzol.

478,819—July 12, 1892. A. C. RAND. *Explosive compound.*

It consists of an oxidant, as chlorate of potash, in a powdered form, and manganese peroxide in the form of coarse grains mixed with the oxidant, say equal parts, and a fluid hydrocarbon, as nitro benzol, say 15 per cent by weight, incorporated therewith.

488,534—December 27, 1892. J. F. ALEXANDER. *Explosive.*

A powder composed of naphthaline or a suitable solid hydrocarbon, sulphur, a potassium salt or salts, and ammonium picrate, with or without ammonium sulphate.

492,089—February 21, 1893. B. LEPSIUS. *Preparing explosive compounds.*

A mixture of picric acid and an enveloping explosive agent, such as tri-nitro-toluol, is heated, in a mold, to a point above the fusing point of the latter ingredient and below that of the former—to avoid fusing the crystals of the acid—and then cooled, thus cementing the crystals together.

495,178—April 11, 1893. J. E. BLOMÉN. *Method of making blasting compounds.*

Picric acid and a hydrocarbon, as naphthalene, are separately dissolved in alcohol, the solutions mixed, and the resulting picrated hydrocarbon dissolved in nitroglycerine.

506,031—October 3, 1893. J. E. BLOMÉN. *Manufacture of blasting compounds.*

A hydrocarbon is first treated with nitric acid; the product is then treated with a mixture of nitric and sulphuric acids, and this second product is then treated with strong nitric acid, and finally incorporated with an oxidizing agent.

506,032—October 3, 1893. J. E. BLOMÉN. *Blasting compound.*

The granules of an oxidizing agent have a coating composed of a mixture of a hydrocarbon and dinitro-phenol.

521,020—June 5, 1894. W. EVELYN-LIARDÊT. *Explosive and process of making same.*

A mixture of tar, picric acid, sawdust, the chloride and the perchlorate of an alkali metal; produced by heating the tar to 120° C., adding the picric acid, gradually adding the sawdust, heating the mixture to about 100° C., cooling and passing through a sieve, adding to the sifted product a suitable mixture of the perchlorate and chloride of an alkali metal, at the same time heating the mass until it assumes a black color, cooling and granulating.

527,563—October 16, 1894. E. A. STARKE. *Process of making ammonium bichromate.*

A solution of ammonium picrate and a solution of potassium bichromate are mixed, through which crystals of potassium picrate form, which are removed, leaving an ammonium bichromate solution that is evaporated to dryness. An explosive compound is formed by mixing the solutions in proper proportions, ammonium picrate being in excess, and evaporating the resultant mixture of ammonium picrate, ammonium bichromate, and potassium picrate to dryness.

530,063—November 27, 1894. J. E. BLOMÉN. *High-power explosives.*

A mixture of nitro-naphthalenes, an oxidizing agent, a mixture of nitrophenols, sulphur, and charcoal.

540,141—May 28, 1895. F. G. A. BROBERG. *Explosive compound.*

A composition of nitro-resin, say, 6 to 10 per cent; nitro-naphthalenes, 5 to 10 per cent; sulphur, 14 or 15 per cent; and an oxidizing agent, such as sodium nitrate, 70 per cent.

540,647—June 11, 1895. S. R. DIVINE. *Explosive compound.*

It is composed of nitrate of lead and a nitrated hydrocarbon of the benzol series, which is of itself nonexplosive, such as dinitro-benzol; 1 part of the latter is melted and 4 parts of the former is mixed therewith.

567,536—September 8, 1896. E. DICKSON. *Gunpowder.*

It consists of a granulated mixture of barium nitrate, flour, potassium ferrocyanide, picric acid, ammonia, potassium chlorate, and lampblack, coated with refined petroleum which has been treated with nitric acid, sulphuric acid, and ammonia.

577,351—February 16, 1897. H. BOYD. *Explosive.*

A mixture of potassium nitrate, sulphur, barium nitrate, picric acid, wood-dust, and a fume absorbent, such as dry pulverized bog ore or other hydrated oxide of iron; characterized by firing without a detonator and absorbing the noxious gases.

594,268—November 23, 1897. F. MÜLLER, S. OBERLÄNDER, V. H. FUCHS, AND S. GOMPERZ. *Blasting powder and process of making same.*

A compound composed of picrate combined with sulphur, nitrate of potassium, and a carrier, such as nitrated cellulose, with or without a substance yielding free oxygen, such as pyrolusite. The process consists in mixing sulphur and carbolic acid; also mixing nitrate of potassium and nitric acid, and then combining the two mixtures and neutralizing with an alkali.

598,064—January 25, 1898. W. P. FERGUSON. *Blasting compound.*

In a granular blasting compound in which the oxidizing agent is coated with a film containing a nitrophenol and a hydrocarbon, lampblack is intermixed with the elements of the film.

598,618—February 8, 1898. E. A. G. STREET. *Explosive and method of making same.*

The combustible agent, such as nitro or azo derivative, or combination thereof, is mixed with an oil at an elevated temperature which is not a solvent thereof at ordinary temperature in such proportion that on cooling it assumes a pasty or solid consistence, and the chlorate powder is mixed therewith, the fluidity being maintained during maxilation. The combustible element is composed of a solution in oil of a less soluble combustible body, such as picric acid, combined with a more soluble body of the same class.

622,800—April 11, 1899. G. M. HATHAWAY. *Detonating compound.*

It is composed of the ingredients of gunpowder with nitronaphthalene, nitrophenol, sodium nitrate, and potassium chlorate, combined in such proportions as to form a detonating compound of low grade.

622,990—April 11, 1899. H. BOYD. *Blasting powder.*

A fumeless explosive, consisting of sodium nitrate, sulphur, picrate of ammonia, and potassium bichromate, with or without commercial lime, cottonseed oil, and peat dust, one or all of them.

625,499—May 23, 1899. F. A. HALSEY. *Gunpowder.*

It consists of picrate of ammonia, 47 per cent; potassium bichromate, 23 per cent, and barium nitrate, 30 per cent.

649,913—May 22, 1900. S. CLARK. *Explosive compound.*

A mixture of sodium nitrate, 19 parts; antimony, $2\frac{1}{2}$ parts; sulphur, 3 parts; charcoal or coke, $3\frac{1}{2}$ parts; picric acid, one-third part; nitric acid, one-third part, and a reducer, such as resin, one-half part.

FULMINATES, PRIMING COMPOSITIONS, AND FUSES.

August 21, 1834. S. GUTHRIE. *Improvement in the manufacture of percussion powder.*

Grains of powder are coated with shellac and before they are dry they are rolled in leaf metal, or any of the metallic powders, with bisulphuret of tin or other metal or metallic compound. After coating they may be again coated with a waterproof varnish.

18,016—August 18, 1857. M. KLING. *Improvement in percussion powder.*

A mixture of antimony, 1 ounce; and potassium chlorate, 1 ounce, with equal proportions of glue dissolved in boiling water, and oxalic acid dissolved in boiling water.

18,199—September 15, 1857. E. GOMEZ AND W. MILLS. *Improvement in safety-fuse compositions.*

A mixture of equal parts of potassium chlorate and ferrocyanide of lead. It is mixed with alcohol and applied as a paint to a strip of paper, and protected by a winding of tape of fibrous material.

35,477—June 3, 1862. F. M. RUSCHHAUPT AND J. SCHULTE. *Improved percussion powder.*

Tannin or pyrogallic acid, or analogous substances, are mixed in chemical proportions with potassium chlorate, a varnish being added as a binder.

38,424—May 5, 1863. L. SHORT. *Improved composition for filling shells.*

A mixture of saltpeter, 7 pounds; asphaltum, 6 pounds; antimony, 2 pounds; sulphur, 7 pounds; and naphtha, 2 gallons, is allowed to stand and settle, and the sediment is pressed into shells, forming combustible missiles to be used with explosive projectiles. The liquid combined with vegetable fiber is also packed in explosive shells.

38,994—June 23, 1863. I. P. TICE. *Improvement in concussion fuse for shells.*

An admixture of fulminates with cotton, gun cotton, wool, sawdust, or other soft material, prevents premature ignition, or the fulminate chamber is lined with soft material. Two fulminates are used, one sensitive and easily ignited and the other burning slower and with a stronger flame. The percussion-fuse plug is of special construction.

41,259—January 12, 1864. H. HOCHSTÄTTER. *Improved composition for percussion caps, etc.*

Chloride of lead, 12 parts, is combined with potassium nitrate, 8 parts, and gum amber, 3 parts.

47,677—May 9, 1865. J. S. BICKFORD. *Improved fuse for blasting, etc.*

A central strand or core of gun-cotton is used in a fuse as a substitute for gunpowder.

48,460—June 27, 1865. H. B. STOCKWELL. *Improved fulminating compound.*

A mixture of fulminating mercury, 4 parts; saltpeter, 3 parts; black sulphuret of antimony, 2 parts; and French chalk, 1 part.

49,474—August 15, 1865. H. HOLDEN. *Improved torpedo.*

A sheet of absorbent paper saturated wholly or in part with a solution of fulminate of silver or of mercury.

56,167—July 10, 1866. G. BOLDT. *Improved fulminating composition.*

Fifteen parts of fulminating silver—formed by dissolving 1 part of mercury, in weight, in 10 parts of nitric acid, then boiling with 12 parts of alcohol, cooling and drying—is mixed with 1½ parts of sulphur-tin—formed by melting together 2 parts of sulphur and 3 parts of tin—and 3 parts of flour and 1 part of powdered charcoal, with a little gum water.

67,714—August 13, 1867. H. BUCHNER AND F. EBERTZ. *Improved fulminating powder for needle-guns.*

A mixture of potassium chloride, sulphur, charcoal, saltpeter, potassium chlorate, antimony, and gum, in about equal proportions.

69,206—September 24, 1867. J. GOLDMARK. *Improved fulminating compound.*

The sulphocyanite of a metal or other base, as the sulphocyanite of lead, is used in combination with potassium chlorate, either with or without other substances.

81,036—August 11, 1868. C. H. F. THIEME. *Improved priming for needle-guns.*

A composition having hyposulphite of any metal as a base, as a mixture of hyposulphite of silver or lead, 1 part; sulphureted antimony, 4 parts; potassium chloride, 10 parts; sulphur, 3 parts; and white sugar one-fourth part.

81,057—August 11, 1868. B. BURTON. *Improvement in the manufacture of water-proof percussion caps, etc.*

Shellac or other gum resin, mixed with alcohol or other readily evaporable solvent, is used in the compounding of fulminating matter.

93,113—July 27, 1869. G. M. MOWBRAY. *Improved method of exploding nitro-glycerine.*

An electrical fuse is composed of a priming composition, inclosing circuit wires at their point of interruption, in combination with an intermediate priming charge of fulminate of mercury, all inclosed in a cylinder.

96,465—November 2, 1869. G. M. MOWBRAY. *Improved compound for priming electric fuses.*

A mixture of phosphorus, sulphur, silver, mercury, and potassium chlorate; so as to form a mixture of subphosphide of silver with subsulphide of silver and potassium chloride, to which is added sulphide of mercury.

97,843—December 14, 1869. R. WHITE. *Improvement in metallic cartridges.*

The fulminate powder is mixed with india rubber or similar elastic substance. The structure of the cup is claimed.

103,931—June 7, 1870. W. H. ROGERS. *Improved fuse composition.*

A composition of powdered charcoal, 20 parts; powdered glass, 10 parts; potassium chlorate, 10 parts; and dissolved india rubber, 30 parts; with sufficient bisulphide of carbon to impart a tough and waxy character.

128,241—June 25, 1872. G. M. MOWBRAY. *Improvement in compounds for priming electric fuses.*

A mixture of mercuric sulphide, amorphous or crystalline—preferably the crystalline—3 parts, and potassium chlorate, 1 part.

139,192—May 20, 1873. E. A. L. ROBERTS. *Improvement in treating explosive compounds to render them safe for blasting and other purposes.*

Explosives, such as fulminates, are combined with water or other liquid, or with a hygrometric salt, so as to form a paste. Moist compounds are exploded by igniting near them or in contact a fulminating or detonating material. Moist or wet compounds are combined in the same charge with dry powder capable of being exploded by a spark or with percussion powder.

152,790—July 7, 1874. C. A. & I. S. BROWNE. (*Reissue: 6,664—July 27, 1875.*) *Improvement in explosive compounds.*

An electrically explosive compound, consisting of pulverized fulminate of mercury intermixed with particles of metal, as antimony, with or without antimonic sulphide or other ingredients.

157,866—December 15, 1874. I. M. MILBANK. *Improvement in explosive compounds.*

A fulminating compound of potassium chlorate, 80 parts; charcoal, 35 parts; and red phosphorus, 4½ parts.

157,857—December 15, 1874. I. M. MILBANK. *Improvement in explosive compounds.*

A fulminating compound of potassium chlorate, 20 parts; prussiate of potash, 10 parts; and red phosphorus, 1 part.

161,430—March 30, 1875. G. M. MOWBRAY. *Improvement in primings for electric fuses.*

A composition of metallic antimony and fulminate of mercury, as a priming for electric fuses.

161,431—March 30, 1875. G. M. MOWBRAY. *Improvement in primings for electric fuses, etc.*

A composition of bismuth and fulminate of mercury.

161,432—March 30, 1875. G. M. MOWBRAY. *Improvement in primings for electric blastings, etc.*

A composition of cadmium and fulminate of mercury; being a mixture of the double-salt mercuric fulminate of cadmium, with an amalgam of mercury and cadmium.

170,066—November 16, 1875. H. J. DETWILLER. *Improvement in explosive compounds.*

A detonating compound consisting of ground bark or sawdust, 5 parts; potassium chlorate, 10 parts; and red phosphorus, 1 part. (Especially adapted for railroad-torpedoes.)

179,067—June 20, 1876. J. D. & W. C. SCHOOLEY. *Improvement in detonating compounds.*

A mixture of potassium chlorate, 3 parts; sulphur, 1 part; and broken glass, 1 part. (For railroad torpedoes.)

184,043—November 7, 1876. W. A. LEONARD. *Improvement in continuous fuse.*

Formed of xylonite, coated with a match composition. (To be used from an air-tight case.)

217,534—July 15, 1879. E. S. HUNT. *Improvement in pyrotechnic cartridges.*

A star having a drop of fulminate secured to its base by shellac dissolved in alcohol. The structure of the cartridge is claimed.

228,935—June 15, 1880. J. A. ROBINSON AND R. H. DIMOCK. *Deflagrating compound.*

Amorphous phosphorus combined with plumbic plumbate and potassium chlorate, produced by mixing, the amorphous phosphorus with sufficient hot water to render the whole mixture of a fluid consistency, adding plumbic plumbate in small quantities with stirring till effervescence ceases, and then adding potassium chlorate in quantity equal to that of the amorphous phosphorus, and thoroughly mixing.

233,406—October 19, 1880. C. A. FAURE AND G. TRENCH. *Detonator.*

A detonating compound of fulminate of mercury, 6 parts, and gun cotton and potassium chlorate, each 1 part.

261,247—July 18, 1882. J. F. A. MUMM. *Compound for railway-signal torpedoes.*

A compound composed of potassium chlorate, gum tragacanth, alcohol, antimony, sulphur auratum antimonii, or golden sulphuret, sublimed sulphur, and French chalk, in the form of pellets or cakes, with packages of gravel interspersed.

269,769—December 26, 1882. A. WOEBER. *Fulminate.*

A mixture of potassium chlorate, 1 pound; washed flowers of sulphur, one-half pound; amorphous phosphorus, 2 ounces; and 12 fluid ounces of dissolved gum tragacanth.

309,441—December 16, 1884. J. C. DE CASTRO. *Explosive compound.*

Bran or other suitable form of cellulose—7 parts—is mixed with tersulphide of antimony, or natural sulphide of antimony—1 part—to which is added a saturated solution of potassium chlorate, and the whole formed into pellets or grains.

418,552—December 31, 1889. P. BUTLER. *Gunpowder.*

A mixture of fulminate of mercury, pulverized soapstone, and a suitable binding material, as black gunpowder.

489,761—January 10, 1893. S. RODGERS. *Detonating compound.*

It consists of potassium picrate, 43 per cent; potassium chlorate, 43 per cent; extract of logwood, 12 per cent; and a gallotannic ink, 2 per cent.

529,334—November 13, 1894. H. MAXIM. *Fulminating compound.*

A pliable, yielding, or elastic explosive, consisting of a fulminate with its particles agglutinated by a dissolved organic nitro compound, as pyroxyline, with or without nitroglycerine, or a deterring agent to lessen its sensitiveness to detonation.

634,716—October 10, 1899. G. P. BICKFORD-SMITH. *Composition for detonators.*

A composition of sodium tungstate, 4 parts; precipitated copper, 2 parts; strontium nitrate, 4 parts; antimony sulphide, 96 parts; precipitated silver, 108 parts; potassium chlorate, 192 parts; and electrotype plumbago, 20 parts.

PYROTECHNIC COMPOSITIONS.

39,746—September 1, 1863. J. P. PERRY. *Improved composition for explosive shells.*

A liquid shell-mixture formed of powdered sulphur, alcohol, and turpentine, used alone or with cotton or other fibrous matter. (The shell has a separate bursting charge.)

41,577—February 9, 1864. E. HARRISON. *Improved inflammable composition for filling projectiles.*

A mixture of gunpowder, amorphous phosphorus, and bisulphide of carbon; forming a thick paste or solid mass.

42,458—April 26, 1864. A. BERNEY. *Improvement in destroying forts, etc., by means of inflammable liquids.*

An inflammable liquid is to be projected by a hose and pump, the jet being ignited at the nozzle.

47,335—April 18, 1865. C. W. ROESLING. *Improved powder for lighting cigars, etc.*

A mixture of potash, 40 parts; burned alum, 30 parts; powdered charcoal, 20 parts; and rye flour, 10 parts, is heated in a closed cylinder to a red heat, then cooled and maintained dry. It ignites by simply breathing on it.

48,187—June 13, 1865. H. W. LIBBEY. *Improved incendiary compound.*

Powdered potassium nitrate, 1½ ounces, and spirits of turpentine, 1 ounce, are added to a mixture of nitric acid, 2 ounces; barium sulphate, one-fourth ounce; and sulphuric ether, 1½ ounces. After standing, the oily substance is treated with alcohol; and hydrocarbon oil, 1 ounce, and tar, one-half ounce, are added; and combustible fibrous material is saturated with the compound.

65,764—June 11, 1867. C. NELSON. *Improved toy torpedo and explosive compound.*

The explosive composition consists of amorphous phosphorus, one-third; potassium chlorate, one-third; sulphur, one-sixth; and pulverized chalk, one-sixth.

144,030—October 28, 1873. A. LAMARRE. *Improvement in pyrotechnic signals.*

Linseed-glue, produced by reducing linseed oil to one-half its volume, by evaporation or burning, is mixed with the chlorates and other chemicals.

309,948—December 30, 1884. J. HERZOG. *Colored-fire compound.*

Sawdust dyed to the color the fire will produce is mixed with the chemical ingredients.

323,662—August 4, 1885. C. GERHARD. *Composition for bengal lights.*

A mixture of strontium nitrate and chlorate, potassium chlorate, powdered glass, and flour, with an alcoholic solution of a resinous substance, such as shellac or resin, or a mixture of the two.

363,224—May 17, 1887. C. GERHARD. *Composition for bengal lights.*

A mixture of strontium nitrate or chlorate, 24 pounds, and shellac, 7 pounds, melted, mixed, and cooled, is pulverized, added to a solution of glue and gum, and 4 pounds of potassium chlorate is added to the paste thus formed.

384,927—June 19, 1888. H. G. PIFFARD. *Photogenic powder.*

It consists of magnesium powder intimately mixed with "wood powder" (Dittmar, No. 145,403), or similar nitro-lignin equivalent.

407,351—July 23, 1889. A. HEMSLEY. *Compound for producing flash-light.*

It consists of powdered or granulated metallic magnesium, one or more nitrates, and amorphous phosphorus.

411,714—September 24, 1889. A. DEL GRANDE. *Preparing pyrotechnic compounds.*

Picric acid is dissolved in hot water and magnesium carbonate added to form a solution of magnesium picrate; then potassium nitrate is dissolved in water and the two solutions mingled, producing a precipitate of potassium picrate ($C_6H_2(NO_2)_3OK$), which is reduced to a granular condition and dried.

415,479—November 19, 1889. J. G. STUTZ. *Colored fire.*

A mixture of potassium chlorate, gum-shellac, gum-camphor (pulverized), brass filings, and magnesia, with or without strontium nitrate.

420,642—February 4, 1890. H. O. FRANK. *Solidifying colored fire.*

Pyrotechnic powders are converted into solid form by adding a small quantity of alcohol to the powdered ingredients and mixing the whole in a water bath, at about 93° C., and while still warm pressing the pasty mass into molds coated with vaseline, and cooling.

449,530—March 31, 1891. C. GERHARD. *Bengal-light compound.*

It consists of copal, ether, alcohol, strontium nitrate, and potassium chlorate, with or without a shellac solution or varnish.

475,897—May 31, 1892. C. SCHMIDT. *Fireworks.*

A composition for making star fireworks, consisting of steel chips, charcoal, lead nitrate, shellac, and spirits.

476,264—June 7, 1892. E. HACKH. *Magnesium-light composition.*

Fibrous material, as long carded unspun wool, is impregnated with vegetable oil, 2 parts; benzine, 2 parts and Venice turpentine 1 part, and sprinkled with magnesium powder.

523,614—July 24, 1894. J. AGOSTINI. *Pyrotechnic compound.*

A composition produced by mixing powdered magnesium and charcoal with starch, rendering the mixture adhesive, coating iron filings with a substance impervious to moisture, and adding them to the mixture.

528,515—October 30, 1894. A. HEMSLEY. *Flash-light compound.*

A mixture of aluminum, a nitrate or nitrates of the metals or alkaline earths, and amorphous phosphorus.

534,557—February 19, 1895. C. GERHARD. *Pyrotechnic compound.*

A mixture produced by dissolving camphor in alcohol, mixing lampblack therewith, adding gum tragacanth and glue, and mixing into these ingredients magnesium, starch, and iron.

535,495—March 12, 1895. J. GRAHAM. *Pyrotechnic compound.*

A mixture of powdered zinc, 320 grains; powdered selenium, 80 grains; in one gallon of carbon disulphide.

590,231—September 21, 1897. E. LEUSMANN. *Pyrotechnic compound.*

A compound for Bengal lights, consisting of an alcoholic solution of shellac, a nitrate of a metal of the alkaline earths, pulverized aluminum, sulphur, an alkaline chlorate—as potassium chlorate—and a binding agent.

594,594—November 30, 1897. J. A. BOSTWICK. *Flash-light composition.*

A sheet of collodion has combined therewith powdered flash-light material to produce an actinic light of brief duration and large area. A layer of powder may be applied between two collodion films.

633,671—September 26, 1899. Z. VALDEZ. *Toy torpedo.*

A ball of clay has a coating of gum-shellac; a coating composed of gum-arabic, 4 parts; phosphorus, 4 parts; and potassium chlorate, 5 parts; and an outer coating of shellac.

MATCH COMPOSITIONS.

1,413—November 16, 1839. J. H. STEVENS. *Improvement in the composition of matter for friction-matches.*

A combination of litharge and the red oxide of lead, or either of them separately, with carbonate of lead, phosphorus, and a glutinous or viscid material, such as gum-arabic, or with black oxide of manganese, phosphorus, and the glutinous material.

1,414—November 16, 1839. J. H. STEVENS. *Improved friction-match for retaining fire, entitled "Stevens' fusee cigar-light."*

The match splint is saturated with a solution of saltpeter, dried, and the phosphoric composition is then applied to the end, without the intervention of brimstone.

2,402—December 23, 1841. N. T. WINANS, T. & T. HYATT. *Improvement in the composition of matter for the manufacture of friction-matches.*

Phosphorus, alone or in connection with other inflammables, is combined with glue or gum rendered damp-proof by being chemically united with shellac.

2,403—December 23, 1841. N. T. WINANS, T. & T. HYATT. *Improvement in the composition of matter for the manufacture of friction-matches.*

Shellac, 3 parts, and borax, three-fourths of a part—or like alkali—is dissolved in water, and three-fourths of a part of phosphorus is combined therewith.

2,494—March 18, 1842. S. BLAISDELL. *Improvement in ignitible compounds for friction-matches.*

The matches are dipped into a compound of sulphur and phosphorus formed into a paste with glue.

2,635—May 20, 1842. G. W. CARLETON. *Improvement in friction-matches.*

A paste formed of phosphorus, gum-arabic, or glue, and a fulminating compound composed of subcarbonate of potassa, 2 parts; nitrate of potassa, 3 parts; and sulphur, 1 part.

3,773—October 3, 1844. E. SMITH. *Improvement in friction-matches.*

Pulverized dried vegetable material, as bark, or nutgalls, is mixed with phosphorus, in place of mineral or earthy substances.

40,259—October 13, 1863. J. W. HJERPE. *Improvement in the manufacture of friction-matches.*

A safety match composition (not using phosphorus or other dangerous substance), igniting only on a prepared rubber composition, consisting preferably of potassium chlorate, 4 pounds; potassium chromate, 4 pounds; specular iron or colcothar, 2 pounds; and gum, 2 pounds. Rubber compound therefor, sulphuret of antimony, 20 pounds; potassium chromate, 2 pounds; red iron oxide or colcothar, 6 pounds; protosulphate of iron, 3 pounds; and gum, 3 pounds. Combined, the composition is friction lighting.

47,311—April 18, 1865. S. KRACKOWIZER. *Improvement in the manufacture of friction-matches.*

A metallic coating of sulphide of lead is formed around the phosphoric mass, by impregnating the friction mass with hyperoxide of lead and nitrate of oxide of lead, and exposing the tipped and moist matches to a stream of hydrothionic acid gas.

50,843—November 7, 1865. H. REIMAN. *Improvement in friction-matches for lighting cigars, etc.*

Pasteboard or other stock for friction-matches is treated with a solution of potassium chlorate and niter.

53,454—March 27, 1866. L. LANSZWEERT. *Improved match-compound.*

A mixture of potassium chlorate, 35 parts; hyposulphate of lead, 15 parts; glass or silex, 4 parts; bichromate of potash, 10 parts; and gum or cement, 4 parts. The matches ignite only on a prepared surface containing black antimony and phosphorus.

66,101—June 25, 1867. L. O. P. MEYER. *Improvement in the manufacture of safety-matches.*

A match mixture of potassium chlorate, gelatine, and quartz or pumice stone, in relative proportions, for example, of 56 per cent, 20 per cent, and 24 per cent. The igniting surface may be formed of the red or the yellow prussiate of potash, mixed with a binder and with powdered glass or aluminous earth (though it is inferior to Hjerpe's igniting surface).

69,891—October 15, 1867. E. ANDREWS. *Improvement in the manufacture of matches.*

Match splints are united in the form of a card by arranging them side by side and dipping the nonigniting ends in glue.

95,730—October 12, 1869. W. H. ROGERS. *Improvement in friction-matches.*

An inflammable coating is applied to a friction match below the ignitible end. The coating may be of potassium chlorate, 8 parts; powdered charcoal, 2 parts; and dissolved rubber, 5 parts.

125,874—April 16, 1872. F. ZAISS. *Improvement in parlor-matches.*

Phosphuret or phosphide of sulphur, white Russian glue, and white dextrine or purified starch, with or without coloring material, is used to produce white or colored matches; and benzoin, cascarilla, or cinnamon to give a perfume while burning.

128,626—July 2, 1872. J. HOWE. *Improvement in matches for lighting cigars, etc.*

A mixture of 1 pound each of benzoin, myrrh, and cascarilla bark; one-fourth ounce each of nutmeg, oil of cloves, and oil of musk; and 2 pounds each of charcoal and potassium nitrate; formed into a paste with a mucilage.

136,953—March 18, 1873. J. F. BABCOCK, W. A. LEONARD, AND E. B. CRANE. *Improvement in match compositions.*

A fuse-strip is formed of pyroxyline, pure or mixed. It is molded with serrations and with friction-match composition on the whole or a part of its surface.

149,324—April 7, 1874. L. O. P. MEYER. *Improvement in the manufacture of safety-matches.*

In the manufacture of safety matches—Nos. 66,101 and 111,075—the paste is prepared with acetates of iron or of alcohol.

150,203—April 28, 1874. C. B. STEPHENS. *Improvement in matches or arrows for use with toy pistols or toy guns.*

A projectile for toy pistols consisting of an explosive coating on a body of wood or other material not easily ignited, as a parlor match made with the omission of coal-wax or like material from the detonating compound and splint.

153,004—July 14, 1874. J. J. MACHADO. *Improvement in the manufacture of friction-matches.*

A match dipped to some length into a slow-burning composition, not liable to be extinguished by a draft of air, and having a head of rapidly combustible composition, igniting only on a chemical-affinity surface. The heads are waterproofed by dipping into a solution of alcohol and tannic acid.

153,181—July 21, 1874. G. C. J. SCHNEIDER. *Improvement in compositions for safety blazing fusees, etc.*

A mixture of glue and starch in water, to which is added powdered glass, potassium chlorate, pumice stone, sulphuret of golden antimony, saltpeter, cascarilla bark, and lampblack.

153,451—July 28, 1874. L. O. P. MEYER. *Improvement in surface compounds for igniting safety-matches.*

A compound of india rubber, or allied gum, sulphur, and gray sulphuret of antimony; in the proportion, for example, of 2, 1, and 23 parts, respectively.

156,328—October 27, 1874. W. S. BEECHER. *Improvement in ammunition-matches for toy pistols.*

The ends of splints have coatings of detonating material and silicate of soda. Either may be first applied.

157,873—December 15, 1874. G. C. J. SCHNEIDER. *Improvement in safety-match compositions.*

A mixture of brick dust, potassium chlorate, golden sulphuret of antimony, flowers of sulphur, starch, and water.

169,539—November 2, 1875. E. HAANEL. *Improvement in safety-matches.*

A match composition of potassium chlorate, 1.6 part; sulphide of antimony, 0.3 part; sesquioxide of iron, 0.35 part; binoxide of manganese, 0.35 part; potassium chromate, 0.05 part; and powdered glass, 0.05 part; formed into a paste with a gelatine mucilage. The friction-tablet composition consists of amorphous phosphorus, 1 part; sulphide of antimony, 0.02 part; and powdered glass, 0.25 part; formed into a paint with the gelatine mucilage.

177,001—May 2, 1876. J. RADFORD. *Improvement in compositions for lighting cigars.*

A mixture of pulverized charcoal, wheat flour, potassium chlorate, and diluted vinegar or acetic acid.

177,134—May 9, 1876. W. J. LITTLEFIELD. *Improvement in compositions for cigar-lighters.*

A compound of lime, charcoal, cascarilla bark, gum, and water.

196,062—October 9, 1877. H. R. WHITEMAN. *Improvement in cigar-lighters.*

A disk provided with a pin or peg and having an inflammable body and a fulminate, the inflammable body consisting of a mixture of charcoal, niter, sulphur, gum-arabic, and flour.

230,226—July 20, 1880. C. F. BONHACK. *Friction-match.*

A mixture of niter, Venetian turpentine, phosphorus, glue, powdered glass, and crocus metallorum or other coloring matter.

230,775—August 3, 1880. G. HAYES. *Compound for preparing the wicks or matches of miners' squibs.*

A mixture of oil, one-half pint; sulphur, 32 ounces; camphor, 8 ounces; and red lead, 2 ounces; boiled and thoroughly mixed.

241,780—May 24, 1881. W. W. BATCHELDER. *Continuous match.*

An igniting pencil, one-half formed of an igniting composition rich in oxygen—as a mixture of potassium chlorate and binoxide of lead—and the other half of inert material, with a core of an ignitible composition, as phosphorus, the latter being separated from the igniting composition by a septum. It is ignited by friction.

242,427—June 7, 1881. D. BLUMENKRON. *Manufacture of matches.*

A match compound consisting of red oxide of lead, phosphorus, sulphuret of antimony, and a gummy vehicle.

A match having a stem of cotton strands saturated and coated with a translucent inflammable water and air proof solution, and a head waterproofed with an alcohol lac varnish.

251,891—December 27, 1881. L. WAGNER. *Manufacture of friction-matches.*

A match composition of hyposulphite of lead, peroxide of lead, potassium chlorate, crude or gray sulphide of antimony, pulverized charcoal, pulverized glass, saltpeter, sulphur, dextrine, suitable gelatinous binding substances, and water.

275,617—April 10, 1883. H. ENDEMANN. *Manufacture of matches.*

A stick, strip, or sheet of paper, pasteboard, or wood, saturated with oleic acid and having a suitable lighting composition held by a basic binding material, such as protoxide of lead, either incorporated with the igniting composition or first applied to the stick.

284,651—September 11, 1883. J. H. MITCHELL. *Manufacture of friction-matches.*

An impalpable dry powder, such as pumice stone or chalk, is injected upon the freshly dipped heads to form a nonadhesive surface.

302,717—July 29, 1884. W. B. ELTONHEAD. *Match.*

A fusee having a head of an ignitable compound combined with a powder made by grinding up discarded crucibles, cupels, and scorifiers.

335,065—January 26, 1886. F. W. FARNHAM. *Match.*

The head is composed of two separate compounds, one a safety composition, and the other, or tip, an ordinary, frictionally ignitible composition.

340,747—April 27, 1886. C. WEIBACH. *Pyrotechnic match.*

A stick having its head coated with a friction-igniting compound and the portion of the body adjoining the head coated with a pyrotechnic compound, or a series of compounds to produce lights of different colors.

418,202—December 31, 1889. J. LUTZ. *Inflammable composition for matches.*

A solution of sodium chlorate, ammonium sulphate, and a carbohydrate. Matches light by frictional contact on a surface prepared with amorphous phosphorus and washed black trisulphide of antimony.

436,877—September 23, 1890. W. M. NIX. *Match.*

A double-headed waterproof match having the splint previously soaked in a bath of sodium phosphate, so that it will not carbonize, and heads composed of glue or other gelatinous binder, paraffine, potassium chlorate, peroxide of lead, sulphide of antimony, and potassium bichromate.

485,103—October 25, 1892. J. KLEIN. *Match-heading composition.*

A compound of dextrine, water, phosphorus, minium, lampblack, and nitric acid.

562,426—June 23, 1896. C. R. A. G. SCHWIENING. *Match.*

A compound of potassium chlorate, red phosphorus, and calcium plumbate, igniting on any frictional surface.

579,913—March 30, 1897. H. ALLDAY. *Match-striking composition.*

A composition of phosphorus, gritty matter, and gum; thus available for both safety and friction matches.

592,227—October 26, 1897. L. ARONSON. *Match and composition for same.*

A fusee consisting of a stem and a friction-igniting head, with a waterproof, persistently combustible compound, not ignitible by friction, enveloping the head and portion of the stem adjacent thereto. The compound consists essentially of potassium chlorate, chromate of lead, amorphous phosphorus, sulphuret of antimony, dextrine, charcoal, and one or more resinous gums.

594,133—November 23, 1897. G. FIRSCHING. *Manufacture of matches.*

In the manufacture of headless safety-matches the end or ends of the match-splints (both ends may be made ignitible), they having been assembled into bundles, are dipped into a solution consisting of sodium chlorate, gum arabic, a sulphate of a metal proper (as of copper or iron), and water; then thoroughly dried; and then dipped, to a greater depth, in a hydrocarbon waterproof solution, as of rosin, turpentine, oleic acid, and linseed oil.

594,677—November 30, 1897. A. CHATELAN. *Composition for lighting cigars.*

A combustible composition of peroxide of manganese, potassium permanganate, potassium chlorate (with or without powdered coke and cinnamon bark), and an outer frictional-igniting head is applied to the end of a cigar or cigarette. A waterproof cap may be added.

603,666—May 10, 1898. A. TACHAUER AND L. BRALY. *Composition for making matches.*

A mixture of an adhesive substance and plumbates of calcium and strontium, metallic aluminum, and monosulphide of calcium, in suitable proportions, with or without powdered glass, hyposulphite of lead, sodium chloride, and potassium chlorate at defined temperature and proportion.

613,021—October 25, 1898. Y. SCHWARTZ. *Flash-light composition.*

A mixture of a light material, as a quickly combustible magnesium mixture, is combined with a cementing medium, such as a solution of pyroxyline in ether and alcohol, and made into the form of a foil.

614,350—November 15, 1898. H. SÉVÈNE AND E. D. CAHEN. *Match composition.*

Sesquisulphide of phosphorus is the essential ingredient, it being mixed with oxidizing bodies, inert matter, and glue.

622,109—March 28, 1899. E. G. BOHY. *Match.*

The match-paste contains a hypophosphite, as hypophosphite of calcium, in addition to the usual materials.

625,299—May 16, 1899. G. HACKEL. *Match-paste composition.*

It consists of potash, gum-arabic, amorphous phosphorus, potassium chlorate, a mineral coloring matter, hyposulphite of lead, and water, in specified proportions.

627,393—June 20, 1899. W. G. CORDES. *Match composition.*

A mixture of potassium chlorate, ground glass, whiting, plaster of paris, glue, and water, and amorphous red phosphorus, in specified proportions.

653,349—July 10, 1900. W. P. JONES AND H. M. BATES. *Match.*

A nonpoisonous composition, comprising potassium chlorate, sulphide of antimony, a metallic thiosulphate, oxide of manganese, potassium bichromate, an inert substance, red prussiate of potash, and adhesive material.

655,864—August 14, 1900. B. HEIMANN. *Self-lighting cigar.*

The ends of the independent leaves, before being rolled into form, are saturated with a composition including potassium chlorate, lampblack, pentasulphide of antimony, charcoal, and gelatine.

GROUP XV.—PLASTICS.

PYROXYLIN PLASTICS.

65,267—May 28, 1867. W. H. PIERSON. *Improved plastic compound made from vegetable fibers.*

A plastic is formed of cotton, hemp, flax, grass, wood, starch, sugar, or other equivalent vegetable matter acted upon by acids (nitric or a mixture of nitric and sulphuric acids) to soften or render soluble or partly soluble said vegetable matter in other solvents than said acids, the vegetable matter not being necessarily dissolved, but softened or pulpified; and articles of manufacture formed therefrom. The plastic, wet with equal parts of alcohol and ether, is applied to cotton batting, or any equivalent fiber, or spread on any mold or surface. Fabrics are waterproofed therewith. The plastic with its solvents is combined with metals and various metallic, silicious, or argillaceous substances in the pulverulent state. The plastic is mixed with drying oils for waterproofing and transparencies. Fur, plush, or other short fiber is attached by means of the plastic to give a fur-like surface. A compound for painting and coloring is formed by admixture of plastic and solvents with paints, oils, dyestuffs, etc.

77,304—April 28, 1868. J. A. McCLELLAND. (*Reissues: 3,777, 3,778—December 28, 1869.*) *Improved material for dental plates and for other purposes.*

Sheets of collodion and its compounds with resinous substances are comminuted and formed into massive forms by treating with ether and alcohol or other solvent, molding, pressing, and drying.

79,261—June 23, 1868. C. A. SEELY. *Improvement in solidified collodion.*

Nitro-glucose is combined with collodion to increase the flexibility and toughness.

88,228—March 23, 1869. L. R. STREETER. *Improved method of veneering articles with pyroxyline.*

Plastic pyroxylin or xyloidin is veneered to a base, dental plates or gums, with or without cement, by compression, and with heat, if need be.

88,260—March 23, 1869. L. R. STREETER. *Improved composition for dental plates.*

Soluble pyroxylin, or xyloidin, or gun-cotton combined with substances that will give the necessary quantities, is used for dental plates, e. g., a compound formed of pyroxylin, 240 parts; wax, 50 parts; zinc white, 30 parts; and coloring matter.

89,253—April 20, 1869. L. R. STREETER. *Improved dental plate.*

Dental plates and gums formed of pyroxylin, reduced to a dough and forced or pressed into molds, brought under pressure, and the solvent evaporated.

89,254—April 20, 1869. L. R. STREETER. *Improved process of treating pyroxle, pyroxyline, and the like substance, for forming useful and ornamental articles.*

Pyroxylin and its compounds are treated with suitable nonsolvents, as alcohol, sulphide of carbon, or naphtha, with or without a cementive agent, and rendered distensible, compressible, and impressible.

89,582—May 4, 1869. J. W. HYATT, JR., AND D. BLAKE. *Improved compound of ivory dust and other materials.*

Ivory dust or other pulverized material is agglutinized by combining collodion therewith and subjecting the composition to pressure during the evaporation of the volatile elements by means of heat.

90,766—June 1, 1869. J. A. McCLELLAND. *Improved machine for treating collodion and its compounds.*

Collodion and its compounds are mixed in a vacuum.

91,341—June 15, 1869. J. W. HYATT, JR., AND I. S. HYATT. *Improved method of making solid collodion.*

Pyroxylin, with or without an admixture of ivory dust or other material, is dissolved in a small quantity of solvent, under great pressure, forming a hard and solid product.

91,377—June 15, 1869. D. SPILL. *Improvement in compounds containing xyloidine.*

Compounds are produced of xyloidine in conjunction with oils, camphor, paraffine, and gutta-percha; one or more of the ingredients, as camphor, is dis solved in the oil, the solution forming a nonvolatile solvent for xyloidine, which becomes a part of the resulting compound.

96,132—October 26, 1869. J. A. McCLELLAND. *Improved mode of producing useful articles from collodion and its compounds.*

A sheet of collodion and resinous matter is heated until soft and plastic, and then the article is stamped out between dies.

97,454—November 30, 1869. D. SPILL. *Improvement in dissolving xyloidine for use in the arts.*

Solvents are employed which are not necessarily in themselves solvents of xyloidine, but become so by the addition of other bodies or compounds. Eight specified solvents include as elements camphor or camphor oil, alcohol or spirits of wine, hydrocarbons having a b. p. 105° to 205° C., castor oil, bisulphide of carbon, and aldehyde.

101,175—March 22, 1870. D. SPILL. *Improvement in the manufacture of xyloidine and its compound.*

Cotton or other vegetable fiber or lignine is reduced to a finely divided state; mixed with the aid of mechanical means in a vessel having revolving arms or beating bars, with a suitable quantity of acid; the acid strained from the fiber; the product pressed to remove excess of acid, and the pressed mass then opened out, washed, drained, and dried. The xyloidine is bleached directly after the removal of the acids and before removing it from the vat by means of any bleaching solution, making use of alternate stirrings and rest. It is dyed after draining and before pressing, by any fiber-dyeing process, either before or after the solution of the same in suitable solvents. For spreading upon fabrics 1 part of xyloidine is dissolved in from 5 to 12 parts of solvent, strained through a fine sieve under pressure, and spread on the fabric or surface in a semifluid condition. To reduce it to a nearly dry condition the strained solution or paste is treated in a closed mixing vessel connected with an exhaust apparatus, the vessel being heated to about 100° C. The solvent vapors that pass off are condensed for re-use.

103,209—May 17, 1870. J. LEWTHWAITE. *Improvement in coating fabrics with parkesine.*

Parkesine or xylonite in a plastic state is spread upon the surface of the fabric and immediately subjected to pressure, which is continued for several days, when the material is to be pliant or supple. If the surface is required to be polished it is subjected to the action of rotating brushes after the parkesine has become fixed.

105,338—July 12, 1870. J. W. HYATT, JR., AND I. S. HYATT. (*Reissues: 5,928—June 23, 1874; 10,546—December 23, 1884.*) *Treating and molding pyroxyline.*

Finely comminuted camphor gum is mixed with pyroxylin pulp and rendered a solvent by the application of heavy pressure in a heated mold.

105,823—July 26, 1870. J. A. McCLELLAND. *Improved process for coating objects with collodion and its compounds.*

Collodion is molded upon the article to be coated, so as to obtain the coating at one operation.

114,242—April 25, 1871. R. H. WINSBOROUGH. *Improvement in the preparation and application of pyroxyline for dental plates.*

Pyroxylin for dental purposes is bleached by the application of chlorine to render it highly translucent. The camphor of dental plates formed by the introduction of camphorated pyroxylin into plaster or porous moulds is expelled by artificial heat or evaporation, or extracted by chemical means.

127,656—June 4, 1872. V. SMITH. *Improvement in compounds for dental purposes.*

A dental plate made of gun-cotton, prepared gum shellac, gum camphor, with a compound formed of oxide of zinc, Chinese vermilion, and oxide of tin and gold, together with sulphuric ether and alcohol.

133,229—November 19, 1872. I. S. & J. W. HYATT. *Improvement in process and apparatus for manufacturing pyroxyline.*

A mixture of pyroxylin and camphor gum is dried by compressing it into cakes and subjecting them to pressure in a pile with interposed layers of absorbent material. Pyroxylin is transformed by means of camphor gum by subjecting the material to pressure in the upper part of a cylinder, kept sufficiently cool to prevent the melting of the solvent during the compression and expulsion of the air, while the lower portion is heated sufficiently high to melt the solvent and transform the pyroxylin, which is forced through the same and out of a discharge nozzle, as a rod, bar, or sheet.

133,969—December 17, 1872. L. DEITZ AND B. P. WAYNE. *Improvement in the manufacture of pyroxyline and articles therefrom.*

Pyroxylin made from ramie, *Bochmeria nivea.*

143,772—October 21, 1873. J. A. McCLELLAND. *Improvement in collodion compounds.*

The converted material is dried by the alternate application of pressure and exposure to the atmosphere. Absorbent pads of felt cloth or other material, with paper interposed, are used while the material is under pressure.

143,865—October 21, 1873. H. T. ANTHONY. *Improvement in preparing soluble cotton for the manufacture of collodion.*

Soluble cotton is subjected to the action of volatilized alkali, preferably ammonia, after the ordinary acid treatment and washing, to remove traces of acid.

150,722—May 12, 1874. D. D. SMITH. *Improvement in artificial coral for jewelry.*

A mixture of gun-cotton, 24 parts; gum copal, 5 parts; alcohol, 10 parts; perchloride of tin, one-twentieth part; gum-shellac, 1 part; ether, 20 parts; perchloride of gold, one-fortieth part; magnesium oxide, 1 part; protochloride of tin, one-twentieth part; and oxide of mercury, 1 part.

152,232—June 23, 1874. I. S. & J. W. HYATT. *Improvement in apparatus and processes for molding celluloids and the compounds of pyroxyline.*

Celluloid is molded in a closed vessel supplied with steam, in a porous or suitable mold. A safety valve regulates the pressure and temperature.

153,196—July 21, 1874. R. FINLEY HUNT. *Improvement in molding celluloids for dentists and others.*

Celluloid is softened and molded with dry heat.

156,352—October 27, 1874. I. S. & J. W. HYATT. *Improvement in manufacturing solidified collodion.*

Pyroxylin is mixed with a latent solvent which becomes active only upon the application of heat, e. g., pyroxylin mixed with 1 part of camphor and 8 parts of alcohol.

156,353—October 27, 1874. J. W. & I. S. HYATT. *Improvement in the manufacture of celluloid.*

A solvent of camphor, such as alcohol, is added to the mixture of pyroxylin and camphor previous to mastication, heat, and pressure, using, say, 100 parts of dry pyroxylin and 25 to 40 parts of gum camphor, with 20 to 40 per cent of alcohol after the aforesaid ingredients are mixed and the aqueous moisture has been expelled.

165,234—July 6, 1875. J. W. & I. S. HYATT. *Improvement in grinding-wheels.*

A grinding wheel made of emery or similar particles united by celluloid, or pyroxylin, or their components.

172,995—February 1, 1876. F. GREENING. *Improvement in the manufacture of soluble gun-cotton and products therefrom.*

A mixture of hydrochloric acid with sulphuric acid and nitric acid is used for the conversion of cotton; as sulphuric acid, 250 parts; hydrochloric acid, 35 parts; and nitric acid, 50 parts. Semitransparent products are obtained by the addition of finely divided and levigated silica, or powdered glass or sulphate of lime; insulating compounds by the use of creosote with soluble gun cotton and certain gums.

173,865—February 22, 1876. C. REAGLES. *Improvement in compositions for dental plates, etc.*

A compound of pyroxylin, 40 parts, by weight; compound ethylated camphor 25 parts; flexible lac, 15 parts; caoutchouc shavings, 5 parts; and cera alba, 5 parts; with Canada balsam and pigments.

184,481—November 21, 1876. P. SWEENEY. *Improvement in lubricating compounds.*

A lubricant consisting of plumbago and collodion, with paper pulp or equivalent fibrous material.

200,939—March 5, 1878. R. H. & A. A. SANBORN AND C. O. KANOUSE. *Improvement in collars and cuffs.*

A fabric for collars and cuffs having outer sheets or layers of celluloid and an interlining of textile or fibrous material.

204,227—May 28, 1878. J. W. HYATT. *Improvement in apparatus for covering cores and forming tubes of celluloid and other plastic materials.*

The composition is fed in equal quantities to all sides of a core, which core is withdrawn from the composition, leaving the tubular coating.

209,570—November 5, 1878. J. W. HYATT. *Improvement in varnishes.*

The solid extract of logwood dissolved in either alcohol or methylic spirit, or both, is combined with a resin soluble in alcoholic or methylic spirit or pyroxyline, and the tincture of the muriate of iron to produce an ebony varnish.

216,474—June 10, 1879. V. TRIBOUILLET AND A. DE BESAUCÈLE. *Improvement in processes of manufacturing solid collodion.*

Dried cellulose is treated with acids in closed glazed vessels followed by pressing, washing, and drying; and the pyroxyle so prepared is treated with solvents, liquid or solid, as camphor, with or without the addition of coloring or other materials.

217,232—July 8, 1879. W. McCAINE. *Improvement in processes for treating pyroxyline.*

Pyroxylin is reduced to a liquid by solvents without heat or pressure—as by dissolving it in a solution of camphor gum in sulphuric ether and then introducing spirits of turpentine—and then cast in porous molds. The product is treated with alcohol to render it plastic, compressed in any desired form, and hardened by immersion in olive oil.

220,502—October 14, 1879. J. S. SPENCER. *Improvement in frames for optical instruments made of celluloid and other fibrous plastic compositions.*

Frames for optical instruments are made from fibrous plastic composition by cutting the frames from the material when in sheets and forming them upon a mandrel. They are removed from the mandrel by introduction of heat into the mandrel.

221,070—October 28, 1879. J. W. HYATT. *Improvement in processes of manufacturing, polishing, and seasoning sheets of celluloid and other plastic material.*

Sheets of celluloid are subjected to pressure between a polished surface and a layer of absorbent material, to both dry and polish.

232,037—September 7, 1880. J. W. HYATT. *Manufacture of celluloid.*

Veneers of celluloid or other plastic material are applied to moldings and uneven surfaces by attaching a strip of the material so as to span the face of the article, then inserting the two in an elastic tube and contracting the tube by means of a vacuum pump or by external pressure.

233,558—October 19, 1880. J. & C. SCHMERBER. *Process of treating pyroxyline in the manufacture of plastic compounds.*

In the manufacture of plastic compounds from pyroxylin, danger of ignition is avoided by treating the nitro-derivative of cellulose, dextrine, or glucose while wet with a solvent, mixing gums, balsams, or pigments and reducing the product to a semi-liquid form by heat, grinding and mixing the semi-liquid mass, and finally drying the compound to a plastic consistency.

233,851—November 2, 1880. N. HART AND R. A. BACON. *Decorating celluloid.*

Celluloid surfaces are decorated and the color united with the celluloid, by the use of aniline colors dissolved in carbolic acid and alcohol.

234,675—November 23, 1880. C. M. JACOB. *Composition for coating surfaces.*

A composition of collodion, creosote from Norway-beech tar, boiled linseed oil, black oxide of manganese, and resin, as a protective coating for materials or for ornamentation. Pigments or mineral colors or bronze or other metal powders may be combined therewith.

237,279—February 1, 1881. S. J. HOGGSON AND G. C. PETTIS. *Method of producing and treating pyroxyline and the manufacture of articles therefrom.*

The fiber is prepared in a sheet form, and treated to the acid bath; the pyroxylin sheet is then applied to the surface to be covered and subjected to a pyroxylin solvent until converted into a gelatinous condition, when it can be rolled, or reëmbossed and finished.

239,423—March 29, 1881. L. S. BEALS. *Treating pyroxyline.*

A compound of mirbane, oil of lavender, benzole, and alcohol is employed as a solvent for pyroxylin, and olibanum frankincense is added, with or without paraffine or vegetable wax, to render it plastic without shrinking or warping.

239,424—March 29, 1881. L. S. BEALS. *Preparing pyroxyline.*

Soluble pyroxyline is rendered permanently plastic under heat by mixing therewith paraffine dissolved in mirbane and the essential oil of lavender.

239,425—March 29, 1881. L. S. BEALS. *Preparing pyroxyline.*

Pyroxylin is treated with vegetable wax, either with or without the addition of paraffine, and preferably by means of a solvent formed of mirbane, oil of lavender, benzole, and alcohol.

239,791—April 5, 1881. J. W. HYATT. *Process of and apparatus for molding celluloid, hard rubber, bonsilate, and analogous plastic materials.*

Molds or dies containing the material are immersed in liquid in a suitable vessel and heat and pressure applied to the liquid.

241,005—May 3, 1881. N. HART AND R. A. BACON. *Decorating celluloid.*

Surfaces composed wholly or in part of compounds of pyroxylin are decorated by applying colors mixed with a solvent of pyroxylin; as aniline colors, dissolved in alcohol and ether, with or without carbolic acid.

244,916—July 26, 1881. O. MONROE. *Process of treating pyroxyline scraps.*

A homogeneous pyroxylin compound is produced from scrap by treating it with a solvent, with or without the addition of a coloring agent, and then subjecting it to the action of a machine which mixes it and compresses it by forcing it through an outlet or nozzle.

245,952—August 23, 1881. S. J. HOGGSON AND G. C. PETTIS. *Manufacture of plastic compounds from pyroxyline.*

Pyroxylin, after washing, is treated in a bath containing in solution hydrochlorate of ammonia, muriate of ammonia, or any of the ammoniacal salts, whereby it is rehydrogenized and rendered less explosive. Sulphate of alumina or any of the "octohedron" or isomorphous salts are combined with pyroxylin; alum being a natural base, working hot or cold or in any proportions, with or without the addition of gums, resins, balsams, oils, pigments, dyes, or coloring ingredients. Flour of steatite is added, acting as a lubricant, when the material is to be pressed in molds or dies.

246,891—September 13, 1881. C. S. LOCKWOOD. *Treatment of pyroxyline.*

Chloral is used as a solvent of camphor in a pyroxylin compound containing camphor, say from 5 to 20 parts of chloral to 100 parts of camphor; it lowers the liquifying temperature.

247,734—September 27, 1881. C. O. KANOUSE. *Manufacture of plastic composition from soluble fiber.*

Soluble fiber is mixed and dissolved in a volatile solvent in a heated state in an open vessel, the evaporation accelerating the solvent action.

248,413—October 18, 1881. I. W. DRUMMOND. *Compound of celluloid and luminous material.*

A solid luminous compound formed of celluloid and luminous or phosphorescent material, as sulphide of calcium.

249,600—November 15, 1881. J. B. EDSON. *Drying apparatus for treating pyroxyline, etc.*

Pyroxylin and similar substances are dried by the use of cold intensely dry air, maintained slightly above the freezing point, introduced through the material while in a finely divided condition, and thence discharged from the receiver.

251,410—December 27, 1881. W. B. CARPENTER. *Waterproofing paper with celluloid and other materials.*

A paper made of asbestos and plastic material such as celluloid, lignoid, coroline, shellac, resin, or gums. The paper may be put through a vapor bath of alcohol, when the substance used, as celluloid, is capable of being dissolved in alcohol, or through turpentine vapor when resin or gums are used, and then through heated rolls to thoroughly integrate the material.

253,480—February 21, 1882. W. B. CARPENTER. *Waterproof paper.*

A paper made of paper-pulp and a plastic waterproof material, such as celluloid, lignoid, etc. It may be put through a vapor bath of alcohol or rapidly through a weak alcoholic bath and then through heated rolls (see No. 251,410).

254,280—February 28, 1882. F. W. COTTRELL. *Manufacture of material to form artificial ivory.*

Fiber is rendered soluble in alcohol by immersion in a saturated solution of nitrous acid in sulphuric acid for a very short period, then slightly pressed and allowed to stand twenty minutes to an hour to complete its conversion. It is then washed, neutralized with a saline solution, afterwards adding strong solutions of alum, carbonate of soda, and silicate of soda.

254,751—March 7, 1882. L. WHITE AND K. WHITCOMB. *Apparatus for determining the nitration of cellular fiber.*

It is determined by the deflection of a galvanometer, using a cathode and anode on opposite sides of a mixing vessel, the deflection being compared with that of a standard quality.

256,597—April 18, 1882. P. REID AND J. EASTWOOD. *Manufacture of pyroxyline for use in topical printing.*

An ink or color for topical printing, or "calico printing," composed of dissolved pyroxylin and a coloring agent.

262,077—August 1, 1882. W. McCAINE. *Pyroxyline compound.*

The essential oil of cassia or cinnamon is used in the manufacture of compounds of pyroxylin; combined with alcohol alone or in conjunction with hydrocarbons, say in the proportion of 1 part to 8 of alcohol, it forms a latent solvent.

264,987—September 26, 1882. E. WESTON. *Plastic compound from soluble cellulose.*

Nonfibrous or amorphous cellulose; produced by reconverting or reoxidizing celluloid in a bath of ammonium sulphide, protochloride of iron, or equivalent reducing agents.

265,337—October 3, 1882. H. PARKES. *Manufacture of nitro-cellulose.*

Nitrocellulose is dyed prior to dissolving or softening and treatment with solvent. Tetrachloride of carbon, together with camphor, is employed as a solvent, or a solvent composed of bisulphide of carbon together with camphor, or sulphurous acid and camphor.

269,340—December 19, 1882. J. H. STEVENS. *Manufacture of compounds of pyroxyline or nitro-cellulose.*

In the manufacture of compounds of pyroxylin a new group of active liquid solvents or converting agents is used, comprising oil of spearmint, nitrate of methyl, butyric ether, valeric ether, benzoic ether, formic ether properly dehydrated, salicylate of methyl, formate of amyl, acetate of amyl, butyrate of amyl, valerianate of amyl, sebacylic ether, oxalic ether, amylic ether (amylic oxide), oxidized wood alcohol, oil of cassia, oil of cherry, laurel, heavy cinnamon oil, oil of melissa (balm), oil of birch tar (rectified), and oil of pennyroyal.

269,341—December 19, 1882. J. H. STEVENS. *Manufacture of compounds of pyroxyline or nitro-cellulose.*

In the manufacture of compounds of pyroxylin certain specified oils are used as latent liquid solvents, viz, oil of caraway seed, oil of hyssop, oil of sage, oil of tansy, oil of cloves, or oil of wintergreen, or mixtures of them.

269,342—December 19, 1882. J. H. STEVENS. *Manufacture of componds of pyroxyline or nitro-cellulose.*

In the manufacture of pyroxylin compounds dinitro-benzine or coumarine are used as latent solid solvents.

269,343—December 19, 1882. J. H. STEVENS. *Manufacture of compounds of pyroxyline or nitro-cellulose.*

In the manufacture of pyroxylin compounds certain new menstrua are used in conjunction with camphor, viz, acetone, acetate of ethyl, acetate of methyl, fusel-oil (amylic alcohol), oil of chamomile, oil of fennel-seed, oil of palmarosa, and oil of worm-seed, or mixtures of any of them.

269,344—December 19, 1882. J. H. STEVENS. *Manufacture of compounds of pyroxyline or nitro-cellulose.*

In the manufacture of pyroxylin compounds fusel oil is employed as a solvent or menstruum in conjunction with the oils of hyssop, sage, tansy, wormwood, fennel seed, cloves, cinnamon, anise, sassafras, chamomile, wintergreen, caraway seed, or of dill, or with acetal, nitrate of amyl, or nitrite of amyl, or mixtures of any of them.

269,345—December 19, 1882. J. H. STEVENS. *Manufacture of compounds of pyroxyline or nitro-cellulose*

In the manufacture of pyroxylin compounds certain menstrua or mixtures of the same are employed in conjunction with alcohol (ethylic or methylic), viz, acetal, nitrate of amyl, nitrite of amyl, oils of chamomile, valerian, golden-rod, sassafras, anise, cinnamon, cumin, cynæ ether, dill, elecampane, fennel seed, wine (heavy), wormseed, myrtle, laurel, marjoram, peppermint, rue, cinnamon leaves, palmarosa, rosemary, and erigeron.

271,493—January 30, 1883. J. A. McCLELLAND. *Pyroxyline fabric.*

A fabric composed of a sheet or sheets of pyroxylin compound with threads, filaments, or fibers embedded therein and all extending in the same direction.

271,494—January 30, 1883. J. A. McCLELLAND. *Process of veneering or covering articles with pyroxyline compounds, etc.*

A sheet or sheets of the plastic material is applied to the article and it is inclosed or surrounded by mobile or yielding material, such as sand or putty, and subjected to pressure.

275,215—April 3, 1883. I. S. HYATT. *Process of manufacturing sheets of celluloid and other plastic material.*

A sheet of polished celluloid having a backing is produced by placing the sheet on a polished surface, laying upon the same a backing moistened or saturated with a solvent of pyroxylin, placing upon the backing absorbent material, and subjecting the whole to pressure.

276,443—April 24, 1883. W. McCAINE. *Process of treating pyroxyline compounds.*

A pyroxylin compound containing a latent solvent is reduced to a powder, then thoroughly dried, and when dry subjected to heat and pressure, whereby a dry product is obtained free from air cells.

280,745—July 3, 1883. J. W. HYATT. *Press or mold for coating articles with celluloid, etc.*

The article is placed between sheets of celluloid and the whole between diaphragms or sheets of flexible material, when fluid pressure is applied to the upper or lower sides of the diaphragms, the fluid being first hot and then cold.

283,225—August 14, 1883. J. B. EDSON. *Manufacture of artificial ivory.*

Artificial ivory is formed by compressing a number of sheets of zylonite, formed of material of different densities or different characteristics of composition, into one entire mass, and then making sections across the several layers.

286,212—October 9, 1883. D. & D. McCAINE. *Process of treating pyroxyline, etc.*

Pyroxylin is dissolved in a suitable solvent, and it is then treated with benzine or equivalent light mineral oil and resin, producing a homogeneous product, free from air bubbles.

289,239—November 27, 1883. J. B. EDSON. *Apparatus for polishing sheets of zylonite, etc.*

The surface is slightly dissolved by any of the well-known solvents, and then the sheet is subjected to pressure, with the slightly dissolved surface in contact with a highly polished surface, such as glass.

289,240—November 27, 1883. J. B. EDSON, *Forming and finishing surfaces coated with zylonite.*

A sheet of fabric coated on one or both sides with thin sheets of zylonite through the medium of an interposed solvent; produced by passing a thin sheet of zylonite and a sheet of the material to be coated between rolls and introducing a solvent between the two sheets to slightly dissolve the surface of the zylonite, whereby the sheets are immediately compressed.

289,241—November 27, 1883. J. B. EDSON. *Patent leather and a substitute therefor.*

A base-forming material, having attached to one of its surfaces a thin sheet of zylonite having a highly polished surface. It is prepared by partially dissolving one surface of the zylonite and uniting it to the base, and then partially dissolving the exterior surface of the sheet of zylonite and compressing the partially dissolved surface next to a highly polished surface.

289,338—November 27, 1883. J. B. EDSON. *Treating material with zylonite to resemble pebble, goat, French calf, and alligator leather.*

A thin sheet of zylonite of a proper color is applied to a sheet of leather, such as are technically called "splits," by partially dissolving one surface of the zylonite by a suitable solvent and applying the partially dissolved surface to the base, then applying pressure for a period of time sufficient to imitate the kind of leather to be produced and to expel the surplus solvent and air. Then partially dissolving the exterior surface of the sheet of zylonite and compressing it against a highly polished surface.

294,557—March 4, 1884. W. V. WILSON. *Manufacture of material for electric insulation.*

Two hundred parts of wood or vegetable tar is combined with about 100 parts of nitrocellulose—the nitration of which has not been carried beyond the point which will effect its greatest solubility—the latter being softened by one or more of its solvents.

294,661—March 4, 1884. G. M. MOWBRAY. *Plastic compound from pyroxyline and mica.*

Mica is combined with soluble pyroxylin.

296,967—April 15, 1884. J. W. HYATT. *Art of manufacturing celluloid and other compounds of pyroxyline.*

Aqueous particles are removed from pyroxylin pulp by displacement, under pressure, with an unobjectionable liquid, as alcohol, which may be utilized as a solvent.

296,968—April 15, 1884. J. W. HYATT, W. H. WOOD, AND J. H. STEVENS. *Process of and apparatus for effecting the desiccation of pyroxyline pulp.*

A pile is formed of layers of pyroxylin and bibulous material, as blotting paper, and subjected to great pressure, the pyroxylin being subjected then to further pressure between dry sheets.

296,969—April 15, 1884, J. W. HYATT, J. H. STEVENS, W. H. WOOD, AND J. EVERDING. *Manufacture of pyroxyline material.*

Pyroxylin material is impregnated with liquid solvents by forming it into cakes or plates, placing them in a suitable vessel where they are held apart, introducing the liquid solvent, and agitating or rotating the vessel, whereby the solvent repeatedly passes over the surface of the cakes or plates.

296,970—April 15, 1884. J. W. HYATT, J. H. STEVENS, AND W. H. WOOD. *Manufacture of celluloid and other compounds of pyroxyline.*

Pyroxylin is formed into cakes and dried, and the cakes then softened with the required amount of liquid solvent by being formed into a pile with the solvent between the cakes, the material being afterwards mixed or masticated in heated rolls.

297,770—April 29, 1884. J. B. EDSON. *Finishing and glossing the surfaces of fabrics having a coating of some pyroxyline compound.*

The zylonite sheet is passed through a fluid acting as a solvent of the zylonite, which upon evaporation leaves a glossy surface. By passing the sheet or coated fabric around a roller in the solvent, one side only is exposed to the action of the solvent.

297,935—April 29, 1884. J. W. HYATT. *Process of desiccating pyroxyline in comminuted form.*

Nitrocellulose is ground in water and then agitated in contact with an absorbent, as bags of porous absorbent material in a closed revolving vessel.

299,857—June 3, 1884. E. SCHERING. *Preparation of collodion.*

An elastic and transparent composition for the preparation of collodion, becoming hard on drying, neither explosive on concussion nor spontaneously combustible; formed by dissolving pure collodion cotton in ether and alcohol and then freeing from its solvents, by distillation after filtration, sufficient to admit of the mass being cast into forms.

300,158—June 10, 1884. J. H. STEVENS. *Manufacture of material to imitate ivory from pyroxyline compounds.*

Strips are cut of one or more thin pieces of material of varied color, treated with a solvent and compacted on edge into a cake, welded together by heat and pressure, and the block then reduced to sheets.

307,032—October 21, 1884. J. B. EDSON. *Manufacture of artificial ivory from zylonite, etc.*

Two or more sheets of soluble pyroxylin having inert matters, and colored or otherwise, are rolled into scroll form, or assembled in block form, and forced through a nozzle or die, so that the several layers shall partially preserve their parallelism; or the scrolls are molded or consolidated into a cake which is then cut into sheets or sections.

309,831—December 30, 1884. J. B. EDSON. *Manufacture of artificial ivory.*

Imitation grain-ivory produced by combining two or more layers of a pyroxylin base pigmentized in slightly varying proportions; as one group of layers of transparent horn-colored pyroxylin with 7½ per cent of oxide of zinc and one-half of 1 per cent of yellow coloring matter, and another group of the same with 15 per cent of oxide of zinc and one-quarter of 1 per cent of yellow coloring matter.

311,203—January 27, 1885. I. V. REAGLES. *Composition of matter for waterproofing.*

A compound of wood alcohol, 1 gallon; castor-oil, 1 pound; gum camphor, 1 pound; pyroxylin, 1 pound; and gum shellac, one-fourth of a pound.

320,884—June 23, 1885. G. M. MOWBRAY. *Plastic-compound resembling ivory.*

A pyroxylin product composed of a series of sheets of pyroxylin and neutral matter of uniform composition, with one or both surfaces of the superposed sheets colored or tinted, and the sections united together by heat and pressure or solvents and pressure.

329,093—October 27, 1885. J. H. STEVENS AND W. H. WOOD. *Utilizing celluloid, etc., in the production of enameled goods or veneering.*

A sheet of seasoned pyroxylin material is attached to a backing and at the same time given a high polish by subjecting them to pressure accompanied by a high degree of heat, the exposed surface of the pyroxylin being in contact with a polished surface.

329,313—October 27, 1885. J. G. JARVIS. *Manufacture of pyroxyline compounds.*

Gum dammar, gum guaiacum, and gum mastic, separately or in mixtures of two or more of them, are used as solvents of pyroxylin with or without pigments or other coloring matters, fixed or volatile oils.

331,241—November 24, 1885. J. W. HYATT. *Method of combining pyroxyline and its solvents in the manufacture of solid compounds.*

Pyroxylin is reduced to a finely divided dry condition, as soluble paper to shreds, then moistened with vinous alcohol or its equivalent, when the powdered camphor is added and the mixture subjected to masticating rolls, or to heat and pressure.

331,242—November 24, 1885. J. W. HYATT. *Method of combining pyroxyline and its solvents in the manufacture of solid compounds.*

The solvent is sprayed against a moving stream of pyroxylin pulp, the sprayed pulp falling into a closed receptacle and resting until the solvent is diffused, when it is masticated.

331,713—December 1, 1885. J. W. HYATT. *Compounding pyroxyline with its solvents in the manufacture of solid compounds.*

Pyroxylin is formed into flock or pulp, and into thin sheets or films, and the solvent then applied to the sheets by spraying or dipping; the sheets are then massed in a closed receptacle and the conversion finally completed by means of masticating rolls or heat and pressure.

342,208—May 18, 1886. J. G. JARVIS. *Manufacture of zylonite and other pyroxyline compounds and articles made therefrom.*

A seasoned, pulverized, and comminuted pyroxylin compound is treated with a solution of camphor, the solvent of which is not a solvent of pyroxylin—such as coal tar naphtha—and the solvent of camphor is then eliminated from the mass. The mass may then be subjected to the action of heated alcoholic vapor.

346,376—July 27, 1886. M. C. LEFFERTS. *Process of printing upon or decorating the surface of celluloid.*

The design is printed or applied in ink or color and the surface is then subjected to the action of heat and pressure while in contact with a polished surface; to prevent displacement it may be confined in a mold or die.

348,222—August 31, 1886. M. C. LEFFERTS and J. W. HYATT. *Printing on pyroxyline compounds.*

The pyroxylin compound is subjected to heat and pressure while in contact with the engraved plates; the ink may contain or consist of a solvent of pyroxyline and a pigment.

349,658.—September 21, 1886. G. M. MOWBRAY. *Process of and apparatus for washing, decoloring, and draining pyroxyline.*

Pyroxylin is decolorized by the action of oxalic acid and hydrochloric acid; it is then subjected to washing by the flow of water through the mass from one side or end of a tank with overflow at the other.

349,659—September 21, 1886. G. M. MOWBRAY. *Method of drying pyroxyline.*

Pyroxylin is desiccated by means of warmed air (not to exceed 38° C.) which has been previously deprived of its moisture by chilling and passing over lime, either or both.

360,811—April 5, 1887. J. A. McCLELLAND. *Method of treating and ornamenting pyroxyline compounds.*

The surface of celluloid containing a pigment is treated, in proper design, with an acid that will dissolve the pigment. The grain of ivory is imitated by coating the surface with a resist, removing parts of the resist according to the graining, or design, and then applying the pigment solvent. Coloring matter may be afterwards applied, with or without a new resist.

366,231—July 12, 1887. J. A. McCLELLAND. *Plastic compound.*

A non volatile gum or resin is used as a solvent for pyroxylin, as kauri gum, with or without pigments, or fixed or volatile oils.

372,100—October 25, 1887. O. P. AMEND. *Compound for pyroxyline or nitrocellulose.*

Chloride of amyl in conjunction with camphor is used as a solvent for pyroxylin.

383,272—May 22, 1888. A. BENSINGER. *Process of ornamenting celluloid surfaces.*

The design, printed on paper with a suitable ink, is transferred to the celluloid surface, the latter being moistened with a solvent of the same and of the ink, under pressure.

408,344—August 6, 1889. F. GREENING. *Substitute for ivory, etc.*

A base is prepared by treating fibrous or cellulose substances, such as cotton combings, rags, paper, etc., with a mixture of fuming nitric acid and sulphuric acid, in the proportion of 30 per cent of the former and 70 per cent of the latter, then washing, and submitting the product to a bath of sodium chloride and ammonia alum, and then dissolving the base in a solvent composed of a distillation of acetate of lead, 2 parts, and anhydrous lime, 1 part, mixed with fusel oil; 2½ gallons of the distillate to 1½ gallons of fusel oil.

409,345—August 20, 1889. C. F. BRADY. *Process of printing pyroxyline compounds.*

Pyroxylin compounds are imprinted with indelible colors by applying the coloring matter to the sheets by pressure and subsequently subjecting them to the direct action of steam in a chamber.

417,727—December 24, 1889. J. G. JARVIS. *Process of ornamenting articles having a pyroxyline base.*

The design is embossed upon the plastic material, then it is stained or colored, and finally the article is submitted to heat and pressure to smooth the embossed surface.

418,136—December 24, 1889. C. H. KOYL. *Reflector or mirror.*

A sheet of transparent celluloid silvered on the back.

418,237—December 31, 1889. R. C. SCHUPPHAUS AND M. T. WHITE. *Process of manufacturing pyroxyline.*

The body of cellulose is confined in a perforated cage while being treated in a nitrating solution to secure it against disintegration or disarrangement.

421,367—February 11, 1890. W. H. WOOD AND G. C. GILLMORE. (*Reissue: 11,374—April 15, 1890.*) *Process of embossing sheets of celluloid.*

The material is embossed between a die and a "force" composed of celluloid or like material, with heat sufficient to cause them both to flow, the pressure being continued until the material to be embossed is forced into the die, and the die, "force," and material to be embossed retained in contact until cooled.

428,654—May 27, 1890. E. N. TODD. *Process of manufacturing thin sheets of nitro-cellulose, etc.*

Glass plates are vertically suspended in a tank of a solution of collodion or pyroxyline, and after standing until all bubbles have escaped, the solution is drawn off slowly from the bottom of the tank, causing a film of solution to adhere to the plates, which, after drying, is removed as a thin, uniform transparent sheet.

458,157—August 25, 1891. F. ECKSTEIN. *Composition of matter for use as a substitute for glass.*

A composition consisting of collodion-wool, a nonresinous oil, as castor oil, and a balsam or soft resin, with or without magnesium chloride to lessen inflammability.

460,086—September 22, 1891. W. HARVEY. *Artificial horn and method of producing the same.*

Artificial horn, produced by coloring sheets of plastic material, as celluloid or pyroxylin, in layers or strata, cutting the sheets into conical figures or forms, nesting or laminating and uniting them, and then rolling and turning off the projecting edges of the series of nested and united cones to constitute a solid laminated mass or rod.

465,784—December 22, 1891. W. SCHMIDT. *Process of polishing sheets of pyroxyline material.*

A sheet of pyroxylin material is subjected to the action of vapor of alcohol and then pressed between polished surfaces.

470,451—March 8, 1892. A. SEHER. *Manufacture of compounds of pyroxyline.*

As direct solvents of pyroxylin or nitrocellulose, there is used propion, butyron, valeron, capron, methyl-ethyl-ketone (acetyl-ethyl), methyl-propyl-ketone, methyl-butyl-ketone, methyl-valeral, ethyl-butyl-ketone, and methyl-amyl-ketone, singly or any mixtures thereof.

474,814—May 17, 1892. A. A. C. DE COËTLOGON. *Process of preparing celluloid and similar materials for printing.*

Celluloid having a surface adapted to be printed upon and absorb the ink; produced by forming on the surface a multitude of minute grains or pores, as by a sand jet, then washing the surface, then varnishing, applying an impalpable powder—as sulphate of magnesia and sulphate of baryta—and then producing a calender finish.

490,195—January 17, 1893. B. B. GOLDSMITH. *Process of producing nitro-cellulose or celluloid surfaces.*

Wood or other absorbent material is first given a coat or coats of varnish containing pyroxylin or pyroxylin compound, then layers of varnish containing resin, with or without a finishing coat of varnish containing pyroxylin.

508,124—November 7, 1893. H. D. TURGARD. *Process of denitration of nitro-cellulose and its compounds.*

Nitrocellulose and its compounds are denitrated by immersing the material in a solution of hydro-sulphate of ammonia and a metallic sulphide, as sulphide of silver.

531,158—December 18, 1894. H. DE CHARDONNET. *Process of manufacturing artificial silk.*

Hydrated pyroxylin—differing from ordinary pyroxylin by containing at least 25 per cent of water and of greater solubility—is produced by treating pyroxylin while still moist with hydrated ether; which hydrated pyroxylin is dissolved to form collodion and spun into threads by discharging through nozzles; certain substances may be added to increase the fluidity. The spun collodion is denitrated by immersion in a bath formed by mixing calcium monosulphide, sulphate of ammonia and water, and removing the precipitate; the bath may be regenerated by adding sulphuric acid, and then calcium monosulphide and separating the precipitate.

546,360—September 17, 1895. J. H. STEVENS AND E. D. HARRISON. *Production of imitation onyx from pyroxylin compounds.*

A rod or sheet of pyroxylin composition in imitation of onyx, consisting of two or more light tints, with streaks of a darker color breaking through or interspersed with the lighter tints; produced by forming the light-tinted parts in solidified strata, cutting through these strata across the edges, inserting coloring matter or pyroxylin of a different color between the cut parts, and then solidifying the whole into blocks or masses.

559,392—May 5, 1896. F. LEHNER. *Process of making artificial silk.*

Two solutions are formed; first, of silk waste digested with caustic alkali, or a solution of copper or a copper salt in ammonia, precipitated from such solution and finally dissolved in concentrated acetic acid; and, second, of a substance containing cellulose macerated with a solution of copper or a copper salt in ammonia, nitrated, and then partially denitrated; which two solutions are mixed and caused to pass through a congealing solution, as of oil of turpentine or other hydrocarbon, to form a thread. The thread is laid in a solution containing soluble glass, whereby it is rendered incombustible.

562,626—June 23, 1896. F. LEHNER. *Art of preparing artificial silk.*

Cellulose is gradually introduced into a nitrating bath and the temperature of the bath progressively raised as the cellulose is added, whereby a homogeneous mixture of tri and tetra nitrocellulose is obtained. The whole mixture is then maintained at the final temperature for several hours; the nitrating liquid separated by centrifugal action; the acid-moist resultant mass immersed in sulphuric acid; a vulcanized drying-oil then added; the mixture finally dissolved in a suitable solvent, such as acetone, an alcohol, or alcohol ether; then the thread is drawn and the same immersed in warm water, then dipped in a solution of ammonium or other alkali hydrosulphide and a neutral magnesium salt at 40° C. (keeping the same therein until the rainbow colors of cellulose are visible under the microscope in polarized light), and finally washed, dried, and finished.

562,732—June 23, 1896. F. LEHNER. *Process of and apparatus for making artificial silk.*

A ground solution is passed into a bath free from oxygen—as of a hydrocarbon, such as oil of turpentine—and the thread drawn from the bath. The ground solution consists of resin, linseed oil, nitrocellulose, and an inorganic salt to render the thread incombustible.

563,214—June 30, 1896. H. M. TURK. *Composition of matter for manufacturing artificial silk.*

It consists of nitrocellulose, 96 parts; gelatin or isinglass, 2 parts; and albumin, 2 parts; dissolved in 1,600 parts of glacial acetic acid.

587,097—July 27, 1897. A. L. KENNEDY. *Composition of matter and article treated therewith.*

A coating solution for the surface of leather and other similar materials, consisting of 1 gallon of amylacetate, 12 ounces of nitrocellulose, 10 ounces of lanolin, and 3 ounces of corn oil, mixed and combined with aniline or other coloring matter.

590,842—September 28, 1897. A. L. KENNEDY. *Waterproof cloth and process of making same.*

A fabric having its face portions composed of natural fibers and its inner portions composed of threads or strands impregnated with a salt of cellulose, whereby ordinary unglazed or uncoated and nappy faces are presented, produced by entwining ordinary threads along with strands of undissolved soluble salt of cellulose to form a fabric, and then subjecting it to a solvent of the salt of cellulose to dissolve the extra strands and cause the dissolved salt to impregnate the ordinary threads.

600,824—March 15, 1898. J. H. STEVENS AND M. C. LEFFERTS. *Process of manufacturing pyroxylin sheets.*

A nonoxidizing solution of a pyroxylin compound is caused to flow in the form of a moving, continuous, fluid sheet, as onto a revolving drum, the thickness of the sheet being regulated by removing the surplus solution, and the volatile ingredients are then evaporated.

601,927—April 5, 1898. F. G. ANNISON. *Enameled paper and compound used to enamel same.*

An enameled paper adapted to receive and retain printing and lithographic impressions, the enamel consisting of a nitrocellulose compound containing oil and pigment, the latter being larger than or in excess of the nitrocellulose.

602,159—April 12, 1898. E. D. HARRISON AND C. H. THURBER. *Method of producing pyroxyline imitations of mosaic.*

Pyroxylin compounds are formed into sticks or rods; coated with a dyeing substance; arranged side by side; welded into a block; and sheets are then cut therefrom.

602,797—April 19, 1898. F. G. ANNISON. *Art of coating fabrics or permeable materials with nitrocellulose compounds and product produced thereby.*

A flexible permeable base is first impregnated to the desired depth with a liquid solution of the compound, dried, and then one or more coats of a heavier solution of the compound are applied, each dried in turn; the coat may be finally compacted by heat and pressure, with or without embossing.

603,001—April 26, 1898. W. H. WOOD AND J. H. STEVENS. *Waterproof fabric.*

A waterproof fabric having two or more successive coatings of a flexible pyroxylin compound, the under coating being more flexible than the upper coat or coatings, as, for example, the inner stratum being richer in oil than the outer stratum.

603,526—May 3, 1898. J. R. FRANCE. *Method of manufacturing pyroxylin compounds in imitation of marble.*

Pyroxylin compounds of different colors are produced; formed into fragments; dipped into a dye dissolved in a solvent of pyroxylin, and the dipped fragments calendered together to form sheeting; which may be compressed into blocks and cut.

608,726—August 9, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition of pyroxylin, and a lead salt of a volatile monatomic fatty acid, as lead acetate, capable of transparent effects.

608,727—August 9, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition of pyroxylin and lactamid, capable of transparent effects.

609,475—August 23. 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition consisting of pyroxylin and a salt of camphoric acid, as sodium camphorate.

610,566—September 13, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition consisting of pyroxylin and a manganese salt of the volatile monatomic series of fatty acids, as acetate of manganese.

610,615—September 13, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition of pyroxylin and a lactophosphate, as lactophosphate of calcium.

610,953—September 20, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition of pyroxylin and a salt of hypophosphorous acid, as sodium hypophosphite; capable of transparent effects.

612,066—October 11, 1898. J. H. STEVENS. *Waterproof fabric.*

A fabric coated or impregnated with a pyroxylin compound containing a nondrying oil, as castor oil, and a salt containing a halogen element, as zinc chloride.

612,067—October 11, 1898. J. H. STEVENS. *Waterproof fabric.*

A fabric waterproofed by a pyroxylin compound which contains pyroxylin, castor oil, and a salt which contains an aromatic acid, as salicylate of soda.

612,531—October 18, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition of pyroxylin and a lithium salt of a volatile monatomic fatty acid, as lithium acetate; capable of transparent effects.

612,553—October 18, 1898. J. H. STEVENS. *Waterproof fabric.*

A fabric coated or impregnated with a pyroxylin compound consisting in part of castor oil and a salt or compound containing the phenoylic radical C_6H_5O, as sulphocarbonate of soda.

613,400—November 1, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition of pyroxylin and a salt of succinic acid having an inorganic base, as potassium succinate.

614,514—November 22, 1898. J. H. STEVENS. *Pyroxylin compound.*

A composition of pyroxylin and an inorganic salt of a halogen acid derived from the volatile members of the monatomic series of fatty acids, as an inorganic salt of chloracetic acid.

615,319—December 6, 1898. J. H. STEVENS. *Waterproof fabric.*

A fabric waterproofed by a pyroxylin compound which contains pyroxylin, oil, camphor, and naphthol.

615,446—December 6, 1898. B. B. GOLDSMITH. *Finishing fibrous or absorbent surfaces.*

A coat or coats of an aqueous solution of casein or casein compound is first applied, and then one or more coats of pyroxylin varnish, with or without finishing coats of gloss varnish.

617,450—January 10, 1899. J. H. STEVENS. *Pyroxylin composition.*

A composition containing pyroxylin and a urea salt of an acid of the aromatic series containing carboxyl (COOH), as urea benzoate; capable of transparent effects.

619,037—February 7, 1899. J. R. FRANCE. *Pyroxylin imitation of mosaic and method of manufacturing same.*

A pyroxylin imitation of mosaic, produced by forming pieces of pyroxylin compounds of different colors, form, and size, dipping them in a dye dissolved in a solvent of pyroxylin, pressing the dipped pieces into cakes, and cutting sheets therefrom.

621,382—March 21, 1899. J. H. STEVENS. *Pyroxyline compound.*

A composition containing pyroxylin and a salt of an acid of the aromatic series containing carboxyl (COOH), said salt having an inorganic base, as sodium benzoate, capable of transparent effects.

621,434—March 21, 1899. J. H. STEVENS. *Transparent pyroxylin plastic composition.*

A solid transparent composition consisting of pyroxylin, camphor, and a preserving potassium salt of a volatile monatomic fatty acid, as potassium acetate, the said salt not exceeding 3 per cent by weight of the pyroxylin.

622,290—April 4, 1899. J. H. STEVENS. *Transparent pyroxylin plastic composition.*

A solid transparent composition consisting of pyroxylin, camphor, and a preserving sodium salt of a volatile monatomic fatty acid, as sodium acetate, the said salt not exceeding 3 per cent by weight of the pyroxylin; the best effects being attainable with about 1 per cent.

622,291—April 4, 1899. J. H. STEVENS. *Transparent pyroxylin plastic composition.*

A transparent solid composition consisting of pyroxylin, camphor, and a preserving calcium salt of a volatile monatomic fatty acid belonging to the group which consists of calcium propionate and calcium butyrate; the said salt never more than 3 per cent and for proper proportions should not exceed 1 per cent.

622,292—April 4, 1899. J. H. STEVENS. *Transparent pyroxylin composition of matter.*

Barium butyrate is mixed with pyroxylin, not to exceed 5 per cent.

622,293—April 4, 1899. J. H. STEVENS. *Transparent pyroxylin plastic composition.*

It consists of pyroxylin, camphor, a liquid solvent, and an inorganic salt of lactic acid, as the lactates of potassium, strontium, calcium, sodium, and barium, the salt not to exceed 5 per cent of the pyroxylin; preferably about 1 per cent.

622,294—April 4, 1899. J. H. STEVENS. *Transparent pyroxylin plastic composition.*

A solid transparent composition consisting of pyroxylin, camphor, and a preserving zinc salt of a volatile monatomic fatty acid, as zinc formate, zinc acetate, zinc propionate, etc., the salt not exceeding 5 per cent of the pyroxylin.

622,727—April 11, 1899. J. H. STEVENS. *Flexible skin or fabric.*

A fabric waterproofed by a pyroxylin compound which contains pyroxylin, castor oil, beta-naphthol, and amyl acetate.

625,313—May 23, 1899. L. L. BÉTHISY. *Uninflammable nitrocellulose product*

It is composed of nitrocellulose with a binder rendered incombustible by the presence of zinc chloride, as alcohol, essential oil, vaseline oil, acetic ether, zinc chloride, and white gelatine.

626,732—June 13, 1899. J. H. STEVENS. *Pyroxylin composition.*

A composition of pyroxylin and strontium butyrate; capable of transparent effects.

651,364—June 12, 1900. I. KITSEE. *Compound useful as a substitute for rubber.*

A composition consisting of a glue compound—as employed for printers' rolls—and celluloid.

657,535—September 11, 1900. C. G. HAGEMANN AND F. O. C. ZIMMERMANN. *Manufacture of celluloid.*

A product consisting essentially of gelatinized nitrocellulose and a hydrate or hydroxid of a metal, as sulphate of alumina, produced by molecularly combining with a solution nitrocellulose; a concentrated solution of a hydrate or hydroxid of a metal; reacting with a concentrated solution of caustic soda; removing the cellulose solvent and soluble constituents; drying, and gelatinizing the compound with a solvent of nitrocellulose holding camphor in solution.

662,961—December 4, 1900. A. N. PETIT. *Solvent material for treating surfaces of celluloid.*

A mixture of a solvent of celluloid and a fatty acid or like material, as amyl acetate and oleic acid.

663,739—December 11, 1900. J. DUQUESNOY. *Process of making artificial-silk thread.*

Nitrocellulose is dissolved in a solvent composed of equal parts of acetone, acetic acid, and amyl alcohol, and expressed from a capillary orifice.

665,975—January 15, 1901. A. PETIT. *Composition of matter for manufacturing artificial silk threads.*

The composition consists of 100 pounds of dry nitrocellulose, 7 pounds of india-rubber solution, and 5 pounds of stannous chloride, mixed with sufficient solvent to bring it to the required consistency.

VISCOSE.

520,770—June 5, 1894. C. F. CROSS, E. J. BEVAN, AND C. BEADLE. *Plastic compound of cellulose.*

A soluble plastic compound derived from cellulose, caustic alkali, and carbon di-sulphide; as by treating cellulose, saturated with a strong solution of caustic soda, in a chamber with carbon di-sulphide.

530,826—December 11, 1894. C. F. CROSS AND E. J. BEVAN. *Manufacture of cellulose acetate.*

The intermediate product manufactured by mixing cellulose hydrate with zinc acetate solution and drying and dehydrating, is treated with acetyl chloride, the crude product of the reaction washed, pressed, and dried, and then treated with chloroform, whereby a solution of cellulose acetate is obtained free from cellulose and the solvent finally evaporated.

571,530—November 17, 1896. R. LANGHANS. *Method of and composition for making artificial silk.*

A noninflammable silk, produced from cellulose and other analogous carbohydrates by purifying the material, subjecting it to the action of phosphosulphuric, sulphuric, and phosphoric acids until a viscid syrup is obtained, increasing the stability of the syrup by treatment with an ethyl ester, drawing it into a filament, removing the acid, and hardening.

604,206—May 17, 1898. C. F. CROSS, E. J. BEVAN, AND C. BEADLE. *Modification of cellulose and method of preparing same.*

A structureless insoluble modified cellulose, obtained by first treating cellulose with caustic alkali and carbon di-sulphide (No. 520,770), and then decomposing the soluble mass thus obtained, as, for example, by exposure to heat above 100° C. or by exposure to steam at the same temperature.

617,009—January 3, 1899. M. FREMERY AND J. URBAN. *Process of manufacturing artificial silk.*

Cellulose is dissolved, without decomposing the same, in a cupro-ammonium salt solution and caused to flow in a thread or fiber-like stream into a bath containing a precipitant of cellulose, such as an acetic-acid solution, whereby the cellulose is precipitated from its solution in a thread or fiber-like form. The thread is wound within the bath as precipitated, then unwound and wound outside the bath, and simultaneously subjected to the action of a drying agent.

625,033—May 16, 1899. J. F. HOYNE. *Process of manufacturing fiberless thread.*

Cellulose is dissolved in a basic solution of zinc nitrate, chloride, or other zinc salts, filtered, and pressed through small holes into methylated spirits—thereby coagulating the cellulose—when the threads are strained nearly to breaking and dried under strain.

634,571—October 10, 1899. J. C. CHORLEY. *Method of producing cellulose films for photographic or other purposes.*

Films of any desired length are produced by a continuous operation by supplying viscose in a regulated and evenly distributed quantity or film, heating the gradually moving film, and simultaneously subjecting it to a current of air traveling in the opposite direction, and subjecting the film to the action of boiling brine to decompose the viscose and regenerate the insoluble cellulose in film form.

646,044—March 27, 1900. E. THOMAS, J. BONAVITA, AND M. OLIVIER. *Manufacture of viscose.*

To alkali cellulose there is added 25 to 30 per cent of sodium sulphite, and about 30 per cent of zinc oxide, calculated on the cellulose contained in the alkali cellulose, and the mixture is then treated with carbon disulphide; the product being free from the objections of color and odor heretofore attaching to viscose.

646,351—March 27, 1900. E. BRONNERT. *Production of cellulose solution for manufacturing threads.*

Clean cellulose is treated with a concentrated caustic alkali lye, washed with much water, treated for two to four hours with a weak bleaching liquor, submitted to centrifugal action, and finally dissolved while wet in an ammoniacal solution of cupric oxide.

646,381—March 27, 1900. E. BRONNERT. *Production of cellulose solutions for manufacturing threads.*

Cellulose in a finely divided state is treated for about one hour with a cold, concentrated solution of caustic alkali, then the product is mixed with a powdered copper salt—such as copper sulphate—in proportion equivalent to the caustic alkali used, avoiding a rise in temperature, and finally the product is dissolved in strong ammonia solution.

646,799—April 3, 1900. E. BRONNERT. *Process of producing solutions of cellulose.*

Cellulose, freed from fat and bleached, is treated with concentrated caustic-alkali solution, as in the mercerizing process, at a low temperature, then submitted to centrifugal action and washed, then treated with an oxidizing agent, and after again washing and submitting to centrifugal action, it is dissolved directly in concentrated zinc-chloride solution.

648,415—May 1, 1900. W. H. KRUG. *Substitute for horn and process of manufacturing same.*

A vegetable tissue, as pith, is subjected to the action of an alkali solution, washed and ground, the nongelatinized fibers removed by washing, and the resultant mass drained and dried.

650,715—May 29, 1900. M. FREMERY AND J. URBAN. *Process of manufacturing cellulose products.*

Cellulose products, as threads and films, are subjected for a short time to the action of water at an elevated temperature of from 60° to 100° C., and then dried at a comparatively low temperature not exceeding 40° C., to impart a glossy appearance and a comparatively great strength.

665,975—January 15, 1901. A. PETIT. *Composition of matter for manufacturing artificial silk threads.*

It consists of about 100 pounds of dry nitrocellulose, 7 pounds of india-rubber solution, and 5 pounds of stannous chloride, mixed with a sufficiency of solvent to bring it to the required consistency.

RUBBER AND RUBBER SUBSTITUTES.

240—June 17, 1837. C. GOODYEAR. *Improvement in the process of divesting caoutchouc, gum-elastic, or india-rubber of its adhesive properties, and also of bleaching the same, and thereby adapting it to various useful purposes.*

The adhesiveness of the surface of caoutchouc is destroyed by the application of an acid solution of the metals, as, for example, a nitrate of copper or a nitrate of bismuth. Caoutchouc paste is bleached by incorporating therewith lime, preferably quicklime.

1,090—February 24, 1839. N. HAYWARD (ASSIGNOR TO C. GOODYEAR). *Improvement in the mode of preparing caoutchouc with sulphur for the manufacture of various articles.*

Sulphur is combined with caoutchouc, either in solution, as in oil of turpentine, or in substance, causing the gum to dry more perfectly and to improve the whole substance.

3,633—June 15, 1844. C. GOODYEAR. (*Reissues: 156 and 157—December 25, 1849; 1,084—November 20, 1860.*) *Improvement in process for manufacture of india-rubber.*

India rubber, combined with or in the presence of sulphur, is cured by subjecting it to a high degree of artificial heat, say, from 212° to 350° F., or approaching 270° F.; or a carbonate or other salt or oxide of lead is added, as india rubber 25 parts by weight, sulphur 5 parts, and white lead 7 parts. Layers of cotton batting may be interposed between those of the gum.

4,005—April 22, 1845. N. GOODYEAR. *Improved method of manufacturing india-rubber cloth and sheet india rubber.*

The gum is impregnated with grit, iron or other metal filings, or other hard substances.

5,592—May 23, 1848. R. A. BROOMAN. *Applications of the substance called gutta-percha alone or in combination with other substances to certain manufacturing uses and purposes and the modes or processes of preparing, combining, and applying the same.*

Gutta-percha is freed of foreign matter by soaking in water and squeezing between rolls, then kneaded in a machine, when it may be mixed with caoutchouc or sulphur or both, and pigments. If caoutchouc is added, a degree of heat not less than 150° F. is necessary to effect the amalgamation. Pulverized chalk or other soft powder may be added, or ground emery, sand, or other hard substance. It is employed in manufacture by molding, stamping, or is used for enveloping. It is reduced to a powder and employed in the making of casts, forms, and impressions in relief, the mold or surface being heated until the material becomes ductile and fills all parts of the mold or form.

8,075—May 6, 1851. N. GOODYEAR. (*Reissues: May 18, 1858—556-557.*) *Improvement in the manufacture of india rubber.*

A combination of india rubber, sulphur, and magnesia, or lime, or a carbonate, or a sulphate of magnesia, or of lime, with or without shellac for making a hard and inflexible substance.

10,714—April 20, 1886. A. KISSEL. *Hardening resins.*

Resins or resinous products are hardened by partially or wholly neutralizing the contained acid or acids with caustic lime or other caustic alkaline earth.

11,096—June 13, 1854. THOMAS, EARL OF DUNDONALD. *Improvement in compositions for coating telegraph wires and for other purposes.*

A compound of bitumen, asphaltum, or mineral pitch, 75 parts; india rubber, 15 parts; and 10 parts of a mixture formed by dissolving gum shellac (1 part) and resin (4 or 5 parts) in oil of petroleum, dead-oil, or naphtha, with steam heat.

15,067—June 10, 1856. A. G. DAY. (*Reissues: 756 and 757—July 12, 1859.*) *Improvement in cleansing caoutchouc.*

Alkali or its equivalent is used for separating bark, sticks, etc., from crude caoutchouc and other vulcanizable gums. The caoutchouc is charged with alkaline liquor by means of an exhausting apparatus.

21,122—August 10, 1858. A. G. DAY. (*Reissues: 620—November 9, 1858; 5,230, 5,231, and 5,232—January 14, 1873.*) *Improvement in hard rubber.*

A mixture of 2 parts by weight of india rubber or other vulcanizable gum, and 1 part of sulphur, vulcanized at a temperature commencing at about 275° F. and carried to 300° or upward.

25,110—August 16, 1859. C. GOODYEAR. *Porous india-rubber cloth.*

A woven or equivalent fabric having a thin porous coating of india rubber or allied gum.

25,192—August 23, 1859. C. GOODYEAR. *Porous napped india-rubber fabric.*

A fabric composed of cloth and india rubber rendered pervious to air, by having fibers incorporated therewith, and impervious to water, with a face of flocks, clippings, or shavings of woolen or other fibers.

26,698—January 3, 1860. J. MURPHY. *Improvement in treating waste and inferior gums.*

The process consists in: First, the manufacture of hard stock of vulcanizable gum by blending it with sulphur and vulcanizing; second, the reduction of the hard stock to powder; third, the formation of a compound of the ground stock and raw gum by blending; and, fourth, the vulcanization of this compound.

27,770—April 10, 1860. J. M. BATCHELDER. *Improvement in insulation of submarine telegraph wires.*

A telegraph wire or other conductor of electricity insulated with a compound substance composed of pulverized silex, glass, or other nonconducting material mixed with india rubber and sulphur and subsequently vulcanized.

27,837—April 10, 1860. C. F. E. SIMON. *Improvement in restoring waste vulcanized rubber.*

Ground or cut waste of vulcanized india rubber is mixed with chloride of lime (100 parts of rubber waste and 2 parts of chloride of lime) and exposed to a heat of 900° to 1,200° F., with stirring, till the volitilization of the sulphur is complete.

29,717—August 21, 1860. A. C. RICHARDS. *Improvement in devulcanizing waste rubber.*

Rubber waste is ground to powder and treated with steam in a closed vessel at a temperature of over 600° F.

30,181—September 25, 1860. DU B. D. PARMELEE. *Improvement in restoring waste vulcanized rubber.*

Waste rubber is powdered and then combined with india rubber which has been modified by heat, so as to obtain it either in a semiliquid or melted condition or in a liquid or vaporous condition.

31,240—January 29, 1861. R. F. H. HAVEMANN. *Improvement in compositions of caoutchouc.*

A substitute for ivory and bone produced by the admixture of oxide of zinc with chlorine-treated rubber or its chlorine-treated allied gums, in the proportion, say, of one part of zinc oxide to two parts of gum.

31,241—January 29, 1861. R. F. H. HAVEMANN. *Improvement in compositions of caoutchouc.*

A substitute for wood, ivory, and bone produced by the admixture with chlorine-treated rubber or its chlorine-treated allied gums, of one-eighth of a dram of aqua-ammonia, one-eighth of a dram of powdered carbonate of ammonia, and half a pound of lime, per pound of gum, with pressure and heat.

33,094—August 20, 1861. C. McBURNEY. *Improvement in utilizing waste vulcanized rubber.*

Comminuted waste rubber is treated with an oil having no solvent action upon the gum, such as resin oil, castor oil, etc.

34,309—February 4, 1862. T. J. MAYALL. *Improvement in restoring waste rubber.*

Vegetable tar or pine oil is combined or incorporated with waste vulcanized rubber.

40,407—October 27, 1863. C. H. & D. E. HAYWARD. *Improvement in treating waste rubber.*

Waste rags of fibrous material and rubber are boiled in an acid or alkali to destroy the tenacity of the fibers of the rags, so that the rubber may be reground and the material will not blister when reused.

40,491—November 3, 1863. T. J. MACKALL. *Improvement in restoring waste rubber.*

Rubber waste is reduced to a fine condition and then subjected to the direct action of the flames of gas or inflammable liquids.

46,610—February 28, 1865. E. L. SIMPSON. *Improvement in the process of manufacturing india rubber, gutta-percha, etc.*

A concentrated preparation of sulphur and linseed or other vegetable oil is employed in the manufacture of india rubber, to produce a product free from the disagreeable odor and deleterious effects of vulcanized rubber.

46,750—March 7, 1865. S. C. BISHOP. *Improved composition for insulating telegraph wires.*

A mixture of gutta-percha or india rubber, 4 parts; paraffine, 1 part; wheat flour, 2 parts; and resin, 1 part; or in lieu of this gutta-percha or india rubber, 6 parts; paraffine, 2 parts; white oxide of zinc, 1 part; catechu, 1 part; and gelatine or glue, 2 parts; mixed in solution or by heated rolls.

51,331—December 5, 1865. F. MARQUARD. (*Reissue: 2,180—February 20, 1866.*) *Improvement in the manufacture of white rubber.*

After bleaching with chlorine gas the rubber or like gum is washed with hot water. It is then subjected to distillation. The product after straining, pressing, and drying, is redissolved in a small quantity of chloroform mixed with phosphate of lime, and subjected to pressure in hot molds.

51,332—December 5, 1865. E. MARQUARD. (*Reissue: 2,179—February 20, 1866.*) *Improvement in the manufacture of white rubber.*

Rubber dissolved in chloroform (or other solvent) is bleached by treatment with caustic ammonia gas or chloride of ammonia. It is then washed with hot water, subjected to distillation, and redissolved as in No. 51,331, and combined with phosphate of lime or a carbonate of zinc by means of pressure in hot molds.

54,523—May 8, 1866. C. L. FRINK. (*Reissues: 4,942—June 11, 1872; 6,014—August 11, 1874.*) *Improvement in vulcanized rubber compounds for packings and other purposes.*

A vulcanized rubber compound formed of rubber, 10 parts; plumbago, 20 parts; carbonate of lead or litharge, 6 parts; sulphur, 4 parts, and brass or other metal filings, 6 parts.

54,554—May 8, 1866. N. JENKINS. (*Reissue: 3,579—August 3, 1869.*) *Improvement in the manufacture of elastic packing.*

An elastic packing, composed of at least four-tenths of finely pulverized refractory earthy material, such as French chalk, mingled with rubber, prepared for vulcanizing and then vulcanized.

58,615—October 9, 1866. A. G. DAY. (*Reissues: 6,707—October 19, 1875, product; 6,708—October 19, 1875, process.*) *Improvement in artificial caoutchouc.*

Vegetable and mineral oils are combined with gum-resins or other resinous bodies, and sulphur at a temperature sufficient to produce vulcanization; the oils and resins are first mixed under heat, and the sulphur then added and the temperature increased. It may be mixed with india rubber or gutta-percha.

62,055—January 26, 1867. W. MULLEE. *Improvement in process of preparing india rubber.*

Thin sheets of rubber are suspended in a bath of melted sulphur heated to 220° to 230° F., then removed, the crystals of sulphur formed thereon removed, and a pile of the sheets are then kneaded, worked, and vulcanized.

83,031—October 13, 1868. S. C. BISHOP. *Improved compound for insulating telegraph and electric wires.*

It consists of $2\frac{1}{2}$ pounds of asphaltum, one-quarter pound of gutta-percha, one-quarter pound of crude resin, half a gallon of spirits of turpentine, with about 1 gill of boiled linseed oil and 2 ounces of umber.

94,631—September 7, 1869. S. MOULTON. *Improved printers' inking roller from rubber sponge.*

To obtain a substance of a mossy nature, vulcanized india rubber is pulverized and subjected to a second vulcanization.

97,880—November 17, 1869. E. CHESTERMAN. *Improvement in the manufacture of rubber sponge.*

Artificial sponge is made by incorporating into a homogeneous mass, on hot rolls, specified ingredients—salt, salts of soda, alum, or other deliquescent or soluble solid not affected by moderate heat, either with or without such liquids as molasses, etc.—and afterwards expanding, revulcanizing, and setting. It is expanded by treatment in a hot water, steam, or other bath. Color is imparted by the use of golden sulphuret of antimony incorporated with the compound.

137,509—April 1, 1873. W. A. TORREY. *Improvement in vulcanized rubber compounds.*

Mica is combined with rubber prior to vulcanization.

140,281—June 24, 1873. D. M. LAMB. *Improvement in the production of waterproof gum.*

Waterproof gum made from the inspissated juice of plants of the asclepias or milkweed family, or any of the analogous plants possessing like properties.

140,282—June 24, 1873. D. M. LAMB. *Improvement in the production of waterproof gums.*

A waterproof gum is extracted from plants of the asclepias or milkweed family, by subjecting the plants to fermentation, and inspissating the resulting liquid by evaporation.

140,283—June 24, 1873. D. M. LAMB. *Improvement in preparing waterproof gums from flaxseed, etc.*

A vulcanizable gum is produced from flaxseed or other seeds possessing similar properties—as rape and cottonseed—by maceration, straining, and subsequent inspissation.

142,908—September 16, 1873. C. L. FRINK. *Improvement in rubber compounds for the manufacture of packings, etc.*

A mixture of india rubber or other vulcanizable gum with sulphur and other solid materials, such as various earths, oxides, metal filings, and the like, forming a nonvulcanized but vulcanizable compound; that is, vulcanized in the place to be packed.

146,158—January 6, 1874. S. W. ANDREWS AND L. GODFREY. *Improvement in compositions of rubber for use in separating cockles from grain.*

A vulcanized composition of 8 ounces of linseed oil and 2 ounces of chalk; 8 pounds of zinc white; and 4 pounds of rubber gum, with sufficient sulphur. It is vulcanized at 260° F. for not to exceed 3 hours and then subjected to a heat of about 212° F. for two hours, more or less.

146,387—January 13, 1874. P. FINLEY. *Improvement in the preparation and treatment of india-rubber varnish.*

Dehydrated or baked india rubber, produced by heating sliced or comminuted india-rubber at a temperature of from 138° to 160° C. for seven to ten hours. It is combined with sulphur and benzine or other solvent of india rubber to form a varnish.

153,447—July 28, 1874. L. O. P. MEYER. *Improvement in processes of producing vulcanized soft india-rubber goods.*

Paraffin is used in covering the plastic compound with sheets or forms of metal preparatory to vulcanization.

153,448—July 28, 1874. L. O. P. MEYER. *Improvement in soft vulcanized india rubber with glossy surface.*

Soft vulcanized rubber having a glossy surface: produced by process No. 153,447.

153,449—July 28, 1874. L. O. P. MEYER. *Improvement in processes for the production of hard rubber or vulcanite with cloth surface or surfaces.*

A thin coat of soft vulcanizable india rubber is applied between the cloth and the hard compound and then vulcanized.

168,129—September 28, 1875. M. W. BEYLIKGY. *Improvement in extracting rubber from waste.*

Rubber solutions are solidified through the agency of a current of air circulating over the surface of the solution, through a condenser to deposit the volatile solvent, then through a heater and back to the solution vessel.

179,576—July 4, 1876. W. D. LATHAM. *Improvement in cement.*

A cement composed of 1 ounce of crude gutta-percha, 5 grains of india rubber, and 1 pound of chloroform.

180,484—August 1, 1876. G. MAGNUS. *Improvement in compositions for billiard balls and processes of manufacturing the same.*

A mixture of india rubber, sulphur, sulphate of baryta—the latter in quantity at least 50 per cent of the rubber—and coloring matter; the composition is subjected, in molds, to a slowly increasing heat for ten hours or more.

210,405—December 3, 1878. A. G. DAY. *Improvement in the combination of vegetable oils and grahamite for the manufacture of vulcanized compounds.*

A kerite product, formed by the combination of grahamite or its equivalent with another resinous body, and with vegetable oil and sulphur: as by mixing cottonseed oil, liquid coal tar, and grahamite with a small quantity of oxide of zinc, heating to about 330° F., cooling to 200° F., and adding linseed oil, and then raising the temperature slightly and adding the sulphur.

210,406—December 3, 1878. A. G. DAY. *Improvement in compounds for the manufacture of kerite.*

Clay or other equivalent earth is mixed as an absorbent with the oils, resinous bodies, and sulphur in the manufacture of kerite.

210,407—December 3, 1878. A. G. DAY. *Improvement in compounds of india rubber and kerite.*

A vulcanized product consisting of the combination of crude kerite with natural india rubber.

210,408—December 3, 1878. A. G. DAY. *Improvement in the manufacture of kerite from gums and oils.*

A vulcanized compound composed of vegetable or mineral oils, a resinous body or bodies, and sulphur; as cottonseed oil, linseed oil, coal tar, and sulphur, and preferably wax with or without paraffin or ozocerite.

210,409—December 3, 1878. A. G. DAY. *Improvement in the manufacture of kerite.*

The process of making a vulcanized product by combining crude kerite or artificial caoutchouc with natural india rubber.

210,410—December 3, 1878. A. G. DAY. *Improvement in preparing vegetable oils for the manufacture of kerite.*

Vegetable oils are subjected to the action of sulphur at a high temperature, as 520° F.

210,411—December 3, 1878. A. G. DAY. *Improvement in the manufacture of artificial caoutchouc or kerite.*

The process of making a vulcanized compound by combining cottonseed oil, coal tar (or pitch or bitumen), linseed oil, and sulphur, with or without vegetable or animal wax, ozocerite, and oxide of iron.

211,340—January 14, 1879. J. MURPHY. *Improvement in vulcanized india-rubber valves.*

Composed of vulcanized rubber and gutta-percha, in the proportions of 2 parts of the former to 1 part of the latter, with or without the addition of metallic earths and oxides; it will resist the action of oils.

216,153—June 3, 1879. D. F. CONNELL AND E. FAGAN. *Improvement in hard rubber compounds.*

Strips or shreds of metal foil are incorporated with caoutchouc prior to vulcanization.

218,842—August 26, 1879. J. W. WATTLES. *Improvements in treating vulcanized india rubber or caoutchouc.*

Vulcanized rubber is treated in a bath of acetic acid, or it is otherwise applied to increase its strength and elastic force.

219,033—August 26, 1879. J. STEPP. *Improvement in the modes of covering wooden and other articles with india rubber.*

Gum is first applied in solution, then the article is covered with a vulcanizable compound and the article subjected to liquid pressure during the process of vulcanization.

226,017—March 30, 1880. C. V. BEACH. *India rubber and other gum compounds for surfacing cloth, and for other purposes.*

Rubber and other gum compounds are deodorized by combining therewith gum benzoin, say 5 per cent, or benzoic acid alone.

226,057—March 30, 1880. H. GERNER. *Process of the treatment of india rubber, etc.*

The process consists in washing india rubber and like gums in warm water in which is dissolved some soda, then cutting into small particles, then freezing, then grinding in a frigid mill, again washing in cold water, then subjecting to the action of solvents in a closed vessel and mixing with desired substances and completing the manufacture.

226,058—March 30, 1880. H. GERNER. *Manufacture of goods from caoutchouc, etc.*

The process consists in first mixing dissolved camphor and sulphur, then evaporating the moisture of the camphor solvent and mixing with caoutchouc and vulcanizing. The rubber compound consists of equal parts of dissolved camphor, sulphur, and caoutchouc.

226,070—March 30, 1880. L. M. HEYER. *Treating waste vulcanized caoutchouc.*

Rubber waste, after the removal of the sulphur by the direct action of heat, is subjected to the action of boiling water or steam until sufficiently fluid to strain, and then strained.

229,038—June 22, 1880. H. GERNER. *Manufacture of vulcanized india-rubber compounds.*

Camphor is mixed with sulphur—as by melting them together, cooling, and grinding—and incorporated with india rubber, with or without the addition of glycerine, and the mass vulcanized.

229,794—July 13, 1880. A. B. ALLEN. *Manufacture of substitutes for hard rubber.*

Hard wood and articles made therefrom are treated with resin oil at a slow heat, and afterwards coated with a solution of gutta-percha vulcanized on the wood.

229,817—July 13, 1880. H. GERNER. *Manufacture of vulcanized india-rubber products.*

A mixture of india rubber, camphor, and flour made from the seed of agricultural germs for the purpose of vulcanization.

232,974—October 5, 1880. A. B. & C. JENKINS. *Vulcanized plastic compound.*

Diatomaceous silica or insuferial earth is mixed with india rubber and gutta-percha, or either, and sulphur, and vulcanized.

233,296—October 12, 1880. E. M. STEVENS. *Enameled rubber cloth.*

The surface consists of substantially equal parts of boiled linseed oil, plastic rubber, and suitable body or coloring matter, combined together by heat before applying to the cloth, and hot calendered after application.

233,600—October 26, 1880. J. H. CHEEVER. *Process of reclaiming rubber from old and waste vulcanized rubber and utilizing the same in manufacturing rubber goods.*

Old vulcanized rubber is boiled with raw petroleum and the resulting product then mixed with new rubber and sulphur and exposed to vulcanizing temperature.

236,240—January 4, 1881. G. M. MOWBRAY. *Method of treating caoutchouc.*

Caoutchouc is treated with naphthaline to preserve the properties of elasticity, durability, etc., and the naphthalized caoutchouc mixed with elements not soluble in naphthaline for the formation of articles. The naphthaline is removed by spontaneous evaporation.

236,709—January 18, 1881. P. KROPP. *Composition for treating rubber cloth, etc.*

A composition for covering the rubber surface of cloth before printing, consisting of linseed oil boiled to a tough paste, with a small proportion of oxide of manganese, and of gum copal added, and then coloring matter equal in weight to the mass.

236,778—January 18, 1881. H. A. CLARK. *Process of desulphurizing and devulcanizing waste vulcanized india rubber.*

Vulcanized india rubber waste is first moistened with water and the water evaporated, and then moistened with turpentine, camphene or equivalent substance and the turpentine evaporated by heating.

236,779—January 18, 1881. H. A. CLARK. *Process of desulphurizing and devulcanizing waste vulcanized india rubber.*

Vulcanized india rubber is treated to the vapors of turpentine or camphene, after it has been boiled in water, to reduce the whole to a cohesive condition.

237,249—February 1, 1881. H. A. CLARK. *Treatment of vulcanized india rubber and gutta-percha.*

Waste vulcanized india rubber is treated with a vegetable oil, such as palm oil, and with a resinous matter.

243,782—July 5, 1881. T. J. MAYALL. *Compound substance for electric insulators.*

It consists of 1 pound of rubber, one-quarter of a pound to 2 pounds of graphite, and one-half pound to 2 pounds of sulphide or sulphuret of antimony, commingled and cured by heat.

244,788—July 26, 1881. L. BECKERS. *Treating caoutchouc with hydrocarbon oils.*

A waterproof compound consisting of, say, 1 part of caoutchouc to 4 parts of hydrocarbon oil of a boiling temperature of about 250° to 300° C.

245,328—August 9, 1881. J. H. TUTTLE. *Process of making sheet packing of rubber, paper, etc.*

Sheet packing provided with a metallic facing; formed by attachment to the face of any suitable fabric by means of rubber cement, or other adhesive material, metal filings or grindings, and subjecting the sheet to pressure. Sulphur may be added to the cement and the sheets vulcanized.

247,834—October 4, 1881. T. J. MAYALL. *Manufacture of hard rubber.*

The sulphides or sulphurets of antimony are mixed with rubber (without the addition of free sulphur) and cured by heat.

247,835—October 4, 1881. T. J. MAYALL. *Rubber veneer.*

A compound of rubber and sulphide (or sulphuret) of antimony, colored and cured by heat.

247,840—October 4, 1881. T. J. MAYALL. *Hard rubber compound called "artificial horn."*

A compound of rubber and sulphide (or sulphuret) of antimony and graphite, hardened by heat.

249,889—November 22, 1881. A. B. & W. P. BROWN. *Composition for coating metals.*

Composed of india rubber, gutta-percha, gum dammar, and wax, dissolved in benzole.

249,970—November 22, 1881. N. C. MITCHELL. *Recovering rubber from rubber waste.*

In the boiling of rubber waste in strong sulphuric or muriatic acid, steam is injected into the acid, whereby the steam penetrates the mass and carries the acid with it.

250,943—December 13, 1881. N. C. MITCHELL. *Recovering rubber from rubber waste.*

Rubber waste is first subjected to the action of hydrocarbon vapors to soften or disintegrate the mass, and then to the action of strong and highly heated sulphuric or muriatic acid.

252,216—January 10, 1882. H. W. HENDRICKS. *Elastic compound for truss-pads.*

It consists of glue, honey, sugar, gutta-percha, glycerine, borax, alum, black lead, sulphur, and saltpeter, in certain specified proportions.

254,205—February 22, 1882. G. A. FOWLER. *Temporary stopping for teeth.*

A composition of wax, 4 parts; oxide of zinc, 15 parts; gutta-percha, 8 parts; and chalk or whiting, 6 parts.

254,462—March 7, 1882. J. D. CHEEVER. *Waterproof and plastic composition.*

Waste rubber is rendered plastic by treatment with vaseline and sulphur, and mixed with short jute fiber or powdered bark, either or both.

254,463—March 7, 1882. J. D. CHEEVER. *Waterproof and plastic compound.*

To a compound of disintegrated fibrous material, earthy materials, sulphur, and vaseline there is added siccative oil treated with chloride of sulphur, the use of vaseline being claimed with any of the products derived from the siccative or drying oils. Also the products derived from the siccative or drying oils in combination with the plastic products obtained by heating waste vulcanized rubber with vaseline, for cementing pigments and fibers.

254,465—March 7, 1882. J. D. CHEEVER. *Waterproof and plastic compound.*

A product of the siccative oils, vaseline, and "pickum gum," produced by treating a solution formed of, say 160 pounds of linseed oil, 20 pounds of vaseline, and 40 pounds of pickum gum, dissolved with heat, with 9 pounds of protochloride of sulphur and 9 pounds of bisulphide of carbon, and granulating after cooling, and washing. A compound of the same is formed with powdered cork, tan bark, short fibers, and coloring matter.

256,470—April 18, 1882. G. S. EVANS. *Plastic composition and vulcanite.*

A plastic material suitable for waterproofing or vulcanization is formed from gums, such as gum kauri or gum manila, by mixing such gum with palm oil and then heating the mixture to about 400° F. The material is vulcanized by treating with chlorite of aluminum and heating.

258,021—May 16, 1882. C. CONNOR. *Rubber compound.*

It consists of a vulcanized mixture of india rubber, 1 pound; soda, 2 pounds; lime, 4 ounces; camphor, 3 drams; and sulphur, 1 ounce and 10 drams. It will stand a high degree of heat.

260,441—July 4, 1862. C. E. W. WOODWARD. *Process of treating india rubber.*

The surface of india rubber is subjected for a limited time to the action of concentrated sulphuric acid and immediately washed to prepare it for adhesion to other objects.

262,079—August 1, 1882. C. J. McDERMOTT. *Restoring rubber waste.*

Rubber waste or scrap is boiled in a solution of acid, bichronate of potash, and manganese, by means of live steam injected into the mass.

263,021—August 22, 1882. H. A. CLARK. *Treatment of india rubber and gutta-percha.*

Restored or devulcanized india rubber or gutta-percha with water is subjected to heat sufficient to evaporate the oils or spirits.

264,821—September 19, 1882. W. O. CALLENDER. *Composition of matter for insulating telegraph wires and for other purposes.*

It consists of 40 to 80 parts of bitumen and 20 to 60 parts of elastikon, or a residual product of vegetable oils, with sulphur or other vulcanizing agents.

265,184—September 26, 1882. J. C. TITZEL. *Process of treating vulcanized india rubber.*

Vulcanized india rubber is dissolved in turpentine and linseed oil; then sulphuric acid is added until the pigment or filling is all dissolved, when the mass is washed. A caustic potash solution is then added to saponify the oil, and the rubber is precipitated from the soapy mass.

276,916—May 1, 1883. W. SMITH. *Insulating electrical conductors and a new compound suitable to be used for this and other purposes.*

A mixture of gutta-percha and ground coal.

277,977—May 22, 1883. E. BAUER. *Process of and composition for the manufacture of substitutes for leather, horn, tortoise shell, etc.*

It is composed of gelatine or glue, $2\frac{1}{2}$ to 5 parts; glycerine, 3 parts to one-half part; fat or oil, 3 parts to one-half part; and caoutchouc, one-half to 1 part; when dried it is treated with tannic acid, the tanning process being accelerated by electric currents.

281,769—July 24, 1883. A. W. KENT. *Separating foreign substances from india-rubber waste.*

Ground or subdivided india-rubber waste is agitated in water within a sieve that supports the rubber, which allows the heavier substances to subside and the loose fibers to wash away.

284,760—September 11, 1883. H. A. ROBINSON. *Metallized rubber compound.*

A compound consisting of 10 parts of finely divided metal and 1 part of vulcanizable gum rendered plastic by a suitable solvent.

285,980—October 2, 1883. W. E. DOUD. *Rubber cement for the manufacture of memorandum blocks and tablets.*

It is composed of 1 part of pure rubber, 6 pounds of bisulphuret of carbon, and 1 pound of ultramarine.

286,442—October 9, 1883. M. HUGHES. *Plastic composition for tailors' cutting-boards, and for other purposes.*

A mixture of sawdust, 10 parts; rubber or gutta-percha, 5 parts; flour, 4 to 5 parts; and linseed oil or soap-boilers' waste, with or without the addition of a bituminous substance.

288,013—November 6, 1883. J. L. CHADWICK. *Method of reclaiming india rubber and fiber from scraps of india-rubber cloth.*

The scraps are first subjected to the action of muriatic acid to destroy the cotton fibers and release the wool from the rubber, leaving the wool intact; and then subjected to a beating and picking action to detach the wool from the rubber.

290,909—December 25, 1883. N. C. MITCHELL. *Rubber compound.*

Particles of leather are incorporated with the rubber compound previous to vulcanization.

292,891—February 5, 1884. A. O. BOURN. *Process of treating fibrous rubber waste.*

Rubber waste containing cotton fiber is subjected to the action of a sulphuric-acid solution of sufficient strength to operate as a solvent of the fiber—3 or 4 per cent solution—and permit its removal with the solvent.

295,615—March 25, 1884. A. O. BOURN. *Process of treating fibrous rubber waste for the recovery of the rubber or caoutchouc therefrom.*

Waste containing cotton fiber is treated with nitric or muriatic acid in solutions of sufficient strength to convert the fiber into soluble matter and permit its removal with the solution.

300,720—June 17, 1884. N. C. MITCHELL. *Recovering rubber from waste.*

Rubber waste is boiled in sulphuric or muriatic acid of a strength sufficient to eliminate and destroy the fibrous material including woolen fiber.

305,184—September 16, 1884. J. J. HAUG. *Substitute for caoutchouc.*

Skins and glycerine are boiled under pressure, then there is mixed with the mass glycerine and chromate or bichromate of potash or other suitable salt acted upon by light, with or without the addition of ground cork, oxgall, and color.

308,189—November 18, 1884. J. J. MONTGOMERY. *Devulcanizing and restoring vulcanized rubber.*

Finely cut particles of the rubber are heated in a closed vessel with hydrocarbon oils obtained from petroleum to above 350° F. until it is reduced to a complete solution, from which the oils remaining in the mass may or may not be extracted.

308,209—November 18, 1894. J. J. C. SMITH. *Manufacture of rubber compositions.*

A rubber compound, consisting of mineral wax or paraffin combined with resin, sulphur, and rubber: formed by first melting together resin, one-fourth to one-half pound, and ozocerite, or similar material, 1 pound, and mixing the same with 4 pounds of caoutchouc and 1 pound of sulphur.

311,135—January 20, 1885. C. J. McDERMOTT. *Recovering rubber from rubber waste.*

Fiber is eliminated from rubber scrap by boiling the scrap in dilute acid—say sulphuric acid of 12° Baumé—and afterwards washing the rubber; or a solution of sulphuric acid, salt, and manganese is used.

312,803—February 24, 1885. C. S. BRADLEY. *Electrical conducting material.*

It consists of gas-retort carbon or other carbon which has grit, and gutta-percha or india rubber vulcanized; may be vulcanized with bromine. The material is nonporous.

315,633—April 14, 1885. H. KELLOGG. *Electrical insulator.*

A mixture of 4 pounds of asphaltum, 4 ounces caoutchouc of oil, 1 ounce of asbestos, and 4 ounces india red; the asbestos and india red, either or both, may be omitted.

318,233—May 19, 1885. J. L. CLARK. *Manufacture and preparation of materials to be employed for insulating.*

A compound of oxidized oil and asphalt, pitch, or bitumen, with a small quantity of hydrocarbon oil or hydrocarbon spirit, with or without india rubber or gutta-percha, black wax or other elements to cheapen the mixture.

319,079—June 2, 1885. J. W. ELLIS. *Composition of matter for the preservation of paper or vegetable tibing used for the insulation of telegraph wires.*

A mixture of asphaltum, 40 parts; resin, 14 parts; petroleum or dead oil, 6 parts; vulcanized rubber, 3 parts, and sulphur, 1 part.

320,921—June 30, 1885. R. S. FERGUSON, W. SCHUMACHER, AND W. TUBMAN. *Compound for insulating electric wires.*

A mixture of pine pitch, 300 pounds; hard or soft rubber, $1\frac{1}{2}$ pounds; and liquid asbestos, 1 gallon, to which is added beeswax or tallow or linseed oil until of the proper consistency to render the compound hard and yet flexible when cool.

321,410—June 30, 1885. F. WILHÖFT. *Vulcanized soft rubber and process of making same.*

Vulcanized soft rubber in which all the sulphur is chemically combined with the rubber: produced by mixing it with $3\frac{3}{4}$ or less per cent of sulphur and subjecting it to a heat of 330° F. or over.

321,548—July 7, 1885. J. J. VARLEY. *Plastic composition.*

Articles made of a plastic composition—of the class containing resins, gums, etc.—are subjected to heat, gradually applied, whereby they are rendered tough, hard, and heat resisting.

322,802—July 21, 1885. A. G. DAY. *Process of making the compound termed "kerite."*

In the manufacture of kerite (see No. 210,411) in place of sulphur, sulphide of antimony, or other suitable sulphide is added, either alone or united with a greater or less proportion of sulphur, to enable the chemical heat to be controlled by the sulphide and to prevent oxidation of the finished product.

322,804—July 21, 1885. A. G. DAY. *Process of manufacturing crude kerite compounds.*

In the manufacture of kerite according to Nos. 210,411 or 322,802, a vegetable astringent—such as tannin or tannic acid, extract of gambia, extract of pine, spruce, or oak bark, extract of nut galls or sumac—is added either before or after, or with the sulphur or sulphide; it imparts a more fibrous character to the product.

327,286—September 29, 1885. S. LOEWENTHAL. *Manufacture of ornamental wall covering, leather cloth, etc.*

A mixture of 100 pounds of African flake, 10 pounds of rubber, 100 pounds of rubber substitute, 10 pounds of ozocerite, 100 pounds of infusoria, and 100 pounds of wood pulp or ground cork, with $2\frac{1}{2}$ per cent of sulphuric acid and 5 per cent of muriatic acid, is spread on a fabric printed with a pattern or design, with or without embossing, and dried.

335,495—February 2, 1886. J. B. WILLIAMS. *Composition of matter for insulating material.*

It consists of gutta-percha, india-rubber, colophony, gum dammar, and asphalt, all in solution, and anhydrous paraffin oil with or without powdered silica.

336,018—February 9, 1886. W. J. RIGNEY AND J. WOLFF. *Composition for insulating electric wires.*

An outer coating of balata, or of a mixture containing balata—obtained from the milky juice of the *Sapota muelleri*, and resembling india-rubber—is employed in connection with an inner coat of adhesive material, as tuna—a substance resembling gutta-percha—or tar.

337,466—March 9, 1886. R. P. WALLIS. *Flexible lead pencil.*

An elastic composition formed of graphite and caoutchouc.

339,787—April 13, 1886. E. D. KENDALL. *Composition of matter for electric insulation.*

A compound of wax tailings of petroleum refining, 32 parts; chicle, 16 to 32 parts; sulphur, 4 to 8 parts; and oil, 1 to 2 parts.

346,224—July 27, 1886. T. C. ROCHE. *Composition for holding photographic paper on its supports; etc.*

A mixture of rubber, pitch, and a solvent, as benzole; also a mixture of rubber, beeswax, and a solvent; the mixtures being combined or used alone.

343,591—June 15, 1886. O. LUGO. *Vulcanite and process of producing the same.*

A vulcanized mixture of hair or horny material, sulphur, and india rubber.

349,885—September 28, 1886. G. W. HOLLEY. *Manufacture of paint.*

A paint consisting of a given quantity of mineral oxides, earths, or other pigments, combined with from one-tenth to one-half its weight of pulverized sulphur and linseed oil: formed by mixing the sulphur with the pigments, then gradually adding with constant stirring about one-third of its weight of linseed oil previously heated to 80° C. and at the same time gradually raising the temperature to 120° or 125° C.; then cooling slowly under constant stirring, and lastly grinding.

350,459—October 5, 1886. A. KISSEL. *Substitute for india rubber, caoutchouc, etc.*

A compound of the hardened resin and balsams of the coniferae and oil and sulphur; formed by hardening the resin and balsams by means of caustic lime or other caustic alkaline earth; dissolving the hardened resin or balsam in oil; adding to the solution a second solution composed of sulphur and oil; adding sulphur to the mixed solutions; and heating the mass.

358,082—February 22, 1887. A. W. SPERRY. *Composition of matter as a substitute for hard rubber, etc.*

It is composed of ivory dust or like material, forming 50 per cent of the compound; a starch mixture consisting of starch, tannin, and an alkali, as alum; a binder mixture consisting of a resinous gum dissolved in alkali, as caustic soda, and milk, glue, shellac, and alcohol.

359,825—March 22, 1887. C. M THOMPSON. *Insulating material.*

A compound of dead-oil of pitch 1 part, and desulphurized old rubber, commonly known as "shoddy," 7 parts: pitch and desulphurized rubber are mixed with cold rollers, then steam is introduced and it is rolled into thin sheets and thoroughly dried.

359 907—March 22, 1887. C. M. THOMPSON. *Process of curing india rubber.*

A compound consisting of india rubber and lampblack, produced by subjecting india rubber to the action of hot rollers, adding from 5 to 20 per cent of lampblack, and then continuing the action of the rollers.

36 137—June 21, 1887. H. W. LIBBEY. *Rubber-covered elastic compound.*

I consists of particles of sponge and india rubber; rubber is reduced by heat and particles of sponge are distributed in the mass and mingled therewith.

368,174—August 9, 1887. H. VOGLEY. *Composition for cementing rubber.*

A composition formed by mixing and dissolving $2\frac{1}{4}$ ounces of pure rubber gum, 3 ounces of pulverized gum gamboge, and 11 ounces of dry white lead, in 1 gallon of benzine; and subsequently adding a mixture of 2 ounces of pulverized sulphur and $2\frac{1}{2}$ ounces of sulphuric ether, with or without one-half ounce of alum and one-fourth pound of burnt brown sugar.

375,405—December 27, 1887. F. WILHÖFT. *Method of manufacturing nonblooming vulcanized soft rubber.*

Rubber is mixed with a sulphur preparation in which this body is in a lastingly-amorphous condition by the addition of a greasy, fatty, resinous, or turpentine body, and vulcanized. The said sulphur preparation is formed by fusing 1 pound of sulphur, say, with one-fourth of a pound of Canada balsam.

375,436—December 27, 1867. S. M. ALLEN. *Recovering and utilizing waste rubber.*

Disintegrated rubber waste is treated in a mixture of nonvolatile oil, asphalt, resin, and sulphur, and heated until the mass is devulcanized, and the fiber converted into gelatine.

378,395—February 21, 1888. S. HEIMANN. *Process of treating peat.*

A vulcanized mixture of dry pulverized peat, caoutchouc and sulphur, with or without plaster of paris.

380,993—April 10, 1888. G. W. COOPER. *Compound oil dressing for rubber belts.*

To a mixture of 8 pounds of crude rubber, one-half gallon oil of turpentine, 1 pound oil of lemon-grass, 1 pound of citronelle, and 6 ounces gum arabic, there is added 8 gallons of light pressed fish oil, and cooked for eight hours; after cooling there is added the condensed product of 4 gallons of linseed oil boiled down to $2\frac{1}{2}$ gallons, and the composition is cooked for six hours.

383,098—May 22, 1888. D. BROOKS, JR. *Covering for electric wires and cables.*

Electric wires are first covered with a fibrous tape saturated with an insulating compound, then with a plastic rubber preparation with interlying canvas wrappings and powdered sulphur, and then subjected to heat to vulcanize the rubber.

383,137—May 22, 1888. W. B. McGARVEY. *Composition for converting india rubber or its compounds into hardened rubber.*

A mixture of oxide of iron and petroleum or rocky oil is incorporated with pure rubber or any of its compounds, and the mass fused and subjected to pressure.

391,927—October 30, 1888. J. A. TITZEL. *Rubber compound or mixture.*

Composed of gilsonite asphaltum, 90 pounds; vulcanized rubber (scrap or waste), 130 pounds; manganated linseed oil, $3\frac{1}{2}$ to 7 gallons; spirits of turpentine, 9 gallons; deodorized petroleum naphtha, 9 gallons; and powdered sulphur, 10 to 15 pounds; for use as a paint, baking-japan, or coating.

393,838—December 4, 1888. W. KIEL. *Vulcanized plastic compound.*

A vulcanized compound of pumice stone, india rubber, and sulphur, with or without oil or beeswax, the pumice stone being from one to five times the weight of the crude rubber.

395,987—January 8, 1889. N. C. MITCHELL. *Process of recovering rubber from waste.*

Rubber waste is immersed in a reclaiming solution containing for each 100 pounds of waste about 15 to 25 pounds of hydrochloric acid, or its specified substitute, in excess of the quantity requisite to combine with the decomposable mineral compounds, and heated in a close vessel under pressure to about 240° F.

396,774—January 29, 1889. A. SOMMER. *Paint-oil.*

A solution in hydrocarbons of the sulpho-chlorinated marine-animal oils.

401,269—April 9, 1889. F. GREENING. *Process of production of material as substitute for india-rubber, etc.*

Fibrous material is steeped or saturated with a mixture of sulphuric acid and nitrate of potash—3 parts of the former to 2 parts of the latter by weight—washed, and then subjected to a bath of liquid carbonic acid or carbonic-acid gas and dried. The converted fiber is then treated with a suitable solvent, as a distillate composed of a mixture of methylated alcohol, resin, or colophony, gum benzoin or benjamin, castor oil, and light hydrocarbon.

411,171—September 17, 1889. C. A. A. H. SIEBERT. *Substitute for gutta-percha.*

A mixture of 1 part of asphaltum, one-fourth to 1 part of balsam of sulphur, and up to one-half part of an easily-melting solid hydrocarbon, such as paraffin.

412,264—October 8, 1889. W. KIEL. *Vulcanized plastic compound.*

Wood is used as a constituent part of a vulcanizable compound.

412,265—October 8, 1889. W. KIEL. *Process of manufacturing vulcanized plastic compound.*

Wood is soaken in oil and subsequently combined by vulcanizing with sulphur and crude rubber.

412,266—October 8, 1889. W. KIEL. *Process of manufacturing vulcanized plastic compounds.*

Wood and sulphur are vulcanized and the product commingled with sulphur and crude rubber and vulcanized.

412,267—October 8, 1889. W. KIEL. *Process of manufacturing vulcanized plastic compounds.*

Wood is mixed with crude rubber dissolved by any solvent, and the product combined with sulphur oil, and beeswax, with or without crude rubber, and vulcanized.

412,268—October 8, 1889. W. KIEL. *Process of manufacturing vulcanized plastic compounds.*

A mixture of wood, sulphur, oil, and crude rubber is vulcanized to a hard state, the product pulverized and combined with sulphur, oil, and crude rubber, ready for vulcanization.

412,269—October 8, 1889. W. KIEL. *Process of manufacturing vulcanized plastic compounds.*

A mixture of wood, sulphur, and oil, or other commingling vulcanizable substance, is vulcanized and the product subsequently combined with crude rubber by vulcanization.

418,044—December 24, 1889. N. C. MITCHELL. *Art of restoring rubber.*

Rubber stock is subjected to the action of live steam in a close vessel; air is drawn through the mass to remove surplus moisture, and finally the rubber is rolled while in a moist condition, until dry.

418,208—December 31, 1889. A. E. MEUNUEZ. *Insulating and waterproofing composition.*

A composition consisting of shoemaker's wax, gutta-percha with or without india-rubber, a suitable solvent, such as chloroform, bisulphuret of carbon, and japan; to which may be added a hardening wax, such as beeswax or paraffin wax.

419,697—January 21, 1890. N. C. MITCHELL. *Process of reclaiming rubber from waste rubber goods.*

First, the stock is ground; second, particles of iron are eliminated by magnetic attraction; third, the fiber is separated from the rubber; fourth, it is washed with water to remove soluble matter; fifth, it is sifted to separate raw sand and other fine particles; sixth, the mass is acted on with a stream of water to float off the rubber from the heavier foreign substances; and finally, it is devulcanized and sheeted.

420,648—February 4, 1890. J. B. WILLIAMS. *Insulating compound.*

A compound of india-rubber, say 40 parts; paraffine, preferably that obtained from ozocerite or mineral wax, 15 parts; a resinous body, as shellac, 40 parts; and sulphur, 5 parts; with or without silica or bituminous matter, produced by dissolving the india-rubber in a volatile solvent, dissolving the paraffine in the india-rubber solution, distilling therefrom the volatile solvent, and then incorporating therewith the remaining ingredients.

420,820—February 4, 1890. N. C. MITCHELL. *Process of restoring rubber.*

Rubber, after reduction to small pieces, is mixed with heavy oil and sulphide of calcium, then subjected to the action of steam until devulcanization is completed, when air is drawn through the mass before its removal from the devulcanizer.

423,071—March 11, 1890. N. C. MITCHELL. *Production of restored or devulcanized rubber.*

The rubber is devulcanized by the action of live steam, then while the rubber is yet moist it is rolled until reduced to a powder, and then dried, at the same time agitating it to preserve the powdery condition.

428,544—May 20, 1890. E. ANDREWS. *Composition of matter for use in the mechanic arts.*

Finely ground or comminuted leatheroid or parchmentized paper mixed with rubber in proportions varying from 40 to 90 per cent of the former to 60 to 10 per cent of the latter, and vulcanized.

430,958—June 24, 1890. W. KIEL. *Vulcanized plastic compound.*

A hard vulcanized plastic compound, consisting of crude rubber, sulphur, and mineral oil, as kerosene; the sulphur being in proportion of not less than approximately 80 per cent of the rubber by weight.

430,959—June 24, 1890. W. KIEL. *Process of manufacturing vulcanized plastic compounds.*

A mixture of sulphur and rubber, with or without oil—the sulphur being in the proportion of not less than about 80 per cent of the rubber by weight—is vulcanized with an initial temperature of not less than about 300° F. and for stated periods of time.

431,104—July 1, 1890. J. H. CHEEVER. *Protective covering for electric cables.*

A compound of 11 parts of rubber, 9 parts of plumbago, 9 parts of asbestos, and 2 parts of sulphur; it is vulcanized after application to a conductor.

433,893—August 5, 1890. J. FOTTRELL. *Insulating material.*

A mixture of india-rubber and aluminium oleate, say in equal parts by weight. It is susceptible of vulcanization.

438,313—October 14, 1890. O. A. ENHOLM. *Composition for cells or retaining vessels.*

A composition of asbestos, mineral wax, and gutta-percha (No. 438,311 with the omission of the hardening medium, shellac).

438,595—October 14, 1890. W. H. ALLEN AND C. LOVELL. *Rubber compound.*

A plastic compound composed of rubber, sulphur, and lithargite (pulverized calcined magnesic silicate).

452,439—May 19, 1891. R. A. LOEWENTHAL. *Production of reclaimed rubber.*

The fiber is decomposed and eliminated from the rubber waste, which is then partially dried and reduced to a fine powder before devulcanization.

452,760—May 19, 1891. F. SALATHÉ. *Composition of matter for insulating purposes.*

A composition consisting of the hydrocarbon product of No. 452,764, with sulphur, with or without the addition of india-rubber, gutta-percha, or oxidized linseed oil. It is subjected to a heat of from 121° to 162° C.

452,765—May 19, 1891. F. SALATHÉ. *Composition of matter for insulating purposes.*

A composition of gutta-percha, gum shellac, and a new hydrocarbon product, a resinoid hydrocarbon of the $C_{10}H_{16}$ series.

454,442—June 16, 1891. N. C. MITCHELL. *Production of waste rubber goods.*

The devulcanized rubber is impregnated with moisture and kept wet during the rolling or pressing process.

454,489—June 23, 1891. G. W. MELVILLE. *Composition of matter.*

A vulcanized mixture of fine Para rubber, 60 per centum; flowers of sulphur, 6 per centum; oxide of antimony, 14 per centum; and magnesia, 20 per centum. It will resist a high heat, and withstand the action of salt-water, grease, or oil.

454,548—June 23, 1891. A. W. SPERRY. *Compound for the manufacture of insulators, packings, etc.*

A compound of 8 pounds of mineral wool, $1\frac{1}{4}$ pounds of rubber and linseed oil combined, and 3 pounds of oxide of zinc.

458,551—August 25, 1891. J. L. MARMAUD. *Insulating compound.*

To a mixture of 1 part of calcined lixiviated infusorial earth, a third of 1 part of pulverized talc or soapstone, one thirty-second part each of lampblack, pulverized sulphur and litharge, one-sixteenth part of pulverized resin, and one sixty-fourth part of silicate of soda in solution, there is added 22 parts of rubber dissolved in benzine or naphtha, one-fifth part of bisulphide of carbon, and one-fifth part of fir balsam.

460,765—October 6, 1891. E. THOMSON. *Composition for insulating material.*

A mixture of asbestos, rubber, and soapstone, say 15 to 25 per cent of rubber and 5 to 15 per cent of soapstone, molded in a heated state with great pressure.

467,520—January 26, 1892. D. H. PIFFARD. *Composition of matter for insulating purposes.*

A mixture of 5 parts of rubber, 24 parts of resin, and 26 parts of plaster of paris; the rubber and resin are first mixed and heated until the readily volatilizable parts are driven off.

468,627—February 9, 1892. A. I. RATH. *Manufacture of india rubber.*

A composition consisting of india rubber mixed with finely-reduced silk fiber.

490,500—January 24, 1893. J. M. RAYMOND. *Process of treating vulcanized rubber to render it adhesive.*

Vulcanized rubber first soaked in benzine or a substance having an analagous action to open the pores, then immersed in a solution of potassium permanganate to secure superficial desulphurization, and again treated with benzine. In certain cases, to give tenacity, before the last-named operation, it may be given a bath of acetic acid or pyroligenous acid.

495,757—April 18, 1893. D. RIGOLE. *Process of and apparatus for the extraction of gutta-percha from the leaves and twigs of the gutta-percha tree.*

The condensed vapors of a solvent are passed through a mass of the leaves and twigs, thereby dissolving the gum; the solvent with gum in solution is conveyed away, and heated to vaporize the solvent and the vapors condensed for reuse.

508,560—November 14, 1893. P. C. BEIERSDORF. *Process of treating gutta-percha or balata.*

To obtain gutta-percha or balata of uniform qualities, a certain quantity is deprived of the whole of its resinous contents by subjecting it to the action of a solvent of said contents, and then there is mixed with the so-deprived quantity a proper quantity of gutta-percha or balata, which is richer in resinous matter than the quality desired.

510,888—December 19, 1893. J. BURBRIDGE. *Process of producing variegated rubber.*

Variegated sheets are formed by twisting strips of consolidated layers of different colored compounds, making up the twisted strips into rings or cylinders, and cutting shavings or sheets before or after vulcanization.

518,046—April 10, 1894. J. M. RAYMOND. *Composition of matter for vulcanizing rubber.*

It consists of benzene, or its derivatives, 30 to 50 parts in weight; camphor, 2 to 5 parts; and chloride of sulphur, 1 to 2 parts; with or without oleic acid, 1 to 2 parts.

518,817—April 24, 1894. R. HUTCHISON. *Gutta-percha or rubber compound.*

A composition consisting of gutta-percha or rubber or mixtures thereof and wool cholesterine.

520,196—May 22, 1894. J. THOMSON. *Method of manufacturing hard rubber articles.*

The crude compound is subjected to combined heat and pressure in a mold until the plastic compound assumes the form of the mold cavity, when the pressure is wholly or partially removed, allowing the material to expand while subjected to heat but not pressure, and then cooling under these conditions.

522,312—July 3, 1894. A. A. BLANDY. *Process of and composition for manufacturing substitutes for india rubber, etc.*

A composition consisting of a drying oil, as linseed oil, a solvent for the same, such as carbon bisulphide, sulphur chloride, asphalt, rubber, and sulphur, with or without a metallic oxide, such as lime. It is formed by mixing together the drying oil, solvent, and sulphur chloride, gently heating the mixture, then adding the asphalt and heating the product, and then incorporating rubber and sulphur, and finally vulcanizing.

525,086—August 28, 1894. J. PATTIGLER. *Elastic or plastic composition.*

A composition consisting of vegetable or mineral oil, caoutchouc, zinc white, soluble glass, minium, and asbestos.

528,264—October 30, 1894. H. TRAUN. *Process of vulcanizing hard rubber articles.*

Pulverized metallic aluminum, or an alloy of aluminum, with tin, cadmium, or nickel, is added to the soft rubber before vulcanization. It increases the heat-conducting power of the rubber and secures uniform vulcanization.

529,730—November 27, 1894. W. GRISCOM, JR. *Hard, vulcanized compound.*

It is composed of candle tar as a vulcanizable adhesive element, sulphur, petroleum residuum, and finely divided solid matter.

538,147—April 23, 1895. C. BARUS. *Process of manufacturing vulcanized rubber.*

Rubber, at any stage of vulcanization, is impregnated with carbon disulphide (with or without sulphur) and the mass subjected to the action of heat (which never exceeds 200° C.) in a hermetically closed vessel until it is melted down to a homogeneous mass.

544,934—August 20, 1895. H. E. SÉRULLAS. *Process of extracting and purifying gutta-percha.*

The parts of the tree are treated with an alkali or its carbonates; the residue then treated with dilute sulphuric acid; next the residue is spread out into sheets, and the sheets treated first with a stream of ammoniacol copper liquid, and afterwards with a current of carbonic-acid gas or hydrogen gas.

547,120—October 1, 1895. S. HEIMANN. *Insulating compound.*

To a mixture of equal quantities of pulverized asbestos and glass there is added 10 to 15 per cent of rubber (the mixture rolled into sheets and dissolved in benzine), 5 per cent of castor oil and 20 per cent each of resin oil and mirbane oil, and then 10 to 15 per cent of celluloid dissolved in amyloxide-acetic. In coating a wire it is first given a coat of a mixture of water glass and pulverized glass.

549,855—November 12, 1895. R. N. PRATT AND H. W. JOHNS. *Composition of matter for compressed or molded articles.*

It consists of asbestos and rubber, or other cementing insulating substance, and an insulating natural lubricant, as soapstone.

551,230—December 10, 1895. R. N. PRATT. *Composition of matter for insulating purposes.*

A composition consisting of dense hard rubber, laminated mica, and fibrous asbestos, produced by dissolving rubber and sulphur in naphtha, incorporating therewith mica and asbestos fibers, molding and vulcanizing.

563,379—July 7, 1896. C. W. JEFFERSON. *Flexible mica insulating sheet.*

The sheet consists of layers of mica scales and adhesive gutta-percha tissue, with or without fibrous layers, as of paper.

563,716—July 7, 1896. C. W. JEFFERSON. *Electrical insulating sheet.*

A sheet formed of layers of asbestos and mica, or paper, asbestos, mica and paper, with adhesive gutta-percha tissue between any and every two of said layers.

575,739—January 26, 1897. H. E. SÉRULLAS AND F. E. HOURANT. *Process of extracting and purifyiug gutta-percha.*

The leaves or other parts of gutta-percha plants are pulverized, the powder dissolved in a hydrocarbon solvent, and the three principal constituents of gutta-percha, viz—gutta-hydrocarbon, fluavil, and alban—then precipitated by the addition of acetone.

580,139—April 6, 1897. W. MORISON. *Composition of matter for manufacturing battery cases, etc.*

A composition of asphaltum with or without a small quantity of gutta-percha, as much asbestos as can be absorbed, and a little sulphur; compounded by melting the asphaltum and adding the gutta-percha, then intimately mixing therewith the asbestos, spreading out the mass on a hot surface and working, heating, and pounding, to drive out moisture and foreign substances; dusting with sulphur and again heating, pounding, and working; the mass being kept hot throughout the process; and finally forming into shape.

581,319—April 27, 1897. P. W. WIERDSMA AND J. KUIPERS. *Substitute for vulcanite, hard woods, etc., and process of manfacturing same.*

The refuse remaining after the manufacture of potato flour is mixed with water, passed through a sieve, washed, bleached, and dried, with or without the addition of waterproofing material, ground into a powder, sifted, and molded dry by great pressure.

584,959—June 22, 1897. C. V. PETRALUS. *Rubber compound.*

A rubber compound having in admixture with caoutchouc and sulphur, finely-powdered native lead sulphide or galena, with or without lead oxide.

598,550—February 8, 1898. B. G. WORK. *Process of treating rubber.*

For the manipulation of raw vulcanizable india rubber in the formation of covered articles in hollow shapes, tubes, etc., the rubber is given a condition of temporary inherent abnormal rigidity by freezing it.

599,694—March 1, 1898. F. FENTON. *Process of producing artificial gutta-percha.*

Tar or other pyroligneous substance is mixed with an oxidizable vegetable oil either in the raw state or more or less oxidized, and the product placed in a bath of diluted nitric acid to form a magma or base, which is then roasted.

601,091—March 22, 1898. P. L. CLARK. *Process of devulcanizing rubber.*

It is saturated with a solvent of rubber and sulphur adapted to vaporize at a temperature below the melting or disorganizing point of rubber (such as gasoline) and maintained in such saturated condition by the pressure of vapor of such solvent while heating it in such vapor, to a temperature adequate to maintain the pressure therein, but lower than the melting or disorganizing point of rubber, until devulcanization is effected.

601,828—April 5, 1898. O. B. DODGE. *Leather and rubber substitute.*

A compact sheet consisting of chemical wood fibers uniformly mixed with and enveloped in a firmly adherent mass of cured rubber and pulverized material; produced by drying chemical wood pulp, separating the fibers into a flocculent mass; mixing the flocculent mass with a mass of rubber cement and a pulverized material, as chalk, lampblack, and sulphur; forming into shape; and subjecting to a degree of heat which is less than that usually employed for vulcanization, preferably about 95° to 105° C.

615,863—December 13, 1898. W. K. LEONARD. *Process of producing rubber substitutes and compositions of matter therefor.*

A composition consisting of 76 per cent of corn oil, 21 per cent of sulphur, and 3 per cent of paraffin wax, formed by subjecting the mass to heat until the oil is vulcanized or the process of vulcanization begins, about 310° F., then shutting off the heat and allowing the process of vulcanization to continue until complete and the mass cools.

615,864—December 13, 1898. W. L. LEONARD. *Process of producing rubber substitutes and compositions of matter therefor.*

A rubber substitute consisting of a mixture of corn oil, say 64 per cent, and castor oil, 13 per cent, combined with a mixture of chloride of sulphur, naphtha, and oxide of magnesia, say in relation to the entire mass of 21 per cent of chloride of sulphur, 0.5 per cent of naphtha, and 1.5 per cent of oxide of magnesia; percentages by weight.

618,166—January 24, 1899. T. CLARKE. *Composition of matter for producing enamel for refixing dental plates of artificial teeth.*

It consists of $1\frac{1}{2}$ parts of dental rubber dissolved in machine oil and scented with attar of roses; 5 parts of yellow gum shellac; 3 parts of plaster of paris colored with carmine; and one-twentieth part of pure Condy's fluid.

619,615—February 14, 1899. C. RATH. *Composition of matter.*

It consists of 76 parts of pure india rubber, 17 parts of bran of almonds, and 7 parts of calcined chalk, combined by kneading while the rubber is in a soft, plastic state; for rubber implements for therapeutic treatment, it combines hardness with elasticity, has a smooth, glossy surface, is moderately porous, and readily absorbs a lubricant.

621,060—March 14, 1899. E. GARNIER. *Manufacture of rubber or other gums.*

Alum treated with a spiritous solution of a gum, as a solution of gum tragacanth in benzol, is incorporated with rubber and the usual vulcanization dispensed with.

626,092—May 30, 1899. J. C. PETMECKY. *Rubber compound.*

A viscous compound, for repairing pneumatic tires, etc., consisting of a mixture of pure rubber dissolved in a quick-drying solvent, as bisulphide of carbon, ground and slightly vulcanized rubber, and cotton fiber cut to one-eighth to one-sixteenth of an inch in length.

626,479—June 6, 1899. P. C. BELL. *Elastic compound.*

A compound of vegetable oil, 59 parts; flower of sulphur, 15 parts; liquid tar, 1 part; petroleum residue, 20 parts; and powdered talc, 5 parts. The petroleum residue is heated to 112° F., the powdered talc and tar is mixed therewith, and the vegetable oil then gradually added while maintaining the said temperature, next raising the temperature to 200° F. and adding the flower of sulphur, and finally raising the temperature to 340° F. and stirring until viscid.

627,689—June 27, 1899. C. HEINZERLING. *Treatment of old or waste vulcanized rubber.*

Waste rubber is dissolved by the action of anilin, toluidin, or xylidin, and the solvent separated from the india rubber.

630,435—August 8, 1899. M. ZINGLER. *Composition for treating decayed or other rubber.*

A solution for treating decayed or other rubber by long immersion, consisting of 30 or 40 gallons of boiling water containing about 5 pounds of tartar emetic, mixed afterwards with 7½ pounds of tannic acid and about 2½ pounds of a metallic sulphite salt such as calcium sulphite.

632,022—August 29, 1899. C. RÉPIN. *Process of treating india rubber, gutta-percha, etc.*

It consists in raising wood oil (expressed out of seeds of *elaeococea vernicifera*), with which may be mixed a cheaper oil having greater density and lighter color, to a suitable heat, as 250° C., whereby the same will be coagulated; pulverizing the solidified oil and mixing with india rubber and the like.

635,141—October 17, 1899. A. H. MARKS. *Process of reclaiming rubber from vulcanized rubber waste.*

Finely ground rubber waste is submerged in a dilute alkaline solution in a sealed vessel and subjected to a temperature of 344° to 370° F. for about twenty hours

637,776—November 28, 1899. A. GENTZSCH. *Plastic felt.*

An intimate conglomeration of gutta-percha with shredded or macerated animal skins and hair.

638,775—December 12, 1899. A. E. J. V. J. THEILGAARD. *Process of devulcanizing caoutchouc, india rubber, etc.*

The comminuted vulcanized material is treated with a solution of sodium sulphite—the amount being in proportion to the contained sulphur—under the influence of heat, and then washed.

639,926—December 26, 1899. O. LUGO. *Rubber substitute or artificial rubber.*

It consists of sulphurized oil practically free from glycerine compounds. Seventy-five per cent of the substitute may be mixed with rubber.

639,927—December 26, 1899. O. LUGO. *Manufacture of rubber substitutes.*

Process consists in subjecting sulphurized oil to hydrosaponification until it becomes liquid, then dehydrating the liquid vulcanite, adding sulphur, and then heating the mass.

640,735—January 9, 1900. P. C. BELL. *White elastic compound.*

It consists of vegetable oil, 65 parts; chloride of sulphur, 20 parts; mineral matter, such as lime, 5 parts; and zinc oxide, 5 parts; and bisulphide of carbon, 5 parts. The vegetable oil is heated to 80° F., the chloride of sulphur and bisulphide of carbon added at 60° F., the mass stirred until it foams and kept in agitation until the maximum bulk is reached, then the mass is broken, the mineral matter added, whereupon it hardens, when the product is pulverized and bleached.

642,764—February 6, 1900. A. E. J. V. J. THEILGAARD. *Process of devulcanizing caoutchouc, india rubber, etc.*

The comminuted vulcanized rubber is treated with a cyanide solution (potassium cyanide) in proportion to the amount of contained sulphur, the temperature being eventually raised; the material is then washed and dried.

642,814—February 6, 1900. R. COWEN. *Process of cleaning rubber.*

Rubber is reduced to a plastic condition by heating, and then strained under pressure to remove foreign materials.

645,331—March 13, 1900. W. PRAMPOLINI. *Composition of matter.*

As a substitute for india rubber, the gummy matter of the shrub *Synantheroeas Mexicanos* (known also by the Indian names of "Tule," "Copalin," "Terba del Negro," "Guayle," "Jiguhite," and "Hule"), combined with the residual oil of a volatile hydrocarbon solvent.

647,112—April 10, 1900. J. J. PEARSON. *Composition of cork and rubber for boot-heels, etc.*

An intimate mixture of cork and rubber, the cork being held under great compression in the rubber.

651,640—June 12, 1900. H. L. RUSSEGUE. *Elastic waterproof composition.*

A composition of balata and vegetable fiber—a sheet of balata is united with dry vegetable fiber by pressure.

651,582—June 12, 1900. H. SCHNEIDER. *Substitute for gutta-percha.*

A composition formed of 45 per cent of asphalt tar, 40 per cent of resin, 10 per cent of spirits of turpentine, and 5 per cent of linseed oil.

651,753—June 12, 1900. B. C. FOWLKES. *Dental compound.*

The compound comprises a solvent, vehicle, and drying constituents, as carbon bisulphide, 2 ounces; benzin, 1 dram; and chloroform, 1 dram; with black dental rubber, one-eighth of an ounce; and powdered aluminum, 1¼ ounces.

CASEIN PLASTICS.

86,710—February 9, 1869. J. & W. THIEM. *Improved composition for moldings.*

A mixture of sawdust, 4 pints; milk curd, 1 pint; slaked lime, one-third of a pint; and cotton, 1 ounce, more or less.

153,939—August 11, 1874. J. FRAUENBERGER. *Improvement in artificial ivory, corals, etc.*

A composition made of casein 2 parts, heated in a closed vessel on a water bath and then boiled under suitable heat with 1 part of a varnish-like solution of copal in concentrated liquid ammonia and alcohol.

169,053—October 19, 1875. J. G. W. STEFFENS. *Improvement in compositions for ornaments.*

A composition of curd, alkali, and resinous matter; fixed by steeping in whey or milk before pressing, and in cold water containing oil of vitriol after pressure.

182,431—September 19, 1876. J. FRAUENBERGER. *Improvement in compositions and processes for making artificial coral, ivory, etc.*

Casein is mixed with sal soda and water and dissolved under the action of heat; the oily matter is removed; and after cooling and coloring, acetic acid is added, and the resulting pasty, gummy mass is freed from moisture by pressure and evaporation.

307,179—October 28, 1884. E. E. CHILDS. *Preparation of casein and of articles made therefrom.*

Casein prepared from milk curd or cheese is worked or kneaded in water at or near the boiling point until it reaches a tough and glutinous consistency.

307,269—October 28, 1884. E. E. CHILDS. *Preparation of casein and of articles made therefrom.*

Casein is prepared from milk curd, having washed or eliminated from it fatty and other objectionable matters, by working or kneading the curd in its naturally saturated condition, sufficient water of saturation being retained to admit of the working, at a temperature below the boiling point of water, until it reaches a tough and glutinous consistency.

353,697—December 7, 1886. L. R. MESTANIZ. *Making artificial bone, ebony, marble, etc.*

Skim milk is treated with salt, caustic soda, terra alba, hydrochloric, nitric, and sulphuric acids, and coloring matter, or with an alum solution and glycerine in lieu of a mixture of hydrochloric and nitric acids. Pot cheese may be used as the base, with borax in place of caustic soda.

610,626—September 13, 1898. P. H. HENSEN. *Composition containing casein for electric insulating or other purposes.*

A composition consisting mainly of casein, india rubber, and asphalt, subjected to pressure in a hot mold.

632,408—September 5, 1899. W. A. HALL. *Process of producing casein.*

See Group XVIII, Fine Chemicals, Proteids.

646,844—April 3, 1900. W. KRISCHE AND A. SPITTELER. *Process of manufacturing water-resisting products from casein.*

Soluble casein is rendered insoluble by the action of acids or salts, as by dissolving casein in water containing 5 per cent of sodium carbonate and coagulating by gradually adding a weak solution of lead acetate, and is then treated with formaldehyde, either while wet or after it has been dried.

649,690—May 15, 1900. W. A. HALL. *Solid casein.*

Solid homogeneous casein produced by hydrating the casein by grinding and thoroughly agitating the same in water so that the water is beaten into every cell thereof, thus forming a thin pulp, and then draining and drying the product and permitting the same to shrink together.

662,444—November 27, 1900. C. JUNG. *Insulating composition.*

A mixture, say, of equal parts of crude caoutchouc and casein, with a minor quantity of a resin, is vulcanized.

OTHER PLASTICS.

3,598—May 25, 1844. E. DEUTSCH. *Improvement in waterproof cements, etc.*

Bitumen, asphaltum, and like material is distilled, the residuum cooled and used as a base to mix with various ingredients as protoxide of lead, siccative oil, resin, wax, sulphur, etc., to form different coating and protecting products.

4,362—January 23, 1846. C. BRANWHITE. *Improvement in compositions for making handles, molds, etc.*

Half a pound of starch in one pint of cold water is added to one quart of boiling water and well mixed, then allowed to cool, when finely sifted dry mahogany sawdust (or wood ashes or whitening) is mixed therewith to form a dough.

17,949—August 4, 1857. W. M. WELLING. *Improvement in factitious ivory.*

A mixture of shellac, ivory dust, and camphor, with pigments, as impalpable white, vermilion, etc., according to the color, mixed and heated, preferably by steam under pressure, to 115° to 138° C.

19,778—March 30, 1858. J. BURROWS HYDE. *Improvement in compositions for coating telegraph wires.*

A composition formed by mixing 1 part of boiled linseed, cotton seed, or resin oil with 8 parts of asphaltum, the latter to be melted and the oil gradually stirred in.

45,518—December 20, 1864. I. N. PEIRCE. *Improved composition for crayons.*

A compound, using kaolin as the base, as kaolin 48 parts, calcined plaster of paris 16 parts, white glue 1 part, and water.

50,658—October 24, 1865. H. J. GRISWOLD. *Improved transparent composition for tablets.*

A coating formed of 5 pounds of chemically prepared soapstone incorporated with 18 pounds of white shellac varnish is applied to a card or other foundation.

51,009—November 21, 1865. R. BORCHERDT AND H. BERGMAN. *Improved composition for the manufacture of toys.*

A mixture of glue, 5 pounds; sugar or honey, 10 pounds; glycerine, 2½ pounds, and Perry's white, 3 pounds.

60,984—January 1, 1867. H. WURTZ. *Improved composition of glue or gelatine, and other materials, called durogel.*

A combination of bichromate of potash with glue or gelatine, as solutions of 250 parts of glue with 5 parts of bichromate of potash, heated together.

63,087—March 19, 1867. A. PELLETIER. *Improved composition for coating wood, cloth, metals, and for forming various articles.*

The compound consists of vegetable fiber, soapstone, silicate of soda, red lead, and litharge. It is made impervious to water when coated by treatment with diluted muriatic acid, 1 part acid and 3 parts water.

71,210—November 19, 1867. A. PELLETIER. *Improved composition for coating wood, iron, paper, etc.*

A mixture of vegetable fiber pulp, silicate of soda, and soapstone, in about equal proportions by weight, made into sheets or used as a coating; it may be given a coat of coal tar and covered with powdered steatite.

71,893, December 10, 1867. R. O. LOWREY. *Improvement in composition of matter for the manufacture of waterproof paper and other articles.*

A new compound, produced by treating vegetable fiber or pulp, or article made therefrom, first, with solution of gelatine or animal glue, soap, and glycerine or saccharine water, and then with a suitable astringent solution which will render it insoluble in water, as of alum and salt in about equal proportions.

72,727—December 31, 1867. A. B. ELY. (*Reissue: 2,969—June 9, 1868.*) *Improvement in heel stiffeners.*

Fiber and resin are mixed and rolled, pressed or molded into form, or felted and woven fabrics are saturated with gums or analogous substances, and heated and pressed in molds.

76,773—April 14, 1868. H. W. JOHNS. *Improved compound for roofing and other purposes.*

The combination of asbestos with pigments, oleaginous or resinous matters or varnishes, or spirits, or ground or powdered minerals, or rubber.

77,938—May 12, 1868. W. M. WELLING. (*Reissue: 5,940—June 30, 1874.*) *Improvement in artificial ivory.*

A mixture of shellac 16 parts, camphor 1 part, and talc 16 parts, all by weight; mixed, heated, ground and molded while in a heated state.

77,991—May 19, 1868. R. O. LOWREY. *Improved plastic compound for roofing and other purposes.*

Vegetable fiber, with or without the addition of sand, clay, or similar substances, is mixed with silicate of soda, and after rolling, pressing, or molding, the article is treated with a solution of chloride of calcium: it may be saturated therewith, and, when hard enough to handle, treated in a hot solution.

79,794—July 7, 1868. S. WHITMARSH. *Improved composition for forming moulded and coated articles.*

A composition of blood with asbestos or other mineral or earthy matter, mixed or ground together and exposed to a temperature of 176° C. to give it a hard and waterproof character.

85,018—December 15, 1868. J. M. MERRICK, JR. *Improved material for the manufacture of boxes, picture frames, buttons, insulators, inkstands, and other articles.*

Powder of silica chemically prepared or in the form of diatomaceous deposits or infusorial earth is mixed with gum shellac or other gums.

85,055—December 22, 1866. C. E. BONNET. *Improved composition for ornamental mouldings.*

One-fourth of a pound of paper pulp is added to a solution of 2 pounds of glue in 5 pints of water, then a mixture of zinc white or white lead and 1 gill of linseed oil, and then sufficient whiting to form a tough dough.

88,516—March 30, 1869. R. W. RUSSELL. *Improved fibrous composition, slab and panel for roofs, floors, walls, tanks, and for other purposes.*

Disintegrated cane fiber is charged with or mixed with bitumen and formed into slabs, sheets, etc.

89,100—April 20, 1869, W. M. WELLING. *Improved elastic composition to imitate ivory and similar materials.*

An elastic compound is formed by a mixture of 1 pound of shellac, and, say, 3 ounces of india rubber; with this base there may be mixed gum-camphor, kaoline, ivory dust, bone dust, or dust of holly, satin, or other woods.

89,531 April 27, 1869. W. M. WELLING. *Improved composition for artificial ivory.*

A mixture of kaolin, 2 parts, and shellac, 1 part, with or without a small portion of gumcamphor. The mixture is passed through heated rolls and molded while warm.

91,090—June 8, 1869. W. COMPTON. *Improved composition-crayon.*

A mixture of about 6 pounds paris white, $3\frac{3}{8}$ ounces starch, 3 ounces of soap, and from one-half to $2\frac{1}{4}$ ounces of gum or glue.

92,303—July 6, 1869. G. F. GOETZE. *Improved papier-maché compound.*

A mixture of paper pulp 5 parts, glue 5 parts, turpentine 2 parts, oil 2 parts, flour 4 parts, and whiting to suit; forming a petrified compound.

99,355—February 1, 1870. G. SCHLUETER. *Improvement in compositions for molding from plaster of paris.*

Dry pulverized gum is mixed with dry plaster and coloring matter, after which water is added.

101,101—March 22, 1870. J. R. COLE. *Improved composition for the manufacture of tobacco pipes, stems, and cigar holders.*

Paper pulp is mixed with a solution of alum or other salts that will render it incombustible, and molded.

121,152—November 21, 1871. M. W. BROWN. *Improvement in composition stoppers for vessels.*

A mixture of 30 parts of glycerine and 40 parts of gelatine, with or without 4 parts of an alkaline solution of 10° Baumé.

122,962—January 23, 1872. C. H. POND. *Improvement in insulating compounds for telegraphs, etc.*

A mixture of coal tar, 1 part, and charcoal, or sawdust, tanbark, or other organic body having fiber or structure, 2 parts. The woody matter may be baked or thoroughly kiln dried.

124,201—March 5, 1872. M. G. FARMER. *Improvement in compounds for insulating telegraph wires, etc.*

A mixture of resin, 24 parts; beeswax, 16 parts; spermaceti, 8 parts; and oil, 1 part; for saturating porous insulators.

129,217—July 16, 1872. A. K. EATON. *Improvement in compounds of gelatine, tannin, and cellulose.*

A compound resulting from the chemical union of cellulose, tannin, and gelatine; say, glue, 54 parts; tannin, 46 parts, in the form of catechu or any of the crude tannin gums, and cellulose, 150 parts.

142,595—September 9, 1873. A. THIELE. *Improvement in composition mastic.*

A mixture of 40 parts of sand, 100 parts of chalk, 15 parts of tallow, and 6 parts of tar.

144,548—November 11, 1873. J. L. KENDALL. *Improvement in paper products.*

Paper pulp and sponge is saturated with linseed oil and subjected to pressure.

148,829—March 24, 1874. I. I. JACKSON. *Improvement in compositions for printers' inking rollers.*

A mixture of glue, 16 pounds, glycerine, 16 pounds; borax, 1 pound; and japan, 1 pound.

148,910—March 24, 1874. A. WILKINSON. *Improvement in compositions for coating telegraph wires.*

A mixture in, say, the proportions of white lead, 1 pound; japan, 1 ounce; pitch, 4 ounces; shellac, 3 ounces; tallow, 1 ounce; naphtha, 1 ounce; and linseed oil, 1 ounce.

149,615—April 14, 1874. D. G. AND S. STAIGHT. *Improvement in artificial ivory for piano keys and other articles.*

Alabaster, gypsum, or other variety of sulphate of lime is treated with heat and subsequent immersion in white hard varnish, olive oil, or other oleaginous, fatty, or waxy matter, and then repeatedly immersed in heated water or alum water; the hardness being varied by the use of the alum.

149,749—April 14, 1874. J. G. HALEY. *Improvement in compounds for a waterproof material.*

A compound made of limesoap, prepared of hydraulic cement and linseed oil, mixed with sulphate of zinc, bisulphuret of carbon, alum, asbestos, and clay.

150,194—April 28, 1874. A. SCHMIDT. *Improvement in composition moldings.*

A composition of ground tanbark, ground eggshells, and slacked lime, with an admixture of glue and linseed oil, is molded under a steam-heated dye with a sheet of veneer for the face of the molding.

168,086—September 28, 1875. F. B. DUFFEY. *Improvement in plastic compounds for making ornamental articles.*

A mixture of Spanish whiting, 3 pounds; white lead ground in oil, 1 pound; coach varnish, 6 drams; dammar varnish, 6 drams; Japan drier, 3 drams, and boiled linseed oil, 10 ounces.

174,527—March 7, 1876. F. HICKMAN. *Improvement in materials for chair seats, backs, veneers, floorings, etc.*

Sawdust or fine shavings, saturated with dissolved glue or melted shellac, is spread upon a backing of cloth or other material, and rolled or pressed before it is completely dry.

189,339—April 10, 1877. B. J. CLARKE. *Improvement in crayons for marking on glass, etc.*

A mixture of 6 ounces of beeswax, 7 ounces of suet, and 1 pound of dry color, with half an ounce of oil of cedar.

190,769—May 15, 1877. A. KIESELE. *Improvement in compositions for casting ornamental figures.*

A composition consisting of paraffin, 1 pound; stearine, 4 ounces; and pulverized sugar, 12 ounces.

192,773—July 3, 1877. O. LONG AND P. H. DRAKE. *Improvement in adhesive substances.*

It consists of a solution of worn-out printers' inking rollers (composed of glue and molasses, or glue, glycerine, and molasses) with the addition of tobacco to render it insect proof.

193,213—July 17, 1877. H. BAYLE. *Improvement in compositions for molded articles.*

A compound consisting of 100 pounds of papier-maché, 20 pounds of gum arabic, and 5 to 6 ounces of bronze powder.

198,884—January 1, 1878. J. B. HAYDEN. *Improvement in composition for molded articles.*

Flexible threads or strips of wood cut with the grain and irregularly crossed—as excelsior—is saturated with glue and compacted under pressure.

201,067—March 5, 1878. J. W. SWARTS. *Improvement in crayons.*

Composed of glue, 8 parts, and an alkali, as a solution of carbonate of soda, 1 part, boiled to a hard saponification of the mass; and 1 part of the same mixed with 3 parts of paraffine wax and coloring matter.

201,283—March 12, 1878. C. C. PARSONS. *Improvement in compositions for crayons.*

Composed of clay, fatty matter, resin, and coloring matter melted together, as hard tallow, 4 parts; resin, 1 part; powdered clay, $1\frac{1}{2}$ parts, and lamp black, one-half part.

201,348—March 19, 1878. J. W. & C. M. HYATT. *Improvement in siliceous material to imitate ivory and similar substances.*

An alkaline silicate, as silicate of soda, is used to agglutinize a solid animal tissue. Comminuted bone, horn, or ivory is mixed with the silicate of the consistency of sirup, and molded or rolled into sheets and dried, or treated with heat and pressure. The composition is treated with calcium chloride to render the silicate insoluble.

202,636—April 23, 1878. W. H. DIBBLE. *Improvement in composition for manufacturing molded articles.*

A dry pulverulent composition formed by indurating and pulverizing blood in combination with animal, vegetable, or mineral solids—about equal parts by weight when dried

206,007—July 16, 1878. G. R. EVANS. *Improvement in nonconducting compounds.*

A fire-resisting and nonconducting compound, consisting of 3 or 4 parts of pulverized petrified wood, 1 part of mica, and 1 part of talc, with sufficient clay or other material to make a pasty mass.

208,036—September 17, 1878. J. ROBLEY. *Improvement in manufacture of floor cloth.*

A mixture of sawdust, ground wood, or other vegetable matter, with copal varnish and dry paint or mineral coloring matter, spread on a canvas, textile, or fibrous base.

209,528—October 29, 1878. C. WALPUSKI. *Improvement in the manufacture of colored crayons.*

A composition consisting of a suitable base, as kaolin, with starch and gelatinous matter combined with coloring matter; (the colors can be worked in a dry state and fixed on paper with water).

210,204—November 26, 1878. A. KEMPENNER. *Improvement in plastic composition for the manufacture of aquarium frames, etc.*

A mixture of sand, fire clay, coal tar, and asphaltum.

215,757—May 27, 1879. A. KIESELE. *Improvement in compositions for casting ornamental figures.*

A mixture of 5 parts of paraffin with 2 parts of starch.

217,360—July 8, 1879. J. C. FRIEDRICHS. *Improvement in compounds for forming letters, figures, or ornaments.*

A mixture of one-half pound of umber, one-quarter pound of litharge, 5 pounds of plaster of paris, 1 pound of clay, one-quarter pound of terra-sienna, 2 pounds of boiled oil, 1 pound spirits of turpentine, and one-half pound of Japan drier.

217,705—July 22, 1879. W. F. NILES. *Improvement in the manufacture of ornamental buttons from blood and other materials.*

A compound formed of powdered blood and colored, lumped, powdered blood with a gelatine or albumin substance, molded with pressure and heat.

218,538—August 12, 1879. J. B. KING. *Improvement in compositions for walls and ornaments.*

A mixture of 3 parts of clay; 1 part pulverized lava; 1 part dextrine or similar gum; 1 part fibrous material, as cotton, paper, wool, or asbestos; 1 part ground plumbago, and 1 part pulverized glass, with sufficient water to render the mass plastic, with or without a small quantity of plaster of paris.

221,825—November 18, 1879. L. E. JANNIN. *Improvement in composition for stereotype molds.*

A mold or matrix for forming stereotype plates is made of a cement composed of protoxide of lead and glycerine.

221,881—November 18, 1879. H. P. WEBB. *Improvements in paints for filling the seams of vessels.*

A quick drying liquid-gum vehicle, composed of resin dissolved in naphtha, combined with an earthy base, as red oxide of iron.

223,593—January 13, 1880. A. KRYZINSKI. *Composition for covering moldings.*

Composed of a solution of glue, 4 pounds; rye-flour, 8 pounds; and whiting, 190 pounds.

223,869—January 27, 1880. N. ULLMAN AND M. D. STILES. *Crayon compound.*

Formed of lampblack, 16 parts; alcohol (95 per cent), 48 parts; and Siberian lead or graphite, 1 part; all by weight.

223,880—January 27, 1880. J. BURBRIDGE, R. C. THORPE, AND T. OAKLEY. *Composition for elastic rollers.*

Composed of sulphurized oil, fibrous material, and gum-resin or pitch; as from $3\frac{1}{2}$ to $4\frac{1}{2}$ pounds of fibrous material added to $1\frac{1}{2}$ pounds of gum-resin and combined with 6 pounds of sulphurized oil. The rollers are subjected to a heat of about 150° C. for about three hours.

225,261—March 9, 1880. O. F. WOODWARD. *Composition of matter for making molded articles of manufacture.*

Gypsum and resin mixed together under heat—say in the proportion of 5 parts of the former to 4 of the latter.

225,679—March 16, 1880. A. T. WOODWARD. *Plastic compound.*

A mixture of pulverized silica—such as flint, glass, or sand—and a mineral or vegetable resin or pitch, with or without boiled linseed oil or other drying oil, or turpentine, or benzine; impervious to water and suitable for insulating purposes.

225,817—March 23, 1880. T. FLETCHER. *Composition for filling teeth.*

A paste composed of alumina pyrophosphate or phosphate triturated with phosphoric or pyrophosphoric acid and mixed with a substance capable of combining therewith and taking up excess of acid and solvent, as powdered hydrate of alumina, magnesia, or heavy oxide of lead.

226,547—April 13, 1880. J. L. POPE. *Composition of matter.*

A mass of pulverized cork mixed with a suitable binder (colored or not), with or without any suitable substance susceptible of taking a polish, and solidified by pressure.

226,583—April 20, 1880. I. B. ABRAHAMS. *Plastic composition of matter for the manufacture of jewelry and fancy articles.*

One part of glue is dissolved in 2 parts of slightly acidulated water and mixed with 1 part of resin or shellac liquefied by heat and the addition of turpentine, when 4 parts of starch and a dilute acid is added with heating.

226,738—April 20, 1880. T. FLETCHER. *Composition for filling teeth.*

A solution of phosphate of tin in phosphoric acid is combined with the powdered product of a mixture of lime 1 part, and silica and alumina each 5 parts, fused together.

227,291—May 4, 1880. E. L. ORMSBEE. *Substance for mounting stuffed birds, etc.*

A mixture of glue, sand or sawdust, and Marseilles green, in about equal proportions; it forms an imitation of wood.

227,352—May 11, 1880. E. EVERHART. *Composition for insulating telegraph wires, coating metals, covering roofs, and for other purposes.*

A mixture of 250 pounds of asphalt and 100 pounds of resin, with 20 pounds each of powdered charcoal and infusorial earth.

229,491—June 29, 1880. P. L. SYLVESTER. *Manufacture of buttons from plastic material.*

An ornamental coating of tinsel, foil, brocade, or gold sand, combined with shellac; produced by mixing shellac and the tinsel, etc., with heat, then pulverizing, and sprinkling the surface of the mold with the powder.

229,494—June 29, 1880. P. L. SYLVESTER. *Manufacture of buttons from plastic material.*

A plastic material composed of bleached shellac, 1 part, and mineral white (carbonate of lime), 2 parts, without pigments.

231,540—August 24, 1880. J. COLLINS. *Lining gas generators, acid chambers, and fountains for mineral waters.*

Powdered asphaltum with sufficient deodorized benzine to form a thick paste is heated until the asphaltum is dissolved, and powdered plumbago added, pound for pound.

231,736—August 31, 1880. J. TAYLOR. *Manufacture of flexible tubes.*

A coating composition consisting of 4 ounces of a product, obtained by dissolving 1 ounce of alum with 1 pound of linseed oil and boiling, mixed with 1 pound of molasses and 1 pound of gum arabic.

235,909—December 28, 1880. G. F. SENTER. *Composition from mineral wool for journal bearings.*

Three parts of mineral wool and 1 part of plumbago are mixed and ground together and sufficient water glass added to form a paste, which is molded into a compact mass with heavy pressure, dried, and dipped in melted paraffin or other unctious material.

236,034—December 28, 1880. J. W. HYATT, C. S. LOCKWOOD, AND J. H. STEVENS. *Factitous material to imitate ivory, horn, etc.*

Bone dust is welded by heat and pressure, with or without the admixture of a water repellant, as a gum solution, or an acid, as boracic acid, to facilitate the welding.

236,480—January 11, 1881. S. BARR. *Compound for manufacture of gas tubing.*

A mixture of glue, 10 pounds; glycerine, 12 pounds; soap, 4 ounces; borax, 1 ounce; and copperas, three-fourths of an ounce; with sufficient water, using heat, to form a paste.

237,569—February 8, 1881. H. B. MEECH. *Dry-ground pulp.*

The pulp of rags, jute, straw, or other wet-pulped vegetable fibers, is dried and then ground or pulverized to a fine powder for admixture with varnishes, gums, or oils.

238,980—March 15, 1880. J. B. SPENCE. (*Reissues: 9,982, 9,983, and 9,984—December 30, 1881.*) *Manufacture of metallic compounds from sulphur and sulphides.*

"Spence's metal," composed of metallic sulphides, as sulphide of iron and sulphide of copper, and sulphur; formed by pulverizing the sulphide and combining it with fused sulphur.

239,409—March 29, 1881. W. A. WALLER AND J. P. HITCH. *Composition for slating surfaces of blackboards.*

A mixture of 1 pound of lampblack and 1 pound of gum arabic in water with 8 pounds of Spanish white and 16 pounds of plaster of paris added.

239,466—March 29, 1881. E. J. DE SMEDT. *Insulating or nonconducting compound for electrical purposes.*

Telegraph wires and electrical conductors are insulated or covered with an oxidized hydrocarbon obtained by treating coal tars and the heavy oils of petroleum with an oxidizing agent.

239,951—April 12, 1881. W. M. GRAZE. *Plastic composition from paper-pulp for floors, brake-shoes, journals, etc.*

A composition of matter, and articles made thereof, consisting of a mixture of paper-pulp and metallic fillings (with or without a sizing of oil, resin, paraffin or the like) solidified under pressure.

242,758—June 14, 1881. C. CRABTREE. *Composition to be used in making squibs waterproof.*

A mixture of 1 pound of beeswax, 3 pounds of flowers of sulphur, 1 pint of alcohol and one-half pound of gum shellac.

244,321—July 12, 1881. J. C. SELLARS. *Composition for molds and composition-mold for forming concrete.*

A lubricating binding material not affected by alkalis, such as paraffin, combined with sand or charcoal.

244,486—July 19, 1881. E. ROSENZI. *Composition of matter for molded articles to resemble glass and iron.*

It consists of sand, 100 parts; coal ashes, 40 parts; lime (burned), 10 parts; with arsenic, magnesia, borax, and soda, in variable quantities, fused in a crucible and cast.

246,391—August 30, 1881. J. R. HOWELL. *Composition of matter to be used in the ornamentation of moldings and picture frames and the manufacture of light hollow ware, toys, trays, etc.*

A mixture of 8 pounds of glue, 6 pounds of resin, 2 pounds of paper pulp, and 2 quarts of linseed oil, thickened to a paste while hot by the addition of whiting.

247,797—October 4, 1881. M. W. BROWN. *Composition of matter.*

A composition consisting of skin glue or gelatine, water, glycerine, carbonate of lime, and earth paint, to be applied to paper or fabrics to render them flexible, tenacious, and resistant to wear.

248,324—October 18, 1881. H. W. JOHNS. *Asbestos material and process of manufacturing the same.*

Asbestos is reduced to fibers; formed into a bat, with or without wires or cords placed therein; moistened, as with a glutinous or waterproofing solution; and subjected to pressure.

250,257—November 29, 1881. O. O. KARSCH. *Composition for artificial-wood ornaments.*

Ten pounds of glue dissolved in 4 quarts of water is combined with 6 pounds of resin dissolved in 1 quart of linseed oil with heat, and sifted whiting and plaster of paris added and molded while warm and plastic.

251,473—December 27, 1881. F. W. SCHROEDER. *Insulating composition or compound for coating electric and other wires or conductors.*

A compound formed from 2 pounds of glue, 16 ounces of mastic, 14 ounces of dextrine, 9 ounces of asbestos, $2\frac{1}{4}$ ounces of chrome-alum, one-fourth of an ounce of chloride of iron, and 16 ounces of glycerine, with or without the addition of 8 to 20 ounces of albumen.

251,474—December 27, 1881. F. W. SCHROEDER. *Insulating composition or compound for coating electric and other wires or conductors.*

The composition is like that of No. 251,473, with the omission of asbestos.

251,970—January 3, 1882. J. TAYLOR. *Coating and insulating wire for electrical purposes.*

A coating of benzoin is applied directly to the wire or outside of a fibrous coating.

253,200—February 7, 1882. T. GUILFORD. *Composition for buttons, etc.*

A mixture of pulverized horn or hoof and steatite, with or without coloring pigments.

254,461—March 7, 1882. J. D. CHEEVER. *Waterproof composition.*

A composition, consisting of short fibers, as of jute, 30 pounds; spent tan bark powdered, 50 pounds; pulverized pagodite or agalmatolite, 30 pounds; powdered red chalk or red oxide of iron and clay, 20 pounds; and flour sulphur, 1¼ pounds, mixed in a mill, with the addition of 10 pounds of vaseline and 20 pounds of caoutchouc—the latter made miscible with coal tar or petroleum naphtha. Burlap is prepared to receive a coating of the above by applying to the same, by hot calendering, a composition of glue, yellow soap, and alum.

254,964—March 14, 1882. B. HARRASS. *Plastic compound.*

For making imitation wood objects, a mixture of 3 parts of paper pulp or cellulose, 1 part of starch, and 2 parts of flour, boiled, and converted into a fibrous paste, is mixed with sawdust; or a mixture of 2 to 10 parts of cellulose, 6 to 30 parts of sawdust, 1 to 5 parts of binding material—as dextrine, albumen, etc.—1 to 5 parts of flour and one-eighth to 2 parts of clay, chalk, etc., for backing veneers.

255,937—April 4, 1882. M. B. CHURCH. *Plastic material.*

For wall covering, a mixture of 5 to 8 pounds of glue, with 1 to 1½ pounds of sulphate of zinc, and 100 pounds of plaster.

257,706—May 9, 1882. W. C. HORNE. *Crayon.*

A luminous substance, such as a phosphorescent powder, is combined with a base or vehicle to form a paste which is molded and dried. It makes luminous marks.

258,549—May 30, 1882. F. BOREL. *Insulating material for electrical conductors.*

A siccative oil, such as linseed oil, transformed by heat into a solid elastic mass, with or without an admixture of a resinous matter, such as colophony.

259,878—June 20, 1882. C. S. LOCKWOOD. *Plastic composition for the cores of billiard balls, and for other purposes.*

Comminuted and desiccated glue, with or without glycerine, is welded and agglutinated by heat and pressure.

261,623—July 25, 1882. H. W. MORGAN. *Preparation of whalebone.*

A solution of whalebone, formed by dissolving shavings, cuttings, etc., in an alkali.

262,427—August 8, 1882. W. M. JACKSON. *Gas-proof cement.*

A compound of glycerine, 24 parts; gelatine, 1 part; and litharge or yellow oxide of lead, 30 parts.

264,771—September 19, 1882. M. W. SAMUEL. *Method of and means for the production of figures in relief on various substances.*

An adhesive plastic, consisting of 45 per cent of wax and 50 per cent of powdered resin, combined with heat, to which 5 per cent of Venice turpentine is added, with boiling.

266,053—October 17, 1882. J. J. SACHS. *Production of materials for castings, cements, lead pencils, etc.*

A composition consisting of sulphur and plumbago or other nonmetallic substances or mixtures, in the proportion of 4 parts of the former to 3 parts of the latter, or thereabout.

266,493—October 24, 1882. W. MATT. (*Reissue: 10,343—June 19, 1883.*) *Artificial stone for veneers, etc.*

A mixture of glue, 6 pounds; resin, three-fourth of a pound; linseed oil, 1½ pounds; paper pulp, 1 pound; glycerine, one-fourth of a pound; and steatite or its equivalent, and coloring pigments.

267,045—November 1, 1882. R. S. WARING, AND J. B. HYDE. (*Reissue: 10,350—July 3, 1883.*) *Insulating material for electric uses.*

An insulating compound composed of two or more of the heavier products arising from the redistillation of the residuum of petroleum, as obsidine tempered with a softer residuum product to give flexibility.

267,046—November 7, 1882. R. S. WARING. (*Reissue: 10,351—July 3, 1883.*) *Insulating compound for electric wires.*

A compound consisting of the liquid distillates of the residuum of petroleum with resinous or bituminous substances, together with clay, chalk, pulp, or like material.

271,120—January 23, 1883. W. F. RIKEMAN. *Composition for covering piano keys, etc.*

It consists of a mixture of gypsum, 60 parts; shellac, 30 parts; silica, 10 parts; and ivory black, 10 parts.

271,994—February 6, 1883. D. M. STEWARD. (*Reissue: 10,344—June 19, 1883.*) *Electrical insulator.*

Steatite, in a natural block cut into the desired form, or in the form of powder, is hardened or vulcanized by treating it with ammonia and muriatic acid and then subjecting it to heat. The vulcanized powdered steatite is mixed with a binding material, as plaster of paris, and molded.

274,622—March 27, 1883. J. F. MARTIN. *Insulating compound for electrical work.*

A mixture of marble dust, plaster of paris, and glue size; it is formed into tubes.

275,123—April 3, 1883. I. R. BLUMENBERG. *Indestructible compound for lining and coating tubes, cylinders, and other vessels, electric wires; also for joint packing, taking impressions, making castings, molds, and ornaments, and ornamental work.*

A compound of lampblack, about 4 per cent; asbestos, 20 per cent; litharge, 45 per cent; and glycerine, 31 per cent.

275,422—April 10, 1883. S. F. SHELBOURNE. *Insulating compound for electric conductors.*

A compound of paraffine and one or more of the heavier and separate distillates passing over in the redistillation of the residuum of petroleum.

275,904—April 17, 1883. C. GRUNZWEIG AND P. HARTMANN. *Artificial cork.*

A composition formed of boiled starch and powdered cork.

276,607—May 1, 1883. G. J. LESSER. *Plastic and elastic composition for forming elastic rolls, elastic pads, and for other useful purposes.*

A compound of glue, 25 pounds; gelatine, 6 pounds; glucose, 25 pounds; extract of lead, 1 pound; and glycerine, 15 pounds; formed by first forming a glue or gelatine with the lead compound, and combining said compound with a compound of glue and glucose with the glycerine added.

276,891—May 1, 1883. J. G. SANDERSON. *Insulating electrical conductors.*

A pulverulent mixture of nonconducting metallic oxide—as the sesquioxide of iron—and sulphur is mixed with melted bitumen.

276,998—May 8, 1883. S. BARR. *Compound for coating gas-tubing.*

A mixture of glue, 30 pounds; glycerine, 30 pounds, and bichromate of potash, 1¼ ounces.

277,707—May 15, 1883. P. E. GONON. *Manufacture of lead-pencils.*

A pencil consisting of a marking core surrounded by material, as wood pulp, pressed around the core in a plastic or semifluid state. (Claims for the apparatus.)

278,481—May 29, 1883. S. M. ALLEN. *Material for roofing purposes.*

Powdered or pulped fiber is mixed with heated asphalt and the paste formed into sheets, or applied to a web or backing of paper or other fabric.

278,536—May 29, 1883. J. GREIVES. *Electrical insulating material.*

A compound consisting of chalk and colophony, and containing from 40 to 90 per cent of chalk.

279,492—June 12, 1883. A. MEUCCI AND T. DENDI. *Plastic paste.*

A composition consisting of gelatine or a substance containing gelatine, 2 to 4 parts; fiber deprived of its mineral, gummy, and resinous substances, one-fourth to one-half part; an acid, as dilute muriatic acid, 1 to 2 parts; starch or analogous substances, 1 to 2 parts; varnish, 1 to 2 parts; oxide of zinc, 6 to 8 parts; and terra-alba, 2 to 4 parts.

281,999, July 24, 1883. J. B. HYDE. (*Reissues: 10,403; 10,404—November 6, 1883.*) *Insulating compound for electrical conductors and apparatus for compounding and applying the same.*

A compound composed of petroleum or mineral oils combined under heat, in a closed vessel, with the hard bituminous residuum from petroleum distillation.

282,014—August 7, 1883. J. F. MARTIN. *Compound for electric-wire insulators.*

A compound of asphaltum and from 40 to 60 per cent of fine marble dust.

283,044—August 14, 1883. D. B. TURNER. *Composition to insulate, preserve, and protect wire for electrical purposes.*

A compound formed of 1 part by weight of castor oil, and 5 parts of the black resinous substance obtained as a residuum of oil distillation, and known as "Nubian pitch," "Nubian gum," and "colophony niger."

283,200—August 14, 1883. H. R. BRISSETT AND J. HOWE. *Composition for coating and insulating underground wires.*

A composition of cottonseed oil, 30 ounces; Venetian turpentine, 30 ounces; resin, 18 ounces; asphaltum, 39 ounces; steatite, 48 ounces; paraffine, 16 ounces; pine tar, 12 ounces; sulphur, 17½ ounces; and red lead, 15 ounces.

283,526—August 21, 1883. J. W. STANSBURY AND J. M. HEDRICK. *Lining for burial caskets, etc.*

A compound composed of 3 pounds of alcohol, 4 pounds of white lead, 3 pounds of gum shellac, 1 pound of white glue, and plaster of paris.

283,793—August 28, 1883. C. S. LOCKWOOD. *Plastic material.*

A compound consisting of 8 pounds of powdered bone or similar material, 2 ounces of phosphate of ammonia or its elements, and 2 pounds of powdered shellac, may be subjected to pressure in heated molds or r ixed with a solvent and mixing rolls.

283,794—August 28, 1883. C. S. LOCKWOOD. *Plastic material.*

Eight pounds of pulverized and desiccated bone is mix . with 2 ounces of phosphate of ammonia and subjected to pressure in heated molds.

283,796—August 28, 1883. C. S. LOCKWOOD. *Zincated bone.*

Bone dust or like material is mixed with sulphate of zinc, the mixture submitted to a water bath, and then the free acid washed out to render the gelatine insoluble.

283,797—August 28, 1883. C. S. LOCKWOOD. *Plastic material.*

A mixture of tannate of iron and bone or horn dust is subjected to pressure in a heated mold, as 8 parts of bone dust and 2 parts of tannate of iron, or a mixture of 16 parts of bone dust, 4 parts of solid extract of logwood, and 1 part of sulphate of iron made into a solution, and the moisture expelled.

284,098—August 28, 1883. R. S. WARING. *Insulating material and preparation of the same.*

An insulating material for lead-covered cables: produced by subjecting natural asphaltum, or the heavier distillates or residual products of petroleum to a degree of heat above the vaporizing point of water, to eliminate the latter and the light and easily decomposed products—approximate, 175° C.—but below the point at which destructive distillation or cracking begins.

287,346—October 23, 1883. C. J. VAN DEPOELE. *Insulating material.*

A mixture of silicate of soda with earthy substances or metallic oxides, as zinc white or red lead; paper is saturated therewith.

287,994—November 6, 1883. H. ARMSTRONG AND J. A. LOUDON. *Boiler-covering.*

Fibrous peat, separated or disintegrated from the bulk of its earthy matter, is mixed with cement as a covering for steam-pipes, boilers, etc.

288,112—November 27, 1883. W. MATT. *Artificial stone for veneers, molded articles, etc.*

A compound consisting of glue, 10 pounds; asbestos, 10 pounds; linseed oil varnish, one-half pound; colophony, one-half pound; glycerine, 1 pound; turpentine, 1½ pound; with steatite or kaolin and pigments.

289,237—November 27, 1883. L. EBERLE. *Composition for gilt moldings.*

A mixture of one-half pound each of stick-lac and sandarac, and one-eighth pound each of galipot, gamboge, and dragon's blood in alcohol.

290,057—December 11, 1883. J. BURROWS HYDE. *Insulating compound for electric conductors.*

Mineral and coal-tar bitumens are melted and combined with petroleum or mineral oil. In coating thread-covered electric wires with an insulating medium, the covering is saturated with a volatile fluid, as crude petroleum, before the wire enters the heated insulating composition. The waste vapors evolved are stored in a sealed and floating holder and used for heating the furnace.

290,058—December 11, 1883. J. B. HYDE. *Insulating compound for electric conductors and the process of compounding the same.*

A compound of dry powdered peat with bituminous substances and hydrocarbon fluid added under heat; short lengths of vegetable fiber may be added to the melted composition.

290,888—December 25, 1883. F. J. KALDENBERG. *Manufacture of articles from waste amber.*

Articles made of pieces of amber and gum animé molded together: formed by pulverizing the gum, mixing it with pieces of amber, and subjecting it to heat and pressure.

291,164—January 1, 1884. A. DICKMAN AND M. HEINTZ. *Veneer.*

A composition veneer built up in alternate layers or wood shavings and glue; the shavings are cut to particles of a uniform size.

291,284—January 1, 1884. E. BRADY. *Composition of matter for molding fruits, fancy-topped tables, birds, etc.*

It consists of 1 pound of pulverized hard stone, 1 pound of pulverized slate stone, one-quarter pound of common sand, one-quarter pound of white sand, one-sixth pound of pulverized clam shells, one-quarter pound of common brick, one-quarter pound of charcoal, 3 pounds of blue clay, 1 pint of linseed oil, and water.

291,716—January 8, 1884. J, GREIVES. *Electric insulating material.*

Caustic lime in powder, hydrated or otherwise, is combined with resin in a fused state, the lime being in excess; from 2 to 5 per cent of a fixed oil, as resin oil, may be added, to render the compound flexible.

291,717—January 8, 1884. J. GREIVES. *Electric insulating material.*

A compound of resin and natural silicate of magnesia—as talc or soapstone—combined by fusion, the silicate being in excess; from 5 to 10 per cent of a fat or oil is added to temper the compound.

291,718—January 8, 1884. J. GREIVES. *Electrical insulating material.*

It is composed of crystalline lime carbonate, as marble, spar, etc., reduced to powder and combined with resin by fusion of the latter, with or without the addition of powdered asbestos.

292,770—January 29, 1884. P. H. VANDER WEYDE. *Manufacturing a rot-proof covering for underground telegraph cables.*

The fibrous envelope of a metallic conducting wire is saturated with Utah elaterite or mineral wax, combined with from 5 to 10 per cent of bitumen.

292,956—February 5, 1884. M. SCHÜTZ. *Compound for preserving the soles of boots and shoes.*

It consists of 25 parts of shellac and 25 parts of alcohol, mixed with 50 parts of boiled linseed oil.

293,784—February 19, 1884. W. S. RAVENSCROFT. *Pulp caster-wheel.*

A caster wheel made of paper or wood pulp.

294,457—March 4, 1884. J. FOTTRELL. *Composition for electrical insulation.*

Metallic soap, which may be formed from a common brown soap and an alum solution, alone or combined with benzine, turpentine or gasoline, and linseed oil and varnish, and with or without a thickening material, as white lead.

297,626—April 29, 1884. J. H. PAGE. *Indestructible compound for coating wires for electrical purposes.*

A compound of litharge and glycerine, formed into a thick paste.

298,072—May 6, 1884. D. H. DORSETT. *Insulating material.*

The residuum of 50 gallons of coal tar, distilled until it will resist 55° to 60° C. without softening, combined with 2 gallons of crude petroleum paraffine, 100 pounds of fine silicious sand, and 50 pounds of pulverized coal-ashes and cinders, with or without one-half pound of black oxide of manganese and one-fourth pound of ammonia chloride.

300,464—June 17, 1884. L. HAAS. *Compound material for the manufacture of sheets, boards, blocks, artificial wood, etc.*

Eighty per cent of wood or vegetable fiber and 20 per cent of scrap leather and shoe waste or shoddy waste and crude asbestos are ground or reduced to a fiber, the moisture evaporated, and mixed with thinned asphaltum blended with a suitable quantity of pitch, sulphur, whiting, crude asbestos, and litharge.

300,729—June 17, 1884. O. F. PARSONS. *Fire and water proof compound.*

A mixture of 20 gallons of coal tar, 12 pounds of air-slacked lime, 7 pounds of Spanish brown, 6 pounds of sulphur, 2 pounds of litharge, 8 pounds of salt, and 7 pounds of American ocher.

302,977—August 5, 1884. W. M. BRASHER. *Floor-covering.*

One hundred and twenty pounds of litharge is added to a solution of 120 pounds of sugar of lead in 100 gallons of water, and 10 gallons of the same is then mixed with 300 pounds of whiting, 300 pounds of ocher, 10 gallons of glue size, 10 pounds of wood pulp, and 20 gallons of linseed oil (three-fourths raw and one-fourth boiled). It is spread on a textile base.

303,301—August 12, 1884. C. LORTZING. *Art of making artificial asphaltum from the residue of tanneries.*

The precipitated residuum of the waste waters of tanneries and the like is dried, powdered, mixed with powdered limestone, and subjected to heat and pressure; the product possesses all of the qualities and appearance of asphaltic mastic.

304,020—August 26, 1884. C. G. MUSKAT. *Composition for covering and insulating electric wires.*

One pound of castor oil is boiled with 2 pounds of gum copal and incorporated with 3 pounds of powdered slate.

304,775—September 9, 1884. S. BARBIER AND C. H. COIFFIER. *Composition to be used as a substitute for hard india-rubber, celluloid, iron, and the like.*

A mixture of ivory waste, or dust, and horn agglomerated by means of albumen.

305,205—September 16, 1884. C. S. LOCKWOOD AND J. W. HYATT. *Plastic material to imitate ivory, etc.*

Organic or analogous material is thoroughly comminuted, say to one twenty-thousandth of an inch, and then subjected to heat (160° C.) and great pressure in a mold; a homogeneous mass being formed without the use of adhesives.

307,184—October 28, 1884. A. DERROM. *Composition mastic for covering roofs, telegraph-wires, and the like.*

A mixture of "crude, hard Venezuelan bitumen" and purified, soft Venezuelan bitumen.

308,778—December 2, 1884. C. T. LEE. *Composition for making nonconducting handles for sad-irons, etc.*

Powdered mica, or like material, is combined with glue which has been treated with acetate of iron, so that the mass does not soften with moisture.

310,899—January 20, 1885. M. MACKAY. *Plastic compound suitable for molding into various useful articles, such as screw-stoppers for bottles, jars, etc.*

It consists of a compound of 75 pounds of lac, 38 pounds each of gum-sandarac, resin, and ivory-black, and 168 pounds of asbestos or other suitable fibrous material or silicates.

311,875—February 10, 1885. R. P. COUGHLIN. *Manufacture of clock-cases, statuary, vases, and other articles from plastic materials.*

A composition of Keene's cement, resin, and alum, with or without coloring matter. A composition for dyeing artificial marble consists of extract of logwood, copperas, tincture of iron, and water.

316,374—April 21, 1885. S. KRAUS. *Artificial slate pencil.*

Colored slate pencil, formed of coloring matter, 10 pounds; talc, 5 pounds; and potters' clay, 10 pounds; mixed, formed, and baked.

317,388—May 5, 1885. C. S. LOCKWOOD AND J. W. HYATT. *Process of treating silicate of soda in combination with zinc oxide, etc.*

A composition, and articles formed thereof, consisting essentially of silicate of soda and zinc oxide, combined, comminuted and partly dehydrated; produced by forming an aqueous solution of the silicate of soda with an admixture of zinc oxide in the proportion of 4 parts of silicate (26° Baumé) to 1 part of zinc oxide, comminuting it, and subjecting it to treatment in an ammoniacal bath.

319,084—June 2, 1885. J. A. FLEMING. *Preparation and production of insulating materials.*

Finely divided wood, or other vegetable fibrous material, is desiccated and impregnated with a mixture of melted bitumen or asphalt incorporated with silicates of magnesia, or lime, iron, alumina, or of two or more of them, and with amber resin, or other resin having a high melting point, as kauri, and molded under pressure.

321,956—July 14, 1885. J. W. ELLIS. *Composition of matter for the preservation and insulation of wires.*

A compound of roofing pitch with sulphur, one thirty-second part; resin, one-sixteenth part; and lime, one thirty-second part.

322,803—July 21, 1885. A. G. DAY. *Vulcanized product, termed "kerite."*

A compound formed by the mixture of cottonseed oil, linseed oil, coal tar or bitumen, and the sulphide of antimony or other suitable sulphide (product of No. 322,802).

322,805—July 21, 1885. A. G. DAY. *Vulcanizable compound, or crude kerite.*

A compound formed by the mixture of vegetable astringents with cottonseed oil, linseed oil, and coal tar or bitumen (product of No. 322,804).

322,996—July 28, 1885. S. P. M. TASKER. *Manufacture of leathery compound.*

Fibrous material—animal, vegetable, or mineral—is saturated with gelatine, molded or worked into the desired form, and then treated with tannic acid.

325,890—September 8, 1885. I. P. WENDELL. *Composition of matter for use as insulating material.*

A mixture of 2½ pounds of asbestos, one-half a pound of antimony, one-eighth of a pound of sulphur, and 2½ pounds of liquid silicate of soda.

325,891—September 8, 1885. I. P. WENDELL. *Composition of matter for use as insulating material.*

A mixture of 2 pounds of asbestos or talc, 1 pound of litharge, one-half a pound of antimony, and 3 pounds of liquid silicate of soda.

327,462—September 9, 1885. H. C. SPALDING. *Insulating compound for electrical cables, etc.*

A permanently viscous or plastic insulating compound consisting of boiled linseed oil and crude turpentine.

327,477—September 29, 1885. H. C. SPALDING. *Compound for insulating underground electric conductors.*

A permanently plastic insulating material, as a filling for underground conduits containing electric conductors, consisting of refined asphalt, 90 parts, and petroleum residue, 10 parts.

328,366—October 13, 1885. C. WALPUSKI. *Composition for pencil-leads and crayons.*

A composition consisting of a base—such as potter's clay—a binding medium, and two distinct colors—a writing color and a copying color.

329,349—October 27, 1885. W H. WIGGINS. *Substitute for billiard-cue chalk.*

Finely granular barytes is mixed with liquid dextrine, with or without a small percentage of gypsum, and molded into blocks.

334,782—January 26, 1886. F. KIMBLE. *Making targets.*

Composed of pitch, 100 pounds, and plaster of paris, or whiting, 25 to 75 pounds.

334,974—January 26, 1886. A. A. OLIVER. *Composition of matter for roofing, furniture, etc.*

A composition of manila or other fibrous stock, say, 1,000 pounds; asbestine powder, 1,000 pounds; linseed oil, 170 pounds; oil of tar, 170 pounds, and tungstate of soda, 90 pounds; with or without ground emery, 50 pounds.

337,472—March 9, 1886. S. M. ALLEN. *Composition of matter for making molded articles.*

A mixture of, say, 100 pounds of asphalt, resin, or equivalent substance, with 10 pounds of a suitable nonvolatile oil—as Trinidad asphalt oil—and 700 pounds of wood pulp or other vegetable or animal fiber. The fiber is saturated with water or spirits preparatory to mixing with the resinous or gummy matter.

339,519—April 6, 1886. W. W. BARNES AND J. D. EMACK. *Composition of matter suitable for casting medallions, tiles, picture frames, moldings, etc.*

A mixture of soluble glass, 100 parts; ground flint, 80 parts; ground iron, 30 parts; and roll sulphur, 40 parts; combined by heating up to 180° C.

339,777—April 13, 1886. J. HOWE. *Composition to be used for insulating wires.*

A mixture of cottonseed oil, 1 quart; asphaltum, 5 pounds; white resin, 4½ pounds; paraffin wax, 1½ pounds, and Venetian turpentine, 2 pounds.

341,072—May 4, 1886. E. C. C. STANFORD. *Manufacture of useful products from seaweed.*

Algic acid is produced from seaweed by an admixture of an alkali with the seaweed from which the salts have first been extracted. One hundred parts of the washed seaweed is mixed with 5 parts of an alkali, as carbonate or hydrate of soda or biborate of soda, and the gelatinous solution separated from the undissolved ingredients.

341,757—May 11, 1886. G. A. LINDGREN. *Compound for preventing window frost.*

It comprises 1½ ounces of sodium chloride, 3¼ ounces of water, 7¾ ounces of glycerine, 2¼ ounces of isinglass, 1 ounce of cologne spirit, and one-half ounce of sulphuric acid.

342,377—May 25, 1886. R. F. NENNINGER. *Composition for floor and wall coverings, etc.*

A mixture of paper pulp in a dry state and the gummy viscous residue derived from heating linseed oil.

342,378—May 25, 1886. R. F. NENNINGER. *Process of manufacturing composition for floor and wall coverings, etc.*

Any fibrous material is molded or pressed into desired shape and dried, then treated with a gummy or resinous waterproof substance, as linseed oil, after heating to a high temperature, dissolved in a volatile solvent, such as naphtha, and finally the volatile solvent is evaporated.

342,684—May 25, 1886. J. W. & F. R. HOARD. *Insulating and protecting electric wires and cables.*

An electric conductor insulated with a covering of linseed or equivalent drying oil, highly oxidized throughout its mass by exposure to air or oxygen to the consistency of a jelly, and applied without a solvent.

344,823—July 6, 1886. J. FOTTRELL. *Composition of matter for the electrical insulation of wires covered with cotton, silk, or worsted braid or tape.*

A compound of boiled linseed oil, 6 gallons; oxide of zinc, 10 pounds; Venetian turpentine, 1 pound; lead shavings, 2 pounds; to which is added, after mixing and boiling, copal varnish, 1 gallon, and sandarac varnish, 1 pint.

345,542—July 13, 1886. A. L. REINMANN. *Cement for securing metal rings to electric-lamp bulbs and for other purposes.*

A mixture of 8 ounces of calamine and 4 ounces of chalk, and a suitable adhesive material, as glue, with or without a small amount of glycerine.

346,002—July 20, 1886. C. N. WAITE. *Marking crayon.*

A hygroscopic substance, such as glycerine or chloride of zinc, is combined with the crayon material, so that the marks formed will not form a dry powder or impair the surface of the board.

346,841—August 3, 1886. E. G. CHORMANN. *Composition for decorative purposes.*

It consists of a mixture of silex, an alkaline salt, carbon, clay, a metallic chloride, and a flux; to be used for coating purposes or to be molded.

347,565—August 17, 1886. O. BRACH. *Porous mass for blotting purposes and for making cigar pipes, etc.*

A porous compound consisting of vitreous sand, coarse river sand, pipeclay, and hogs-bean meal. The molded material is dried and burned at nearly the melting point of silver.

348,994—September 14, 1886. T. J. PEARCE AND M. W. BEARDSLEY. *Insulating wire and conductors for electrical purposes.*

A mixture of bisulphide of carbon and maltha is employed as an insulating coating.

349,751—September 28, 1886. A. H. ROWAND AND R. S. HUNZEKER. *Composition of matter for packing the joints of gas pipes, etc.*

It is composed of pitch and molasses.

351,611—October 28, 1886. R. ALEXANDER. *Compound for insulating telegraph wires, etc.*

A compound of mineral wool or glass-flock, say, 100 pounds; asphaltum, 60 to 70 pounds; and cement or carbonate of lime, 20 to 30 pounds. The glass-flock is treated to a hot bath of boracic acid previous to mixture to anneal or soften the fibers.

352,445—November 9, 1886. J. W. BUTLER. *Composition for the manufacture of blocks for containing electric wires or cables.*

A compound of trinidad or other bitumen, say, 15 pounds; crude paraffin, 12 ounces; Portland cement, 6 ounces; Aylesford sand or finely powdered limestone, 8 pounds; roughly pulped wood, or sawdust, or tan-yard waste, 8 pounds; with or without Taranaki sand, 8 ounces.

352,449—November 9, 1896. C. W. COLLINS. *Cement for pipe-joints.*

Composed of plaster of paris and limewater; the latter neutralizing any free acid.

352,852—November 16, 1886. D. BROOKS, JR. *Insulating material for electric wires.*

Resin and resin oil are combined in about equal proportions.

353,653—November 30, 1886. C. J. VAN DEPOELE. *Composition of matter for insulating electric conductors.*

A mixture of pulverized mica, silicate of soda, and a pulverulent earthy substance.

355,776—January 11, 1887. W. J. MICHELS. *Plastic composition for wall-hangings, etc.*

One hundred pounds of a vulcanized composition composed of a vegetable oil, as castor oil or castor oil and cottonseed oil, say 100 pounds; kauri gum, 25 pounds; resin, 6 pounds; camphor gum, 1½ pounds; and 25 pounds flowers of sulphur is mixed with 100 pounds of wood pulp and 1 pound of paraffin.

356,363—January 18, 1887. J. JAMETON. *Composition for blackboards.*

A mixture of coke-dust, 50 parts; soap-plaster, 39 parts; carbon-black, 10 parts; and graphite, 1 part.

356,411—January 18, 1887. T. McSWEENEY. *Composition for packing joints and other purposes.*

It consists of resin, 1 part, and mineral asphaltum, 4 parts, mixed together and melted, and 6 parts of the mixture combined with 6 parts of black wax-tailings, and 6 parts of thick yellow wax-tailings.

358,746—March 1, 1887. H. S. MEYERS. *Copying-pencil, etc.*

It consists of a soluble color (described), a soluble color with lime (described), mineral wool, soap, oxgall, and soap-paste. It gives copies in black.

361,347—April 19, 1887. C. T. CROWELL. *Dielectric composition.*

A mixture of sand or marble dust, 4 parts; pulverized glass, 1 part; lime, 2 parts; resin, 1 part; isinglass, 1 part; and coal tar or "unitite," 2 parts.

362,076—May 3, 1887. S. H. GILSON. *Composition for insulating and other purposes.*

A compound of gilsonite, 90 parts, and oil or fat, 10 parts; with or without india rubber.

366,263—July 12, 1887. R. F. SILLIMAN. *Underground cable for telegraph wires.*

Wires are coated with powdered mica mixed with caustic potash or soda, dried, and heated to a red heat.

366,336—July 12, 1887. H. W. MERRITT. *Compound for covering electric wires.*

A compound of quicklime, 1 pound, slaked in 1 quart of water; 1 pound of fir-balsam; 4 pounds of ground asbestos; 1 ounce of sugar, and a small quantity of oxalic acid, 3 grains, dissolved in hot water.

366,337—July 12, 1887. H. W. MERRITT. *Semielastic compound for covering electric wires, etc.*

Two pounds of fluid silicate of soda is substituted for the quicklime of No. 366,336.

366,898—July 19, 1887. J. TATHAM. *Insulating compound.*

A compound of 4 to 6 parts of resin to 1 part of cottonseed oil.

366,967—July 19, 1887. W. MATT. *Plastic compound for use in the decorative arts, etc.*

It consists of gelatine, 10 pounds; water; digested skins, cut into small pieces; Venetian turpentine, 2 pounds; linseed oil, 2 pounds; and resin, 6 pounds; thickened with the addition of 20 pounds of paper pulp, with or without marble dust.

369,099—August 30, 1887. N. J. CLAYTON. *Composition to be used as a nonconductor of heat and for other purposes.*

Cottonseed hulls, or waste or refuse of cottonseed oil mills are saturated with a solution of alum to render them incombustible, and then combined with sawdust treated with a hydrate of lime, and mixed with plaster of paris, in the proportion of 1 of plaster to 4 of hulls.

371,406—October 11, 1887. W. W. BARNES. *Plastic composition for insulating electric wires, etc.*

A mixture of mineral coal, 50 parts, and sulphur, 10 parts, each reduced to an impalpable powder and then mixed, and fused by heat. Also available for building and paving blocks, etc.

371,681—October 18, 1887. J. GRANT. *Conductor for electric wires.*

A compound of resin and petroleum residuum, forming a semiplastic mass.

372,552—November 1, 1887. T. McSWEENEY. *Composition for the manufacture of structural articles.*

A mixture of asphaltum, 60 pounds; resin, 20 pounds; and coal tar 20 pounds; the latter reduced to one-fourth of its bulk by boiling; 1 part of the aforesaid mixture being combined with 7 parts of paper pulp and 3 parts of pulverized glass or fine sand.

375,633—December 27, 1887. DE WITT C. JAMES. *Underground electric conductor.*

An inclosing and insulating compound of resin, pulverized glass, and sulphur.

376,456—January 17, 1888. C. WALPUSKI. *Copying pencil.*

Composed of nigrosine, tannate of iron, a suitable oleate, and a binding medium.

377,072—January 31, 1888. C. E. HAYNES. *Compound for making paper leather-board, etc.*

To a mixture in water of silicate of soda, 1.42 parts; rosin, 1.42 parts; alum, .76 parts; crude potassa, .4 parts; and fish glue, 2 parts; assisted by electro-chemical action, and heated, there is added 39 parts of pulp, and it is then manipulated in the ordinary way.

377,081—January 31, 1888. J. F. MARTIN. *Compound for coating iron, wood, canvas, etc.*

A base or body composed of glue, sulphureted water or sulphur in solution, paris-white and zinc white, with or without shellac and alcohol, and coloring matter.

377,343—January 31, 1888. I. P. WENDELL. *Compound for safe linings, etc.*

A mixture of fiber or powdered asbestos, fossil meal or infusorial earth, and silicate of soda; say in the proportions of 1 part each of asbestos and the earth, and 1 to 2 parts of the silicate.

382,832—May 15, 1888. J. A. KIESELE. *Composition of matter.*

Composition for castings, consisting of ozocerite and sugar; say 5 parts of the former and 5 to 7 parts of the latter.

383,096—May 22, 1888. D. BROOKS, JR. *Anti-induction composition for electric cables.*

A composition of low induction capacity, consisting of a powdered electrical conducting material, as plumbago, gum copal, linseed oil, and turpentine, in about equal parts.

383,698—May 29, 1888. C. F. BROADBENT. *Composition of matter to be used in the manufacture of medallions, etc.*

Sulphur and powdered pumice stone constitutes the base, with powdered antimony and boneblack.

386,064—July 10, 1888. H. F. FERRIS. *Material for railway-rails, building-blocks, paving-blocks, etc.*

A mixture of paper pulp 500 parts, silicate of soda 25 parts, and barytes 10 parts.

387,017—July 31, 1888. W. A. SNYDER. *Putty for making ornamental moldings.*

It consists of dissolved glue, resin, and whiting, combined with paraffine oil and spirits of turpentine.

387,041—July 31, 1888. W. S. BLAKE. *Tobacco-pipe bowl.*

A mixture of ground corncob and silicate of soda, with or without earthy material.

389,519—September 11, 1888. C. T. LEE. *Composition of matter.*

A laminated substance, such as mica, in a comminuted state, is mixed and incorporated with a resinous gum, such as shellac.

393,029—November 20, 1888. A. POITEVENT. *Insulating composition.*

A mixture of common lime, say 2 parts; crude turpentine, 1 part; and pine tar, 2 parts.

393,382—November 27, 1888. F. A. MEYER. *Plastic compound.*

A composition consisting of sulphur, fibrous material, finely divided mineral, and a waxy or similar substance, such as paraffine, whose fusion point is below that of the sulphur.

393,644—November 27, 1888. S. HEIMANN. *Non-conducting compound.*

A mixture of 60 pounds of dry, pulverized peat, 25 pounds of ground asphaltum, $2\frac{1}{2}$ pounds of pulverized plumbago, and a thin solution of 5 pounds of plaster of paris and of soluble glass; compacted by heat and pressure.

394,937—December 18, 1888. C. M. REQUA. *Composition of matter for marking pencils or crayons.*

A mixture of 7 pounds of paraffine, 1 pound of beeswax, and 1 pound of resin, with coloring matter.

395,241—December 25, 1888. E. LANGEN. *Substitute for cork.*

Powdered pith is mixed with an adhesive material—as starch, paste, and linseed oil or tar, to render the mass elastic—and dried; a fireproof material, such as water glass, may be added.

396,300—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound, for incandescent illumination: formed of magnesia oxide or carbonate, 37 per cent; caustic strontia, 37 per cent; calcium fluoride, 26 per cent; and feldspar (added after first heating), 3 grains to 100 grains of the prior mixture. The resulting powder is mixed in glycerine, molded or coated, and subjected to heat, it being white or opalescent, rough on the surface, and practically infusible.

396,301—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound for incandescent illumination: composed of magnesia oxide or carbonate, 50 grains; caustic strontia or carbonate, 55 grains; alumina oxide or carbonate, 10 grains; calcium-fluoride, 30 grains; and feldspar, five one-hundredths grain.

396,302—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound for incandescent illumination: composed of calcium oxide or carbonate, 210 grains; magnesia oxide or carbonate, 40 grains; caustic strontia or carbonate, 180 grains; alumina oxide or carbonate, 15 grains; calcium fluoride, 100 grains; and feldspar (added after first heating), 2 grains to 100 grains of the prior mixture.

396,303—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound for incandescent illumination: composed of calcium oxide or carbonate, 65 grains; magnesia oxide or carbonate, 50 grains; strontia oxide or carbonate, 30 grains; alumina oxide or carbonate, 15 grains; and cryolite, 20 grains.

396,304—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound for incandescent illumination: composed of calcium oxide or carbonate, 480 grains; magnesia oxide or carbonate, 96 grains; strontia oxide, 110 grains; strontia carbonate, 65 grains; feldspar, 100 grains; and aluminite or ammonia alum, 32 grains.

396,305—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound for incandescent illumination; composed of arragonite, or the caustic lime from arragonite, 80 grains; magnesia oxide, 160 grains: celestine or strontia sulphate, 350 grains; barium sulphate, 17 grains; and calcium fluoride, 142 grains.

396,306—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound for incandescent illumination: composed of celestine or strontia sulphate, 131 grains; magnesia carbonate, 96 grains; silica or silicic acid, 15 grains; carbonate of soda, 24 grains; and carbonate of potassa, 32 grains.

396,307—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

A refractory crystalline compound for incandescent illumination: composed of magnesia oxide or carbonate, 438 grains; strontia oxide (caustic), 342 grains; strontia carbonate, 90 grains; strontia sulphate, 90 grains; calcium oxide or carbonate, 208 grains; glucinium oxide or carbonate, 24 grains; with or without zirconium oxide, 20 grains; and fluor spar, as a flux, 230 grains.

397,612—Februrary 12, 1889. F. S. RANDALL. *Composition for making articles of commerce and art.*

A mixture of 2 parts of sawdust, 4 parts asbestos, 1 part alum, 2 parts dextrine, and 6 parts of glue mixed with 1 part of acetic acid.

400,335—March 26, 1889. J. L. HASTINGS. *Plastic mineral composition.*

A composition for forming a refractory compound for incandescent illumination, consisting of magnesium oxide, 250 grains; uranium oxide, $2\frac{1}{2}$ grains; calcium fluoride (for flux), 60 grains; starch, 50 grains; and gum-tragacanth, 100 grains; the gum being treated in a solution of one or more salts of acetate, chloride; or nitrate of magnesium, strontium, calcium, or aluminum.

400,336—March 26, 1889. J. L. HASTINGS. *Plastic mineral composition.*

A refractory compound for incandescent illumination, containing strontia oxide, strontia carbonate (native rock), strontia sulphate (native rock), calcium oxide, calcium carbonate, magnesium oxide, magnesium carbonate, calcium fluoride, magnesium chloride, magnesium sulphate, uranium oxide, and starch, in varying proportions.

401,014—April 9, 1889. A. DE FIGANIÈRE. *Insulating and coating compound.*

A hard fusible compound consisting of 6 parts of pulverized semibituminous coal, 2 parts of unslaked lime, and 7 parts of coal tar pitch.

403,548—May 21, 1889. B. E. OLSEN AND C. GABRIEL. *Compound for piping, bowls, etc.*

It consists of sand, 43 per cent; sulphur, 33 per cent; pitch, 1 per cent; and an earth, such as ground burnt clay, 23 per cent; mixed together under the action of superheated steam.

403,631—May 21, 1889. A. T. WOODWARD. *Plastic compound for use in various arts.*

It consists of 100 pounds of powdered silica or silicate—such as glass—50 pounds of mineral or vegetable resin or pitch, 150 ounces of oxide of lead or zinc, and the same of animal or vegetable wax, and 75 ounces of boiled linseed oil, with a slight admixture of drying oil.

406,427—July 9, 1889. J. R. CLUXTON. *Compound for the scrubbing surfaces of washboards.*

A mixture of 4 pounds of powdered fire clay, 1 pound of litharge, 1 pound of Spanish white, one-half pound finely granulated or powdered wood, one-fourth pound of pitch, and one-fourth pound of gum shellac, with a solvent oil, mixed with heat and molded.

407,271—July 16, 1889. A. T. WOODWARD. *Plastic compound.*

A compound of 50 pounds of silica, 10 pounds of sulphur, 2 pounds of arsenic, 5 pounds of manganese, and 25 pounds of resin, or gum, with or without 3 pounds of wax, and 5 pounds of oil.

407,896—July 30, 1889. F. MARQUARD. *Insulating composition.*

A compound of 20 pounds of wood pulp, 1 pound extract of logwood, one-eighth pound of bichromate of potash, one-eighth pound of sulphate of iron, 4 pounds of animal glue, 10 pounds of rosewood sawdust, and $2\frac{1}{2}$ pounds of an albuminous substance, as bullock's blood with or without vegetable fiber, such as flax, hemp, etc.; forming a dark, almost black material.

407,988—July 30, 1889. F. MARQUARD. *Insulating composition.*

A compound of 20 pounds of fine rosewood sawdust, 1 pound extract of logwood, one-eighth pound bichromate of potash, one-eighth pound sulphate of iron, and 5 pounds of an albuminous substance, such as bullock's blood, with or without vegetable fiber.

408,222—August 6, 1889. M. L. DEERING. *Composition of matter.*

It consists of fibrous material, blood, waterproof gum, and creosote, in the general proportions of 1 pound of fiber to 1 quart of blood.

408,951—August 13, 1889. C. S. BUSHNELL. *Process of packing roofing composition.*

The base material is placed in a shipping case and a tubular jacket introduced to form a chamber within said material. The ingredients with which the base is to be mixed are then melted and poured into said chamber, and the jacket removed, leaving the ingredients in the center surrounded by the base material.

409,584—August 20, 1889. J. L. HASTINGS. *Plastic mineral composition.*

A composition for forming a refractory compound for incandescent illumination, containing two or more metallic compound substances—such as oxides, carbonates, or sulphates of metals—a flux, a moistening fluid, and one of flame or light coloring substances, such as oxide of uranium, strontium, and lead chromate or chromium oxide, permanganic acid, cadmium sulphide, sodium salts, or indium oxide, and calcite.

409,985—August 27, 1889. C. T. LEE. *Composition of matter.*

A composition consisting solely of comminuted mica (in flakes or scales) and silicate of soda.

414,208—November 5, 1889. P. E. GONON. *Composition of matter for moldings.*

It consists, essentially, of a mixture of dry fibrous or cellulose material treated with coloring matter, with one-third pulverized soapstone, and an adhesive material composed of one-third glue and two-thirds starch; 20 to 30 grains of the binding material is used for 500 grains of the pulp and coloring matter.

414,209—November 5, 1889. P. E. GONON. *Composition of matter for moldings.*

It consists of fibrous or cellular material, soapstone, an adhesive material composed of glue and starch, and bronze powders.

415,648—November 26, 1889. S. H. GILSON. *Composition for overhead insulators.*

A compound of gilsonite, 20 parts; granulated material, as sand, 74 parts; and petroleum-still wax, 6 parts.

415,962—November 26, 1889. O. A. ENHOLM. *Composition for lining electric-battery jars.*

It consists of mineral wax, say, 50 per cent; sulphur, 25 per cent; ground glass, 15 per cent; and resin, 10 per cent.

418,947—January 7, 1890. A. HART. *Crayon.*

Composed of a pigment and carnauba wax, 1 pound; stearic acid, 1 pound; and paraffine wax, $1\frac{1}{4}$ pounds.

425,615—April 15, 1890. A. A. KNUDSON. *Insulating compound.*

A plastic compound of substantially equal proportions of carbolic acid and shellac, or like material, capable of being brought to a viscous condition.

426,202—April 22, 1890. J. F. MUNSIE.[1] *Insulating compound.*

A composition consisting of paper pulp treated so as to be noninflammable, fire clay, Portland cement, and a noninflammable agglutinating or binding agent, as white glue and silicate of soda. Molded articles after drying are immersed in a hot bath of india rubber or fireproof paint.

427,167—May 6, 1890. N. C. FOWLER. *Heat-insulating compound.*

The base consists of sifted or lixiviated ashes (or carbonate of magnesia, diatomaceous earth, or clay) and carbonate of calcium, with which may be incorporated finely fiberized fiber, lampblack, and pumice stone.

431,646—July 8, 1890. W. A. BURROWS. *Composition for the soles of boots and shoes.*

Leather waste reduced to flock is mixed with an aqueous solution of gelatine, to which not more than one-tenth per cent of chrome alum has been added to render the mixture nonabsorbent of water when dry.

431,743—July 8, 1890. C. R. GOODWIN. *Composition for porous carbon structures.*

A composition of finely divided gas or other hard carbon, with agglomerants forming moldable paste and with organic matter of cellular or fibrous structure that when baked will form a highly porous structure.

433,215—July 29, 1890. I. RABINOWICZ. *Insulating compound.*

A composition of 70 pounds of palm starine pitch, 40 pounds of gilsonite, 9 pounds of potassium bitartrate, and 2 pounds of tartaric acid.

436,733—September 16, 1890. J. W. EASTON. *Insulating material.*

Powdered soapstone, from 60 to 70 per cent, is mixed with fibrous material, as jute, and waterproofing material, as paraffine.

438,311—October 14, 1890. O. A. ENHOLM. *Composition of matter for making cells or retaining-vessels.*

A mixture of asbestus fibers, say, 40 parts; mineral wax, 30 parts; gutta-percha, 30 parts; and shellac, 10 parts.

438,698—October 28, 1890. A. E. MENUEZ. *Insulating compound.*

A composition of equal parts, by measure, of powdered mineral wool, powdered graphite or a hardening clay, and asbestus fiber, with liquid silicate of soda to form a thick paste. The graphite may be omitted.

439,526—October 21, 1890. O. KLETTE. *Composition for paper stucco.*

Vegetable pulp is impregnated with glue, plaster or whiting, siccative, sulphuric acid, and linseed oil. A finished stamped piece is covered with silk, by applying a coat of gelatine and affixing the silk, first steamed, by pressure under heat.

439,796—November 4, 1890. T. D. BOTTOME. *Insulating composition.*

Finely powdered silicon dioxide is mixed into a stiff paste with a solution of orthosilicic acid.

440,391—November 11, 1890. F. E. BLAISDELL. *Insulating composition.*

Seventy-two parts of asbestos and 18 parts of plastic clay, mixed dry, are mixed with a flux, as of feldspar and borax.

444,775—January 13, 1891. A. & S. DU PONT. *Process of manufacturing artificial ivory.*

Hydrate of lime is treated with an aqueous solution of phosphoric acid to form phosphate of lime; there is then mixed therewith carbonate of lime, magnesia, alumina precipitate, gelatine, and albumen. The mass is desiccated and subjected to great pressure until solidified.

445,111—January 20, 1891. J. GROTE. *Composition for treating articles made from paper.*

A composition comprising starch, water glass, and a fatty substance, such as beeswax.

446,502—February 17, 1891. E. G. WRIGHT. *Composition of matter for cable-filling.*

A mixture of crude petroleum, 1 pound 7¾ ounces; tallow, 1 pound 10 ounces; gypsum, 8 ounces; whiting, 3 ounces; pine tar, 2 pounds; and paraffin wax, 1 pound.

447,412—March 3, 1891. J. S. PALMER. *Composition of plastic material.*

A mixture of stearine, bitumin, wood-flour, and ground fiber, with or without whiting, or pigment, or coloring substance.

452,182—May 12, 1891. F. C. GOODALL. *Marine cement.*

A mixture of 40 parts by weight of hard asphaltum, 40 parts of liquid asphaltum, 8 parts of boiled or other siccative oil, and 12 parts of finely ground cork.

452,763—May 19, 1891. F. SALATHÈ. *Composition of matter.*

It consists essentially of pulp or fibrous material and a certain resinoid hydrocarbon of the $C_{10}H_{16}$ series.

452,869—May 26, 1891. G. W. TOOKER. *Artificial ivory.*

A compound of albumen, bone-ash powder, and talc, with fibrous material when it is desired to show a grain.

454,547—June 23, 1891. A. W. SPERRY. *Insulating material.*

A compound of, say, 3 parts of mineral wool, 6 parts of liquid silicate of soda, and 1 part of zinc white.

460,249—September 29, 1891. R. F. FLYNN. *Floor covering.*

A base of palm-oil pitch with the addition of coarse granules of cork is applied to a textile backing.

461,467—October 20, 1891. M. O. FARRAR AND C. C. HOWE. *Composition of matter for insulating purposes.*

It consists of silica, 434.7 to 478.4 parts; alumina, 297.6 to 362.3 parts; peroxide of iron, 13.4 to 88 parts; magnesia, 3.7 to 21 parts; lime, 2.9 to 13.8 parts; soda, 3.2 to 41 parts; potash, 55.1 to 124.4 parts; water, 14.5 to 62.2 parts; asphaltum, 50 to 75 per cent; mixed with the aid of heat and molded under pressure.

464,367—December 1, 1891. S. W. KIMBLE. *Insulating composition.*

It consists of pulverized mica, say, 40 parts; a mineral substance, such as talc free from lime, 40 parts; and silicate of soda, 3 parts; combined and molded under pressure.

464,369—December 1, 1891. S. W. KIMBLE. *Composition of matter for insulating purposes, etc.*

A mixture of pulverized mica, say, 50 parts; a mineral substance, such as asbestos or feldspar, 50 parts; soluble glass, from 3 to 10 parts; and sulphur or sulphur compound, as iron or copper pyrites, 2 parts; molded under high pressure without heat.

471,433—March 22, 1892. G. SCHWARZWALD. *Composition of matter for pencils or crayons.*

It consists of 100 ounces of paraffin wax, 2 to 10 ounces of dammar gum, 2 ounces of bichromate of potassium, 100 ounces of bronze powder, and 25 ounces of naphthol.

472,352—April 5, 1892. I. HILL. *Compound for insulating electric wires.*

A mixture of 1 pound each of pittizite pitch, candle tar, and coal tar, and one-half pound each of asphalt pitch and resin.

474,865—May 17, 1892. P. VON SLAMA. *Composition for use as ornamental moldings, etc.*

It is composed of dextrine, sulphate of lime, silicate of soda, and vegetable fibers; 10 parts of soluble glass is mixed with a 40 per cent solution of dextrine in water, 40 to 60 parts of sulphate of lime added, and vegetable fibers worked in.

479,967—August 2, 1892. R. G. DE VASSON. *Plastic composition.*

It consists of 1 to 2 volumes of fragments or powder of cork, and 2 to 1 volumes of an agglutinant composed of plaster of paris, dextrine, and sesquioxide of iron, with an oxychloride, such as the oxychloride of zinc, when it is to be used in damp places.

480,094—August 2, 1892. S. D. HOFFMANN. *Composition for and method of making heads and limbs of dolls.*

A compound of 100 parts of glue and 25 parts each of glycerine, zinc oxide, and Japanese wax.

484,345—October 11, 1892. J. T. SMITH. *Process of treating cork.*

It is confined in a mold and subjected to heat under pressure, whereby the resinous matter is vaporized and the pieces are cemented and solidified.

490,641—January 31, 1893. M. H. DEVEY. *Insulating compound.*

A mixture of slag, 8 parts, and glass, 2 parts; ground fine, with a binding medium, as boiled linseed oil, driers, shellac, and paraffin, to form a paste.

495,581—April 18, 1893. W. P. EMERY. *Composition of matter for railroad ties, etc.*

A mixture of 479 parts of paper pulp, 10 parts of albumen, 5 parts of sour milk, 1 part of lime, and 5 parts of chloride of zinc.

503,425—August 15, 1893. J. W. KIDWELL. *Non-corrodible plastic composition.*

A mixture of titanic minerals or natural oxide of titanium (as from the phosphate ores of Nelson county, Va.), 8 parts; and asphaltum or like hydrocarbon, 2 parts. To render it extremely refractory it may be heated to about 1,400° C.

504,988—September 12, 1893. J. MELLINGER. *Method of manufacturing artificial wood.*

To a mixture of 150 pounds of fibrous material—as tan bark—and 15 pounds of slaked lime, there is added a solution formed of 1 pound of borax, 2 pounds of alum, one-half pound carbonate of potassium, one-half pound zinc sulphate, 3 pounds sodium chloride, and 1 pound of sodium bicarbonate, in water, with 30 pounds of liquid silicate of sodium and 25 pounds of lye of 35 per cent; the pulp is molded and subjected to pressure.

505,916—October 3, 1893. J. HOFFMAN. *Insulating compound and method of manufacturing the same.*

A compound of asbestos fiber with a binding material composed of asphaltum, beeswax, and shellac; produced by spraying the asbestos with a mixture of beeswax and asphaltum with a suitable solvent, as benzine; drying; then mixing powdered shellac, with or without albumen, with the mealy substance thus formed; and molding under heat and pressure.

507,678—October 31, 1893. J. J. FANNING. *Insulating compound.*

A mixture of 6 ounces plaster of paris, 5 ounces pulverized asbestos, 4 ounces dextrine, and 1 ounce of linseed or other oil.

508,107—November 7, 1893. H. HAYNES. *Insulating compound for printing-presses.*

A mixture of 1 gallon of machine oil, 1 quart of glycerine, three-quarters of an ounce of paraffine wax, and 2 ounces of castor oil; to be applied to the tympan sheet of the press.

514,015—February 6, 1894. J. L. MILLER AND W. T. CROSSE. *Composition of matter for making chalk engraving-plates.*

It consists of 2½ drams of silicate of soda, 4 drams of silicate of magnesia, one-half pound of French chalk, and 1 pound of barytes.

515,192—February 20, 1894. G. A. CANNOT. *Material for insulating electric wires.*

An insulating coating for electric wires consists of, first, a coating of bitumen; second, of peat fiber; third, of spermaceti; fourth, of tar; and, fifth, of peat fiber. The wire is passed through a guide, by which its surface is leveled and made uniform.

517,452—April 3, 1894. A. GENTZSCH. *Insulating compound.*

The volatile elements of the fossil resins ozokerite, asphalt, and amber are driven off by distillation, and the residuums are mixed in the proportion, say, of ozokerite, 50 parts; amber, 45 parts; and asphalt, 5 parts.

522,745—July 10, 1894. J. L. TRUSLOW, JR. *Insulating composition.*

It is composed of ground cork, 90 parts, infusorial earth, 5 parts, and a binder, binder, as resin, 5 parts.

523,582—July 24, 1894. C. KÖSTER. *Process of manufacturing veneers.*

Concentric layers of a plastic mass in contrasting colors are formed on a core, and then veneers are cut therefrom in a direction transverse to the length of the core. The composition consists of glue, glycerine, and fossil meal.

524,021—August 7, 1894. A. HAGELE. *Floor-cloth.*

A composition consisting of dried and ground leaves, and a binder, such as an oil, resin, and gum, applied to a textile backing.

528,744—November 6, 1894. O. STILES. *Insulating compound.*

A mixture of 6 parts of alcohol, 3 parts of shellac, 3 parts of asbestos, and 1 part each of mica and alum.

529,728—November 27, 1894. W. GRISCOM, JR. *Vulcanizable compound.*

It is composed of substantially equal parts of animal fat candle tar (a residual product from the distillation of animal fats, oils, etc.), and a hard or nearly hard residual product from petroleum distillation, and sulphur in proportions of from 2 to 8 per cent of the mass.

537,321—April 9, 1895. A. C. THOMPSON. *Insulating compound.*

A mixture of 1 gallon alcohol, 5 pounds of gum shellac, 6 pounds pulverized asbestos, 4 pounds pulverized French chalk, 1 pound balsam tolu gum, and 4 pounds ground mica.

538,614—April 30, 1895. J. W. KIDWELL. *Insulating material.*

A mixture of titanic mineral (see No. 503,425), asphaltum, and silicious material, say 5 per cent, such as rice hulls or other organic material rich in silicic acid.

551,588—December 17, 1895. H. R. KNOCH. *Artificial building-block.*

A mixture of 50 parts of paper pulp with 12 parts of peanut shells, 2 to 3 parts of gum-tragacanth, and 2 to 5 parts of dissolved caustic soda.

551,530—December 17, 1895. G. DOEBRICH. *Composition for hands and feet of dolls, etc.*

A mixture of glue, 1 pound; glycerine, one-fourth pound; saccharine material, one-half pound; flour, 1 tablespoonful; albumen and coloring matter.

552,269—December 31, 1895. W. L. WOODS. *Plastic composition and process of combining same.*

A composition consisting of silica, 60 parts; magnesia, 30 parts; sulphur, 60 parts; and mineral wax, 3 to 10 parts; produced by grinding the silica and magnesia to a powder and expelling the moisture therefrom, repeatedly melting the sulphur and the mineral wax and pouring them into cold water, remelting the sulphur and mineral wax at about 150° C., adding the silica and magnesia, and then gradually increasing the temperature to 260° C., and cooking until the sulphurous fumes are expelled.

559,376—May 5, 1896. A. GENTZSCH. *Composition for electric insulation and process of making same.*

A composition of shellac, 50 parts; resin, 50 parts; birch-tar oil, 5 parts; aniline oil, 5 parts; and anthracene, 20 parts; produced by treating the shellac and resin with repeated washings to dissolve out all soluble matter, then melting and boiling together, melting the anthracene, mixing in a molten state, and adding the aniline oil and birch-tar oil, which have been previously freed of water and matter soluble in water.

560,321—May 19, 1896. J. J. MURPHY. *Composition of matter for making and sealing joints between pipes, etc.*

A compound of flower of sulphur, 100 pounds; fine flint sand, 100 pounds; antimony, 2 pounds; lead, 9 pounds; bismuth, 1 pound; powdered glass, 10 pounds; and borax, 2 pounds.

586,683—September 29, 1896. L. HONIG. *Insulating compound.*

It consists of alcohol, 30 parts; gum shellac, 25 parts; wheat flour, 20 parts; powdered asbestos, 20 parts; glue, 2 parts; varnish, 2 parts; and glycerine, 1 part.

571,117—November 10, 1896. F. R. HALL. *Composition of matter.*

A mixture of 9 parts by weight of prepared pitch—roofing pitch which has been distilled until a portion of its oil has been driven off and the melting point raised to about 170° F.—5 parts of asbestos fiber, and 4 parts of gum kauri.

572,016—November 24, 1896. C. KÖSTER. *Composition of matter for manufacturing artificial veneers.*

It consists of 11 grams of sawdust, 14 grams zinc-white, 40 grams flour paste (from 4 grams of flour), 1 gram resin glue, 20 grams boiled linseed oil, and 10 grams grape sugar or like saccharine matter. (See No. 523,582.)

578,514—March 9, 1897. W. HOSKINS AND W. A. SPINKS. *Substitute for billiard chalk.*

A compound of normally white pulverized silica, with or without corundum, a binding agent, as glue, and a coloring agent.

594,888—December 7, 1897. A. MILLAR. *Process of obtaining useful products from silkworms.*

The large intestines of silkworms, when they have attained the maximum size and are about to begin spinning, are subjected to pressure, without preliminary treatment, and the gelatin product drawn into threads and dried.

595,776—December 21, 1897. H. D. HOLBROOK. *Sheet material of cork and mechanism for producing same.*

A flexible, elastic sheet consisting of a homogeneous body of granulated cork and elastic cement molded under pressure, with threads running through the body of the material, and with the cork protuberances removed by sandpapering or otherwise.

597,283—January 11, 1898. M. HOCQUET. *Method of producing plastic composition from cork, etc.*

A plastic composition consisting of cork impregnated with borax, a gelatinous substance, tannin, and bichromate of potash; produced by treating comminuted cork with a solution of borax, drying and then mixing with a solution consisting of gelatin, 40 parts; Dutch glue, 25 parts; glycerin, 15 parts; crystallized sugar, 16 parts; ammonia, 2 parts; and sulphur, 2 parts; with a tannin solution and potassium bichromate solution added.

597,806—January 25, 1898. H. MARANGOLO. *Compound for treating glass.*

A fluid compound composed of 40 per cent of alcohol, 40 per cent of glycerine, and 20 per cent of water. To impart luster and prevent formation of frost.

606,921—July, 5, 1898. G. B. FRALEY. *Composition of matter for electric heaters.*

A mixture of talc, say, 60 parts; silicate of soda, 20 parts; carbonate of soda, 10 parts; and water, 10 parts.

611,814—October 4, 1898. A. MILLAR. *Insoluble gelatine thread or filament.*

An insoluble thread or filament composed of gelatine: produced by dissolving the gelatine in hot water and adding the proper chemical substances, such as bicromate of potash, either directly or in the form of a solution. The mixed solution is then concentrated to a suitable degree of thickness and forced through nipples in the form of threads. The threads may be formed of simple gelatine and then hardened.

613,763—November 8, 1898. J. C. GRAFT. *Plastic compound.*

It is composed of 2 parts of shellac, 1 part of French chalk, 1 part rice flour, and a small part of beeswax.

615,000—November 29, 1898. S. R. THOMPSON. *Composition for pipe-joints or the like.*

A mixture of 12 parts of paris white (calcium carbonate), 5 parts of oxide of iron, 2½ parts of brick dust, and one-half part of plumbago, with boiled linseed-oil to form a stiff putty.

616,560—December 27, 1898. H. REDHEAD AND G. W. EMMERSON. *Composition for making tight joints.*

A mixture of cement, 50 parts; boiled oil, 20 parts; venetian red, 10 parts; litharge, 5 parts; and chalk 15 parts.

619,019—February 7, 1899. J. HAVERSTICK. *Composition for floor-coverings, etc.*

It consists of a base or filling of ground corn-cob with a binding material.

619,337—February 14, 1899. W. PAINTER. *Gluten compound.*

A compound of gluten and a ground or pulverized body material, produced by mixing gluten in the plastic state with pulverized cork, wood pulp, or other material—say in the proportions of 2 parts of gluten to 1 of cork—rolling or molding into form, and subjecting to heat, as a temperature of 120° C., for about ten hours.

619,338—February 14, 1899. W. PAINTER. *Gluten compound.*

Gluten in its plastic state is mixed with glycerine, and then with a body material—as gluten 65 per cent, glycerine 5 per cent, and ground cork 30 per cent—and the product subjected to heat—about 100° C. for seven hours.

621,807—March 28, 1899. B. FORD. *Insulating compound.*

A liquid insulating compound heavier than water, composed of a mixture of 2 parts by weight of asphalt and 1 part of paraffin oil.

625,345—May 23, 1899. A. MILLAR. *Insoluble thread or filament.*

A thread or filament composed of a proteid strand insoluble in water; produced by treating threads of albumen or casein or the material before it is formed into threads, with chromic acid, tannic acid, picric acid, etc.

625,894—May 30, 1899. J. J. NUGENT. *Composition for blackboards.*

It consists of slacked lime, 100 pounds; black stain, 25 pounds; ground quartz, of a plurality of grades, 39 pounds; plaster of paris, 40 pounds; cement, 18 pounds; and glue, 6 ounces.

626,479—June 6, 1899. P. C. BELL. *Elastic compound.*

A compound consisting of vegetable oil, 59 parts; flour of sulphur, 15 parts; liquid tar, 1 part; petroleum residue, 20 parts; and powdered talc, 5 parts; produced by heating the petroleum to 112° F., adding the talc and liquid tar, then gradually adding the vegetable oil while maintaining the same temperature, raising the temperature to 200° F., adding the sulphur, and finally raising the temperature to 340° F., and stirring the mass until viscid.

627,008—June 13, 1899. G. OLNEY. *Composition of matter.*

A mixture of sodium silicate, in a plastic or liquid state, say, 2 pounds; dry paper pulp, 4 ounces; and powdered glass, 8 ounces.

627,207—June 20, 1899. D. ROGERS. *Plastic material for manufacturing shuttles, bobbins, etc.*

A mixture of wool flock, resin, terra alba, china clay, Brits white, grated potatoes, aluminum, shellac, alcohol, and coloring matter in equal or varying proportions according to the hardness required.

627,367—June 20, 1899. H. TZSCHUCKE. *Translucent plastic compound.*

A composition prepared by forming a milk of chalk or gypsum and separate solutions of glue, alum, magnesium sulphate and coloring matter, mixing and stirring the same, then adding glycerine, oil, and alcohol, stirring, straining, or filtering, heating to near the boiling point, and cooling slowly.

629,600—July 25, 1899. R. PLATZ. *Composition of matter for molding purposes.*

A mixture of saw dust, 17 parts; pulverized chalk, 27 parts; and water-glass, 56 parts.

632,014—August 29, 1899. S. HACKELBERG. *Composition for protecting panes of glass.*

A mixture of water, 30 parts; glycerine, 60 parts; sugar, 9 parts; and cumarin, 1 part; to prevent the deposit of vapor and hoar frost.

636,367—November 7, 1899. A. P. TSCHIRNER. *Dental cement.*

A cement free from substances soluble in water, formed of phosphoric acid, ammonia, and metallic oxides, such as zinc, tin, and aluminum.

636,657—November 7, 1899. F. GATZSCHE. *Composition of matter for soles and heels of boots or shoes.*

A mixture of waste of paper manufactories, 4 to 5 pounds; asphaltum, 1 pound; resin, one-half pound; turpentine oil, one-fourth pound; peroxide of iron, 2 ounces; and tallow, one-fourth pound.

636,818—November 14, 1899. P. H. A. LEDER. *Packing.*

An elastic and compressible packing, consisting essentially of asbestos fibers, cellulose, and paraffine.

637,106—November 14, 1899. F. GATZSCHE. *Composition for making floor-cloth.*

A mixture of water, 7 gallons; glue, 1 pound; wax, one-fourth pound; plumbic ocher, one-fourth pound; linseed oil, one-half pound; and tungstic acid, 1 ounce; made at a temperature of 80° C.

638,003—November 28, 1899. T. H. BLACKNALL AND W. T. JORDAN. *Composition for blackboards.*

It consists of emery flour, about 3 per cent; pumice stone, 2 per cent; lampblack, 3 per cent; and chrome green, 1 per cent; mixed with an adhesive liquid, and incorporated with 91 per cent of paper stock.

642,319—January 30, 1900. F. GATZSCHE. *Composition for making artificial leather fabric.*

A mixture of glue, 1 part; wax, 1 part; oil, one-half part; turpentine, one-fourth part; and alcohol, one-half part.

643,251—February 13, 1900. G. McKAY. *Composition of matter for sealing purposes.*

It consists of 45 per cent of sulphur, 25 per cent of brick dust, 10 per cent of foundry sand, 2 per cent of tin, 2 per cent of lead, 2 per cent of bismuth, 4 per cent of plaster of paris, 5 per cent of iron filings, and 5 per cent of borax.

643,989—February 20, 1900. F. SEHR. *Manufacture of cement.*

It consists of 50 per cent of powdered hard porcelain, 35 per cent half-burnt porcelain, 15 per cent of raw feldspar, and water glass to form a paste.

647,764—April 17, 1900. O. H. SCHNEPPER. *Plastic compound.*

A composition consisting of a gelatin solution, calcium chloride, coloring matter, and ether. Adapted to be applied to glass and give the effect of stained glass, or as a backing for mirrors.

654,688—July 31, 1900. J. E. THORNTON AND C. F. S. ROTHWELL. *Substitute for celluloid, etc., and process of manufacturing same.*

A transparent substance consisting of a dissolved and hardened salt of aluminum and a fatty acid, as aluminum oleate treated with benzole.

645,689—July 31, 1900. J. E. THORNTON AND C. F. S. ROTHWELL. *Article applicable for various purposes, together with process of manufacturing same.*

A transparent substance consisting of a dissolved and hardened salt of zinc and a fatty acid, as zinc oleate treated with benzole.

656,252—August 21, 1900. F. G. KLEINSTEUBER. *Compound for dissolving resins.*

A compound to be used with solvents of resin, consisting of 3 parts of dammar dissolved in 5 parts of oil of turpentine, with a mixture of 50 parts of tung or wood oil, 23 parts of benzole, and 5 parts of oil of turpentine added thereto; a suitable proportion is added to the resin solvent, of benzole, alcohol, oil of turpentine, or the like.

663,572—December 11, 1900. S. HEIMANN. *Substitute for gutta-percha.*

A compound of finely-pulverized peat, resin-oil, say, equal parts, and about 2 per cent of amyl acetate.

PROCESSES.

2,048—April 16, 1841. S. GOODWIN. *Improvement in the mode of hardening manufactures of cement and rendering them impervious to moisture.*

Cement casts are rendered impervious to air, moisture, or decay by boiling in a mixture of oil and resin.

47,068 March 28, 1865. A. MEUCCI. *Improved process for removing mineral, gummy, and resinous substances from vegetable fibre.*

The material is treated, first, in a dry state with the gases produced by the action of nitromuriatic acid upon carbonate of lime and iron; second, in a wet state with the same substances; and third, with a caustic alkali, with or without oil.

61,267—January 15, 1867. A. T. SCHMIDT. *Improvement in the manufacture of paper and treatment of paper pulp.*

Paper, paper pulp, and textile fabrics of vegetable fiber are treated with a mixture of glycerine, oil of vitriol, and water, and subsequently with an alkaline bath, rendering them water proof and like parchment.

102,484—May 3, 1900. W. M. BRYANT. *Improvement in preparing the pith of corn stalks for use in the arts.*

Vegetable pith is compressed and then coated with tenacious material, such as cloth, paper, varnish, paint, etc.

103,199—May 17, 1870. S. KINGAN, administrator of J. Anderson, deceased. *Improvement in the manufacture of roofing-felt.*

Roofing sheets formed by saturating fibrous material with a mixture of purified asphaltum and oil, or tar, at or immediately before the felting operation.

113,454—April 4, 1871. A. T. SCHMIDT. *Improvement in treating paper and vegetable fibrous substances.*

Paper (sized or unsized), paper pulp, and other vegetable fabrics and substances are treated with a bath of the mother water of the chlorides of zinc, tin, calcium, magnesium, or aluminium, or either of them, with or without the admixture of carbonates and oxides or other substances, and washed with water or alkaline solution, to render them tough, impervious to water, and resistant to the action of acids and alkalis. To impart flexibility and softness the material is then treated with a solution of glycerine and water, or sugar and water. Layers of treated paper are combined with layers of vegetable cloth similarly treated for the manufacture of belting, packing, etc.; also with emery, powdered glass, sand, or other pulverized or granular metal or mineral for use in the arts.

114,880—May 16, 1871. T. TAYLOR. *Improvement in the treatment of paper and paper pulp.*

Paper is treated in a concentrated solution of chloride of zinc, followed by thorough washing.

120,380—October 31, 1871. D. W. HANNA. *Improvement in methods of utilizing the waste chloride of zinc in treating paper.*

After paper has been treated in a bath of the solution as per No. 113,454, it is washed in water until the amount of the liquor washed from the paper raises it to from 30° to 40° Baumé. The waste or surplus mother-water is then concentrated by boiling to from 65° to 75° Baumé, at which gravity it is used for treating paper.

166,475—August 10, 1875. W. F. NILES. *Improvement in processes of manufacturing articles from horn and hoof.*

Horn or hoof is powdered, mixed with boneblack, bolted or sifted, then slightly moistened and subjected to pressure in heated molds.

186,924—February 6, 1877. B. CARPLES AND J. M. KOEHLER. *Improvement in processes of treating animal bones and making artificial whalebones therefrom.*

Bones are boiled in an acid bath, to remove the earthy salts, then repeatedly washed in cold water, cut into shapes and sizes, and pressed until dry.

192,863—July 10, 1877. W. H. DIBBLE. *Improvement in processes of making composition articles.*

Either organic or inorganic, pulverized or granulated substances, as sawdust or clay or slate, are mixed with blood, as in equal quantities by weight, the mass heated, and then subjected to great pressure in heated molds, forming articles of great hardness.

193,322—July 24, 1877. W. COURTENAY. *Improvement in making hollow articles of vulcanized fiber.*

Tubular articles are formed from vulcanized fiber by partially dissolving the edges in chloride of zinc, forming the tube upon a mandrel, cementing the edges under heat and pressure, and wetting and shrinking upon a mold, or mandrel, to impart the desired contour while drying.

193,846—August 7, 1877. J. BLISS AND F. O. BADGER. *Improvement in processes of treating blood for forming ornamental articles.*

Blood alone is reduced to a dry and powdered condition and subjected to heat and pressure in molds or dies.

196,894—November 6, 1877. T. HANNA. *Improvement in the manufacture of water-proof vulcanized fiber.*

Vulcanized fiber having its substance rendered moisture proof is formed by submitting the article or the material to a bath of nitric acid or a mixture of nitric and sulphuric acids, or sulphuric acid and nitrate of potash, or the fumes arising in the manufacture of bisulphate of potash.

196,895—November 6, 1877. T. HANNA. *Improvement in the manufacture of vulcanized fiber.*

The waste or cleansing bath holding chloride of zinc in solution is utilized by submitting it to the action of chemical reagents, as by adding to it a solution of carbonate of soda, or any of the alkaline carbonates, carbonate of zinc being precipitated and sodium chloride remaining in solution.

197,088—November 13, 1877. J. F. BOYNTON. *Improvement in ornamentation of the surfaces of hard material.*

The surface of shell, bone, marble, or other hard substance is dried and then impregnated, to a greater or less depth, with one or more halogens, such as iodine or bromine.

210,617—December 10, 1878. W. J. LEWIS. *Improvement in the manufacture of buttons and other articles from vegetable ivory, etc.*

Vegetable ivory is pulverized and subjected to pressure in heated molds, with or without agglutinizing matter.

213,733—April 1, 1879. J. BLISS. *Improvement in the treatment of albumen for the production of molded articles.*

Vegetable or animal albumen is dried, pulverized, and sifted, and compressed in heated molds or dies.

217,418—July 8, 1879. G. H. SMITH. *Improvement in treatment of bone, vegetable ivory, etc.*

Bone, vegetable ivory, and other porous hard material is treated with a solution of gum or other converting agent—as a solution of gum in bisulphide of carbon or like volatile solvent—and the material then drained and the superfluous converting agents removed by volatile solvents, whereby the pores are filled with transparent or translucent material.

221,852—November 18, 1879. W. F. NILES. *Improvement in manufacturing buttons, etc.*

Paper pulp is dried; separated into a linty mass; saturated with albumen or gelatin; dried; broken up into small pieces or bunches, and subjected to great pressure in molds at a heat of 100° C. or upward.

224,036—February 3, 1880. W. F. NILES. *Process of manufacturing buttons and other articles from fibrous material and powdered hoof.*

Paper pulp is dried; separated into a linty mass; saturated with albumen or gelatin; broken into small pieces or bunches; mixed with dried powdered hoof, one-fourth part by weight, and molded with great pressure at a heat of 100° C. or upward.

225,556—March 16, 1880. J. BLISS AND F. O. BADGER. *Manufacture of buttons and other articles.*

Coarsely powdered hoof is moistened with a pigment, dried, mixed with dried blood, and finely ground, and subjected to high pressure in heated dies.

233,322—October 19, 1880. L. A. BRODE. *Manufacture of slabs or blocks from wood or paper pulp, or from sheets made from such pulp.*

Slabs or blocks are formed of pulp, treated with a solution of gum tragacanth or tragacanthin, and a paste formed of rye or wheaten flour, pitch powder litharge, alum, and gelatine, and submitted to heat and pressure.

233,885—November 2, 1880. W. H. SMITH. *Art of preparing waste vegetable products for use and transportation.*

Loose fibrous or granulated vegetable material, as sawdust, bran, etc., is heated to 65° to 150° C., to dry and soften the natural gums or resins, and then subjected to impact in molds.

237,497—February 8, 1881. A. R. DAVIS. *Method of making articles from waste amber.*

Amber is reduced to a plastic condition by the agency of solvents—as bisulphide of carbon—and then subjected to pressure under heat. Mottled or blotched amber is produced by molding together ground amber with large fragments.

239,776—April 5, 1881. W. T. HENLEY. *Mode of insulating electrical conductors.*

Submarine telegraph cables are insulated by first covering the wires with india rubber and then vulcanizing the same in ozocerite, paraffine, or similar hydrocarbon.

239,794, April 5, 1881. J. W. HYATT. *Manufacture of factitious material to imitate ivory.*

Articles are formed from an inert material, as zinc oxide, and an adhesive agent, as shellac, by mixing, say, 8 parts of powdered shellac with 32 parts of a solvent, as aqua ammonia, and 40 parts of zinc oxide, subjecting the mixture to the action of a mill, then desiccating the solid elements of the mixture with, in some cases, a second grinding in a dry state, and finally compressing and solidifying the powder in heated molds.

243,963—July 5, 1881. J. PATHE. *Method of treating horn shavings.*

Horn shavings are soaked in a solution of boracic acid and arsenious acid, first cold and then warm, and the swelled horn shavings are then heated up to 120° C., under pressure, and united into a solid mass.

244,170—July 12, 1881. S. BARR. *Manufacture of gas tubing.*

Bichromated oil varnish is applied to the surface of a glue and glycerine compound to render the same indestructible by heat and insoluble in water.

247,477—September 27, 1881. W. V. BRIGHAM. *Art or method of making ornamented or variegated gelatinous sheets to imitate tortoise shell, etc.*

A solution of gelatine, suitably colored, is flowed upon glass, and sprinkled with a second solution of gelatine or analagous substance, suitably colored or prepared, while liquid or semiliquid, which solutions are then mingled or blended. The film is backed by covering it with paper or cloth, which is permitted to dry thereon, the film being detached from the glass after drying.

256,043—April 4, 1882. C. POPPENHUSEN. *Molding articles of india-rubber and other vulcanizable gums.*

The mold is filled with a liquid, as linseed oil, to exclude all air therefrom, and the liquid is then displaced by pressing the compound into the mold so filled.

256,872—April 25, 1882. F. BODINE. *Method of treating pulp and the resultant material.*

Vegetable pulp is saturated with linseed or other vegetable or drying oil, and rolled, pressed, or molded, with or without coloring material.

257,607—May 9, 1882. A. PARKES. *Treatment of cellulose and the manufacture of articles therefrom.*

In the manufacture of articles of cellulose, or coating therewith, the cellulose is dissolved in a solution of iodide or nitrate of zinc or nitrate of lime, molded to the form required; the solvent then removed by washing and treating with an alcoholic or vegetable naphtha solution, and the article rolled, pressed, or calendered.

259,271—June 6, 1882. J. A. FLEMING. *Preparation of materials for use in electric insulation.*

Finely pulverized wood, desiccated, is saturated or impregnated with paraffine wax or with a mixture of wax and resin, and molded under pressure.

268,034—November 28, 1882. M. MACKAY. *Manufacture of insulating compounds.*

A mixture of mineral wax, such as paraffine wax or ozocerite-wax, 1 part; vegetable tar, 24 parts; and shellac and asbestos or other dry fibrous substance, 32 parts of each. Ground slate or silica or clay free from iron is sometimes employed in place of wax.

279,384—June 12, 1883. C. HEMJE AND T. C. BRECHT. *Machine for compressing plastic and other material.*

The materials are subjected to a bath of a sprayed fluid and then to compression.

284,289—September 4, 1883. J. A. FLEMING. *Preparation or production of insulating materials or articles.*

Finely pulverized wood, desiccated, is impregnated, under pressure, with a mixture of melted bitumen or asphalt incorporated with a substance of the resin type, and with or without a substance of the paraffin type or of the anthracene type, or of both paraffin and anthracene types.

288,300—November 13, 1883. B. BOROWSKY. *Method of uniting small pieces of amber into a large block.*

The pieces of amber are hermetically closed in a receptacle, subjected to a light pressure, heated to a high degree of heat, about 500° C., a strong pressure then applied, and finally it is slowly cooled.

297,639—April 29, 1884. R. SCHIMMEL. *Process of manufacturing chair-seats of vegetable fiber and chromic acid.*

Ground rags and vegetable fiber, in equal parts, are mixed and formed into a paste with the addition of chromic acid, 3 parts to 100 parts of water; formed into sheets; backed with textile fabric; molded and pressed; varnished and dried.

301,405—July 1, 1884. F. THIEMER. *Method of producing molded articles from substances containing ligneous fibers.*

Molded articles are produced from sawdust, wood shavings, wood pulp, straw, etc., by treatment with chloride of zinc and basic chloride of magnesium, compression into molds, and drying.

302,795—July 29, 1884. F. TAYLOR. *Method of treating vulcanized fiber and like material.*

To impart softness and flexibility to vulcanized fiber, the fiber, after the organic change has been produced, is subjected to the action of a solution of deliquescent salt, as chloride of zinc, with or without glycerine or sugar water combined therewith.

317,387—May 5, 1885. C. S. LOCKWOOD AND J. W. HYATT. *Process of treating alkaline silicates, etc.*

Articles are formed of an alkaline silicate with or without an inert material, by forming a solution of the silicate, and introducing, if preferred, the inert material, desiccating the solution, comminuting the compound, and subjecting the powder to pressure in heated molds, with or without subsequent treatment in a bath.

317,390—May 5, 1885. C. S. LOCKWOOD, J. W. HYATT, AND J. H. STEVENS. *Process of treating gelatine when combined with tannic acid, etc.*

One hundred parts of gelatine, say, are combined with 5 to 10 parts of tannic acid, the compound dried and comminuted, and the desiccated powder subjected to pressure in heated molds.

326,220—September 15, 1885. A. H. HUTH. *Manufacture of compounds of india-rubber, gutta-percha, and like materials.*

Earth wax and gums and resins are fused and maintained in a state of fusion until all matters volatile at the fusing temperature are expelled, then cooled, powdered and mixed with india rubber, gutta-percha, or analogous substances.

330,019—November 10, 1885. A. HAMANN. *Process of rendering billiard and writing chalk unbreakable.*

Cubes or pieces of chalk are saturated with fluid-oil varnish or boiled linseed oil or other drying oil.

343,590—June 15, 1886. O. LUGO. *Producing solid compounds resembling vulcanite from hair, etc.*

Hair is subjected to heat and pressure.

349,760—September 28, 1886. E. C. C. STANFORD. *Algin and other useful products.*

Seaweed is mixed with a solution of carbonate of soda and boiled to produce a cellulose residue; the solution is treated with sulphuric acid, or hydrochloric acid may be used, producing alginic acid as a precipitate; the remaining solution is neutralized with alkaline earth, producing a precipitate of sulphate of lime; the remaining solution is evaporated to a density at which sulphate of soda crystallizes out as Glauber's salts; and the mother liquor is finally evaporated to dryness and the residue carbonized, forming kelp substitute.

355,998—January 11, 1887. M. KAMAK. *Treating horn.*

Horn is subjected to the action of a solution of water, sugar of lead, and vinegar until it assumes a light brown hue. To give it the appearance of mother-of-pearl it is then introduced into a solution of muriatic acid.

359,156—March 8, 1887. C. JACKSON. *Manufacture of hardened asbestos.*

Fibrous asbestos is combined with a binding material, as shellac, rendered liquid in a solvent; the solvent is evaporated; the material pressed in molds; exposed to heat to perish the binding material or change it so that it is no longer soluble in the solvent; when the article is simultaneously subjected to heat and heavy pressure.

366,341—July 12, 1887. H. W. MORROW. *Method of treating vulcanized fiber.*

To impart softness and flexibility to vulcanized fiber, the fiber, after the organic change has been produced, is subjected to the action of a solution of deliquescent salt, as chloride of calcium, with or without glycerine or sugar water combined therewith. (See 302,795.)

370,645—September 27, 1887. H. ORDENSTEIN. *Manufacture of articles from plaster-of-paris or other compositions or materials.*

A formed article of plaster of paris or other porous material is treated with carnaub-wax to fill the pores and strengthen and harden and give a polishable surface.

371,550—October 18, 1887. E. T. L. CLARK. *Process of hardening and preserving plaster-of-paris casts and molds, and making them impervious to water.*

The casts or molds are immersed in a solution of borax and then treated with white or paraffine wax.

389,210—September 11, 1888. C. A. FAURE. *Method of preparing asbestos.*

A sheet of asbestos is immersed in a soluble salt, as chloride of calcium or chloride of barium, dried, and again immersed in a second solution containing a silicate, such as the silicate of soda or a fluosilicate, whereby it is rendered insoluble in water and acid and its strength is increased.

395,083—December 25, 1888. W. SIEMENS. *Process of manufacturing insulated conductors.*

The fibrous matter covering wire strands is impregnated with caoutchouc, oil, or similar liquid, by drying the covered wires under vacuum by means of sulphuric acid or other hygroscopic substance, and then admitting the heated caoutchouc, oil, or other substance into the vacuum chamber containing the wire.

405,201—June 11, 1889. B. E. CHURCH. *Process of treating asbestos.*

Broken asbestos is mixed with a solution of rubber and naphtha which has been mechanically distended by water—as by mechanically mixing a solution of rubber in naphtha with water—then the water is removed by pressure, and the mass is formed into shape by heat and pressure; the asbestos may be soaked with water and the india-rubber solution then mixed therewith.

410,042—August 27, 1889. J. L. STEWART AND J. L. HASTINGS. *Process of producing refractory compounds.*

A refractory crystalline compound for incandescent illumination is produced by pulverizing and mixing a strontium compound or salt with one or more pulverized mineral substances and with a flux composed of a fluoride or a fluorine compound, making the mixture plastic and molding it into shape, then subjecting the molded material to a moderate drying heat, and finally to a high temperature.

419,779—January 21, 1890. G. KOLLER. *Process of treating glue and gelatine molds.*

Glue or gelatine molds are treated with strong oxidizers, as an aqueous solution of anhydrous chromic acid, and afterwards exposed to light; or the glue may be dissolved in an aqueous solution of an energetic oxidizer, the mold formed, and afterwards exposed to the action of light.

420,763—February 4, 1890. W. BOOTH. *Art of manufacturing articles from wood pulp.*

Wood pulp is reground, after it has been subjected to the indurating pickle and dried, and the ground product is then compressed into the desired form.

422,760—March 4, 1890. R. P. FIRST. *Article of chemically treated fibrous material and mode of making the same.*

Shaped articles composed of laminated forms of chemically treated fibrous material are produced by producing a laminated body from a chemically treated sheet of fiber, and then subjecting these laminæ to endwise pressure, whereby they are swaged into the desired form.

428,925—May 27, 1890. I. W. MARSHALL. *Process of treating fibrous material.*

In washing sheets of fibrous material which have been treated with acids, the sheets are confined under pressure between plates having corrugated faces with or without perforations.

429,999—June 10, 1890. C. A. CATLIN. *Plastic composition.*

A fibrous material is combined with a cementing agent in a pulverulent state by mixing the substances together with water and after a thorough mixture, removing the surplus moisture, and compacting with heat and pressure.

437,044—September 23, 1890. F. L. RAWSON. *Method of impregnating parts of electrical apparatuses.*

Hollowed or cored insulating parts of electrical apparatus formed of hydraulic cement are impregnated with heavy, oily, or resinous matter, by means of a closed, heated vessel placed with the molded article with the impregnating matter around it.

438,309—October 14, 1890. T. A. EDISON. *Method of insulating electrical conductors.*

Balata or similar gum is prepared for insulating purposes by dissolving in a solvent of chloroform and passing chlorine gas through the solution until the hydrogen of the material is sufficiently replaced by the halogen. if the chlorination is carried so far that the material is brittle, a small quantity of the gum solution not chlorinated is mixed therewith.

441,870—December 2, 1890. E. T. GREENFIELD AND J. NAGEL. *Process of working high-boiling hydrocarbons for impregnating purposes.*

For impregnating fibrous, porous, or cellular bodies, a high-boiling hydrocarbon is maintained in a liquid condition by adding from time to time a lower-boiling hydrocarbon to supply the volatile matters evaporated.

441,951—December 2, 1890. G. W. GOETZ. *Process of and apparatus for comminuting materials of a viscous or pasty nature.*

Material of a viscous, pasty, or gummy nature is comminuted by subjecting it to motion and attrition in a closed receptacle under a reduced temperature, where the material becomes friable.

445,285—January 27, 1891. F. EGGE. *Method of molding amber.*

Pieces of amber are molded into an integral article by the application of heat and an automatic pressure constantly and uniformly applied; as by the action of a weight applied through a lever.

460,056—September 22, 1891. E. FAHRIG. *Process of manufacturing a composition applicable for electrical insulating purposes, etc.*

Properly prepared pulp—cellulose or linen pulp—is beaten up with manila fiber; then there is added a soap solution and the mass is treated with a precipitate until precipitation shows in the whole mass; the pulp formed into sheets; powdered with an insulating powder; subjected to pressure and dried; treated with an insulating solution; and again subjected to heavy pressure.

468,222—February 2, 1892. H. B. GARRIGUES. *Process of molding plastic material.*

Plastic material is packed in foil by introducing the material into molds of thin foil while the latter are suspended in open-mouthed pockets, reducing the diameter of the article by means of cold, and afterwards closing the open ends of the molds by turning the edge of a blank over the end of the core and mold.

483,646—October 4, 1892. A. H. S. DYER. *Process of making artificial mica sheets for electrical insulation.*

Overlapping mica scales are laid on a freshly varnished foundation plate, the sheet is varnished, and additional layers of mica are laid in a similar manner until the required thickness is obtained, when the sheet is heated to evaporate the solvent of the varnish, rolled, submitted to heavy pressure, and cooled.

483,653—October 4, 1892. C. W. JEFFERSON. *Molding mica forms for electrical insulators.*

Laminated mica sheets are formed and set by cementing together laminæ of mica scales with overlapping edges, compressing the sheet into the desired form while the cement is wet, drying the cement by evaporating the solvent thereof, and chilling while under compression.

492,056—February 21, 1893. M. SICHEL. *Method of producing dental cement.*

Metallic aluminum is first dissolved in glacial phosphoric acid to produce a phosphate of aluminum; next oxide of zinc is subjected to a white heat to reduce it to a gummy condition, the two are mixed and the compound subjected to heat, then cooled and pulverized, more of the gummy oxide added, and the whole mixed in a powdered condition; and finally, when ready for use, sufficient of the said phosphate of aluminum is added to reduce the whole to a plastic condition.

494,891—April 4, 1893. R. REIMAN. *Process of manufacturing artificial bone.*

Natural bone or bone meal is chemically dissolved, the elements precipitated, filtered, and washed, and then mixed with albumen, alumina sulphate, and cellulose in solution, and subsequently partly dried and subjected to a high temperature, at the same time keeping the mass under strong pressure.

497,324—May 16, 1893. C. W. JEFFERSON. *Process of making mica insulating plates.*

Mica sheets are distributed evenly upon and within liquid cement by showering them thereon through the air at a sufficient height so that the sheets become substantially parallel to a horizontal plane before reaching the cement—say 18 feet—and the excess of cement is then expelled by pressure, the plates dried, and the surface ground until parallel; successive showerings of mica sheets are made into the cement, iron foundation sheets being introduced between the showerings, and the mass divided up into separate parts.

501,222—July 11, 1893 P. C. DAME AND L. PRUD'HON. *Method of making artificial whalebone.*

Animal hair is subjected to a softening bath, as of lime and potash, then immersed in a bath of acetic acid, and finally subjected to pressure.

508,653—November 14, 1893. E. THOMSON. *Insulating composition.*

Silicious or like material, as fine kaolin and soluble silicate of soda, is applied to sheets of paper, the sheets piled together and dried; they may be baked and the paper carbonized, with layers formed of more or less vitrified silicious material.

517,011—March 20, 1894. J. C. PEABODY. *Method of making indurated articles from plastic material.*

Wood fiber or paper stock in dry condition is mixed in the presence of heat with linseed oil and resin, and then powerfully compressed, while still warm and plastic, in cold molds.

520,283—May 22, 1894. K. WITZ. *Manufacture of plastic articles.*

Paper board or like material is impregnated with hellebore juice to increase its elasticity and tenacity, prior to subjection to pressure between dies.

522,242—July 3, 1894. A. F. TINNERHOLM AND C. F. PETERSON. *Process of manufacturing insulating material.*

Mica plates are built up by forming superposed layers of mica scales covered with finely powdered gum or resin, and subjecting the combined layers to heat and pressure.

529,905—November 27, 1894. W. GRISCOM, JR. *Method of compounding vulcanizable compounds, and vulcanizing and applying same.*

Vulcanizable compounds containing such plastic material as candle tar are compounded by heating the plastic matter to a melted condition, separately melting the sulphur, and then mixing the melted masses; the compound is then applied in permanent adherence to fabricated material.

530,517—December 11, 1894. A. N. FORD. *Process of manufacturing insulating compositions for electrical purposes.*

Fibrous material is saturated with a partially oxidized drying oil, then dried, and then repeatedly saturated or coated and dried until the mass has increased in weight from 50 to 200 per cent; when the material is ground to a homogeneous mass, mixed with gutta-percha or like material, reground, and formed into blocks or sheets.

530,958—December 18, 1894. B. MCCABE AND A. THAYER. *Method of molding vegetable fibrous material.*

Vegetable fibrous material is first treated with acid, then forced through apertures in a head, whereby it is formed into strips or strings, which are deposited in a plastic condition in a mold, compressed, and finally immersed in water.

533,746—February 5, 1895. R. REIMAN. *Process of manufacturing artificial bone.*

Natural bone is macerated, the liquid separated from the organic solids, the gelatine separated from the residue of the organic matter, and the gelatine product is then combined with a chromate and a drying oil, and a material that will give body to the composition.

538,265—April 30, 1895. H. P. LANE AND E. FOLK. *Process of making molded articles from wood pulp.*

The article is molded of wood pulp, then impregnated with oil and resin, baked, and then subjected to heavy pressure between smooth mold surfaces, warmed sufficiently to soften the coating, but not the material.

539,928—May 28, 1895. J. A. WHEELER. *Process of molding fibrous pulp.*

Fibrous pulp, moistened with water, is mixed with sodium silicate, and then with pulverized calcined magnesite sufficient to convert it into a doughy body; then with pulverized quicklime; then pulverized resins or gums are added, and the mass heated and molded, dried or baked, and subjected to a bath of a solution of chloride of magnesia or other chlorides.

549,254—November 5, 1895. C. F. PETERSON. *Method of making insulator-rings.*

In forming flanged insulator rings of built-up pieces of mica, the pieces of mica are bent and assembled to form the predetermined ring and cemented together as the irregular structure is built up; the structure is then subjected to pressure and heat in a mold, and chilled.

561,938—June 9, 1896. T. G. B. GOLDMANN. *Process of making articles from homogeneous plastic compositions.*

A binding substance is dissolved in a water-soluble solvent, such as alcohol; then mixed with a filling material and pigment in finely divided state, in proportion to their specific weights in dry state; next water is added to the mixture under continuous stirring until the intimately mixed mass of binding substance and filling material is separated from the solvent and precipitated as a thick paste; when the water is removed, the paste dried, pulverized, and compressed while subjected to heat.

574,793—January 5, 1897. A. N. FORD. *Art of making oil fabrics.*

Fibers are loosely separated and repeatedly immersed in boiling oil so as to coat the separate fibers; the oil oxidized after each immersion by the action of air, with the fibers maintained in their loosely separated condition, and the coated fibers finally ground to form a homogeneous mass.

589,256—August 31, 1897. J. GRAY AND C. H. CASE. *Process of making insulating material.*

Pulp is formed into shape, heated in a bath of molten sulphur, then subjected to heat under pressure, and subsequently immersed in a cold bath.

589,637—September 7, 1897. W. G. BRISTOW. *Method of and means for molding plastic material.*

A partial vacuum is created beneath a flexible tissue placed over a pattern, the plastic material is then cast within the tissue thus drawn into the mold; hardened; and the pressure is then restored beneath the tissue, forcing it from the pattern and releasing the cast from the tissue.

595,168—December 7, 1897. L. GROTE. *Process of manufacturing moldable mass or articles from asbestos.*

Asbestos is steeped in a bath composed of a solution of 1 part of glue, 6 parts of a solution of soluble glass of 20° to 30° Baumé, and 7 to 9 parts of a solution of 40 per cent formaldehyde; it is then compressed to remove superfluous moisture, subjected to a bath of a salt of alumina, dried, pulverized, compressed, and then dried first in the open air and then in an oven.

618,692—January 31, 1899. F. LAMPLOUGH. *Process of manufacturing a substance having insulating properties.*

Vegetable fiber is submitted in presence of oxidizable resinous bodies and a proportion of nonoxidizable oil to a gradually-increasing heat until all air, dampness, and volatile matters are driven off; the action of the heat is continued until the nonoxidizable oil is destroyed and until the vegetable fiber is changed into a homogeneous mass, when the fluid portion is removed, air is introduced under pressure to oxidize the material, and it is pressed and desiccated.

622,325—April 4, 1899. H. BRUNSWIG. *Method of transforming fibrous cellulose into a dense material.*

Fibrous cellulose is reduced to an impalpable condition in water, the water drained from the mass, with or without boiling to expel the air, and molded and dried.

623,608—April 25, 1899. C. IVES. *Process of treating gelatin, glycerin, and bichromate of potash.*

A substance of rubber or gutta-percha like character is produced from a composition of gelatine, glycerine, and bichromate of potash, with which adulterating material may be combined, by mixing the ingredients in as nearly an anhydrous state as possible, whereby chemical action between the bichromate of potash and gelatine is sufficiently inactive to allow time for molding the composition under pressure, and heating it while under pressure to 95° to 150° C.

625,372—May 23, 1899. J. A. WHEELER. *Process of molding fibrous pulp.*

To give more body and increase the solidity, fibrous pulp is mixed with pulverized incombustible material; moistened with hot water; sodium silicate added, the mass kneaded, and quicklime added thereto; and pulverized resins are mixed with the mass while heated, with or without the subsequent addition of calcined pulverized magnesite soaked in chloride of magnesia.

625,450—May 23, 1899. J. KAISER. *Process of manufacturing materials similar to wood from fibrous refuse.*

Fibrous refuse is fluxed with lye, then saponified with resin, and subjected to pressure, when ground wood and an agglutinant, as grape sugar, is mixed with the said material and the mixture dried and kneaded.

631,719—August 22, 1899. A. IMSCHENETZKY. *Refractory material.*

The process of forming refractory material consisting of asbestos, with or without the admixture of other material, bound together by means of silica, consists in first saturating articles of asbestos with a solution of sodium silicate mixed with sodium bicarbonate, then saturating the same first with a sodium-silicate solution, and then with a sodium-bicarbonate solution.

640,725—January 2, 1900. P. W. WIERDSMA AND J. KUIPERS. *Process of treating vegetable waste.*

Vegetable waste—produced in the manufacture of potato flour—is treated for the removal of dirt and matters soluble in water; then dried and disintegrated; mixed with resin or other gum to render the mass waterproof; dried; reduced to a powder; and molded under pressure.

643,012—February 6, 1900. A. SMITH. *Process of producing material suitable for electric insulation or other purposes.*

Two parts (by measure) of acetic paraldehyde and 1 part of methylated spirit are mixed; 3 parts of liquid carbolic acid, which has been liquified by adding 5 per cent of water, added: and to the mixture, in a closed vessel, there is added in small doses, while cooling, 3 to 6 parts of methylated spirit, which has been saturated with hydrochloric-acid gas; and the material is molded; the molded article may be impregnated with paraffin.

647,119—April 10, 1900. T. SEEHAUSEN. *Process of compounding fillings for rubber tires.*

Light ground vulcanized rubber is mixed with resin oil, heated for two hours at a pressure of 45 pounds per square inch; then there is added a second mixture of ground vulcanized patent rubber waste, which has first been washed in water and dried with loofah fibres, solar oil, and turpentine; and finally there is added to this mass a mixture of india rubber, sulphur, ammonia, soda, and neutral acetate of lead.

652,144—June 19, 1900. A. SKROBANEK. *Process of producing artificial wood.*

It is produced by cleaning and carding peat, separating the humic and ulmic acids as borates and silicates, mixing the peat-mull with a filler and a hardening material—such as a composition of silica, alumina, and sodium borate and silicate—forming alternate layers therewith and with the carded fiber laid in different directions, and molding the compound; the mull is treated with a hot solution of sulphuric acid and alum.

654,646—July 31, 1900. F. G. KLEINSTEUBER. *Method of dissolving resins.*

There is mixed with the resin solvent a suitable quantity—2 to 10 per cent of the resin—of a compound composed of a solution of dammar and tung or wood oil in benzole, and oil of turpentine with or without oil of rosemary.

654,951—July 31, 1900. W. J. CORDNER. *Process of manufacturing composition applicable for electric insulation.*

Rhea fiber is treated in a solution of silicate of soda of 15° to 20° Baumé, dried, saturated with a heavy hydrocarbon, such as resin oil and the like, the surplus heavy hydrocarbon removed, the saturated fiber treated with heat to transform it into a heavy hydrocarbon cellulose, which is disintegrated and mixed with gums, resins, oxidizable oils, and the like to form a composite material.

655,130—July 31, 1900. R. M. THOMPSON. *Method of treating wurtzilite.*

The mineral is subjected to the action of steam heat to reduce it to a softened or fused state.

655,131—July 31, 1900. R. M. THOMPSON. *Wurtzilite method and product.*

The mineral is softened, as by the action of heat, and combined with a hardening material, as mica, asbestos, or soapstone, and afterwards a quantity of sulphur.

657,818—September 11, 1900. M. FREMERY AND J. URBAN. *Manufacture of cellulose.*

Cellulose material, such as cellulose, hydrate of cellulose or hydrocellulose, is subjected to an energetic preliminary treatment with reducing or oxidizing bleaching media, such as sulphurous-acid salts or chlorine in the form of hypochlorite, and then subjected to the action of an ammoniacal solution of copper.

659,358—October 9, 1900. J. G. BIERICH. *Process of producing homogeneous horn substances.*

Horn cuttings and shavings are cleaned, mixed with glycerine, and the mixture subjected to a temperature of 100° C. for about forty minutes and at a pressure of about two hundred atmospheres, the process being carried on under exclusion of air.

662,929—December 4, 1900. W. GELINEK. *Process of manufacturing solid substances from fibrous material and product thereof.*

A composition of fibrous material, with coal tar, colophony, asbestos, kaolin, infusorial earth, and lime, compressed when hot in molds under high pressure.

GROUP XVI.—ESSENTIAL OILS.

ESSENTIAL OILS, PERFUMES, AND FLAVORS.

162,529—April 27, 1875. A. G. CAMPBELL. *Improvement in portable toilet waters and extracts.*

Fragrant attars are absorbed by carbonate of magnesia and then reduced to a powder, the same being adapted to readily produce toilet waters and extracts by lixiviation with alcohol. Thus, for cologne water, a mixture of 3 ounces of attar of bergamot, 2 drams of attar of neroli, and 1 dram of attar of rose is poured on 4 ounces of carbonate of magnesia.

200,168—February 12, 1878. D. M. BUIE. (*Reissue: 10,338—June 5, 1883.*) *Process of manufacturing oils from organic substances.*

Steam and carbonic acid are injected into the retort containing the materials, such as pitch pine, sassafras, juniper, myrtle, peanuts, cottonseed, etc., and heated to a high temperature.

330,274—November 10, 1885. A. M. TODD. (*Reissue: 10,705—March 30, 1886.*) *Process of obtaining menthol.*

A crystalline product is obtained from the oil of *mentha piperita* by congealing it to a jelly-like form and draining the oil therefrom; the crystals may be fused and subjected then to a second congealing and draining and a gradual raising in temperature.

556,944—March 24, 1896. J. C. W. F. TIEMANN. *Process of converting compounds of the citral series into isomers.*

Compounds of the citral (geranium) series are subjected for some time to the action of dilute sulphuric acid, producing isomers having a lower b. p. and a higher sp. gr. than the original bodies.

557,431—March 31, 1896. L. R. SCAMMEL. *Process of obtaining eucalyptol.*

A solution of phosphoric acid is added to the eucalyptus-oil or other volatile oil containing eucalyptol, and the eucalyptol phosphate formed is then decomposed by hot water.

588,766—August 24, 1897. M. EKENBERG. *Process of making perfumes.*

Perfumes, contained in closed vessels, have an inodorous hydrocarbon or ether added, as butane, having a boiling point below 30° C., to be readily vaporized at the temperature of the hand or the air of a living room.

600,429—March 8, 1898. E. DE LAIRE. *Ionone derivative.*

A new product, an isomerid of ionone, b. p. 140° C., of the odor of violets, is produced by treating ionone or pseudo-ionone with a concentrated condensing-acid, such as sulphuric acid.

601,193—March 22, 1898. J. ZIEGLER. *Essence of violets.*

Citral, or an oil containing citral, is treated in a mixture of acetone and diluted alcohol, with an active oxidizing agent, as a saturated solution of chloride of lime or barium peroxide, and the product further oxidized by boiling with ferric chloride.

617,552—January 10, 1899. P. BARBIER. *Synthetic violet-oil and process of making same.*

A new product, $C_{11}H_{24}O$, a yellowish oil, b. p. 162° C., under pressure of 10 m. m., is produced by condensing an aldehyde of the formula $C_{10}H_{16}O$, as citral, with methylpentenone (oxide of mesityl) under the influence of an alkaline reagent, and transforming the product into an isomeric ketone by the action of an acid condensing agent.

626,585—June 6, 1899. J. ZIEGLER. *Synthetic violet-oil and process of making same.*

A new product, b. p. 138° to 149° C., under pressure of 12 m. m. It is produced by heating a mixture of acetone, lemon-grass oil, alcohol, cobaltous nitrate, and chloride of lime; distilling off first the lighter and bad-smelling portions, then the essential oils, mixing these oils with sodium bisulphate and fractionally distilling.

637,209—November 14, 1899. I. KLIMONT. *Process of making ionone.*

Citral and acetylacetone in acid solution are heated with reagents adapted to combine with the water, and the oily matter is separated and purified.

650,028—May 22, 1900. J. C. W. F. TIEMANN. *Process of decomposing ionone.*

The ionone is boiled with an alkali sulphite in the presence of a binding agent for any liberated alkaline hydrate; the solution subjected to steam distillation; and alkali added to the remaining solution to liberate the alpha ionone.

ARTIFICIAL MUSK.

412,545—October 8, 1889. E. SCHNAUFER AND H. HUPFELD. *Process of making artificial musk.*

An oil having the formula $C_{12}H_{17}NO_2$, adapted for use as a substitute for musk, is made by digesting a mixture of metaxylol and isobuty alcohol with chloride of zinc, nitrating the resulting hydrocarbon, and separating the oil by dissolving out extraneous matter.

416,710—December 10, 1889. A. BAUR. *Process of making artificial musk.*

Toluol is mixed with butyl chloride; the product of the reaction diluted with water and distilled with steam; the vapors treated with a mixture of fuming nitric and sulphuric acid; and the product, a substitute for musk, crystallized from alcohol.

451,847—May 5, 1891. A. BAUR. *Artificial musk.*

A new product, being a trinitrated hydro carbon derived from toluene or its homologues, in solid crystalline form. It is made, for example, from toluene, or xylene mixed with a butyl halogen compound, distilled, treated with fuming nitric and sulphuric acid, and crystallized with alcohol.

481,685—August 30, 1892. A. BAUR. *Artificial musk and process of making the same.*

A new product, being a trinitro-derivative of the butylated or analogous metacresol in a white crystalline form, is produced by mixing an ether of metacresol or other substituted phenol, with a metallic chloride, as aluminium chloride; heating, mixing with water, and isolating the butylated cresolether, thereby obtaining an aromatic, colorless liquid; introducing the ether into fuming nitric (or nitric and sulphuric) acid; heating, and crystallizing from a solvent, as alcohol.

536,324—March 26, 1895. A. BAUR. *Artificial musk.*

A new compound, the trinitro-derivative of butylhydrindene, in the form of white needles, sparingly soluble in alcohol having a m. p. 139°–140° C., is produced by heating an ethol-aromatic hydrocarbon, such as hydrindene, with a chloride, such as butylic chloride, in presence of a metallic chloride, and nitrating the product.

546,086—September 10, 1895. A BISCHLER. *Artificial musk and process of making same.*

A new compound, a white crystalline body, insoluble in water and soluble in alcohol and ether, is produced by forming a cyanide derivative of an aromatic butylic hydrocarbon—such as cyanide of butyl toluene—heating the same in a mixture of fuming nitric and sulphuric acid, and cooling and precipitating from a solvent, as alcohol.

559,783—May 5, 1896. A. MÜLLER-JACOBS. *Process of making artificial musk.*

A saturated solution of the soluble parts of kerosene or naphtha in ice-cold sulphuric acid is nitrated, then gradually heated to 65° to 82° C., neutralized with ammonia or other alkali, and the neutralized product, mixed with a neutral resin soap, is precipitated by means of a solution of a metallic salt, as sulphate of aluminum.

560,771—May 26, 1896. A. BAUR. *Artificial musk.*

A new product, crystallizing in white needles, m. p. 137° C., insoluble in water and soluble in organic solvents as alcohol, is produced by treating butylxylene in the presence of aluminium chloride with homologous fatty chlorides such as acetyl chloride, and nitrating the ketone thus obtained.

602,961—April 26, 1898. C. SCHMID. *Process of making artificial musk.*

A new product, derived from resins, a heavy orange-red oil, is produced by distilling certain fossil resins, such as copal, amber, or retin resin, with superheated steam; treating the distillate of wax-like or oily consistency with oxidizing reagents, as a mixture of potassium bichromate and sulphuric acid; neutralizing the filtered mass by ammonia and alcohol; driving off the alcohol, and extracting with ether.

For other products of this group, see Group XVIII, "Fine Chemicals."

GROUP XVII.—COMPRESSED AND LIQUEFIED GASES.

HYDROGEN.

*229,339—June 29, 1880—*C. M. TESSIÉ DU MOTAY. *Process and apparatus for manufacturing hydrogen gas.*

A current of watergas and steam is passed through a body of highly heated lime, thereby converting the mixture into hydrogen and carbonic acid, and then through a body of lime at a lower temperature whereby the carbonic acid is absorbed. The carbonate of lime is reconverted for reuse by burning in its presence a gas containing hydrogen.

229,340—June 29, 1880. C. TESSIÉ DU MOTAY. *Process for the production of hydrogen gas.*

A current of coal gas is passed through a secondary highlyheated converting-generator, thereby increasing its volume, subsequently said gas is passed through a highly heated body of lime, decomposing during the passage the hydrogen compounds contained in the gas, in connection with water vapor, and then the products are passed through lime at a lower temperature.

366,081—July 5, 1887. H. H. EDGERTON. *Obtaining hydrogen from water gas.*

Hydrogen is separated from the heavier constituents of water gas by dialysis.

CHLORINE.

506,640—October 10, 1893. R. KNIETSCH. *Package of liquid chlorine.*

A new article, liquid chlorine in an iron or steel vessel, and sufficiently anhydrous not to attack the iron or steel.

649,565—May 15, 1900. C. E. ACKER. *Process of manufacturing caustic alkali and halogen gas.*

See Group X, Electro-chemistry.

OXYGEN.

66,279—July 2, 1867. H. A. ARCHEREAU. *Improved mode of preparing oxygen and applying the same to useful purposes.*

Sulphuric acid is heated and decomposed into sulphurous acid, water, and oxygen, and the oxygen collected and compressed for use in producing high temperatures in metallurgic operations.

71,657—December 3, 1867. B. R. SMITHSON. *Improved apparatus for generating oxygen gas.*

Sulphuric acid is fed into a retort filled with pumice stone maintained at a red heat; a washer absorbs the sulphurous-acid vapors, the oxygen passing to a receiver.

86,248—January 26, 1869. O. M. PHILLIPS. *Improvement in the manufacture of oxygen-gas.*

In the production of oxygen gas from alkaline manganates a partial vacuum is formed at certain intervals in the retort to facilitate gas generation.

307,041—October 21, 1884. M. HERZOG. *Apparatus for the dialysis of air.*

A dialyzing apparatus for air has a series of chambers separated by a series of colloid or caoutchouc septa with an air pump for creating a suction and eliminating the nitrogen and producing superoxygenated air.

432,815—July 22, 1890. A. BRIN. *Process of obtaining oxygen from air.*

Barium oxide is heated in a retort to from 650° to 800° C.; air is then admitted until peroxidation takes place, when the air supply is shut off, and the barium is deoxidized by reducing the pressure without changing the temperature of the retort.

440,777—November 18, 1890. F. SALOMON. *Process of obtaining oxygen.*

A mixture of a metallic oxide, such as lead monoxide or lead carbonate, and an alkaline earth, such as lime, is heated in a current of air so as to cause oxygen to be absorbed, which is then expelled by a current of carbonic-acid gas.

500,697—July 4, 1893. G. WEBB, Jr., AND G. H. RAYNER. *Process of making oxygen.*

For the production of ogygen gas from air a composition is used, formed of caustic soda dissolved in hot water with oxide of manganese and manganate of soda added, all in equal parts; the mass being then heated and evaporated to dryness, and then heated to a temperature in excess of that of the oxygen manufacture. After cooling, the mass is broken into pieces and rolled in powdered oxide of manganese prior to use.

545,973—September 10, 1895. J. PURVES. *Process of making gas and apparatus therefor.*

Fuel gas is made with denitrogenized air to increase its calorific power. Oxygen produced from air by the action of a metallic oxide—as barium oxide, which will absorb oxygen from air when heated, and liberate the absorbed oxygen when raised to a higher temperature—is fed to the producer, the heat of the hot gases being used to heat the oxygen retorts. The latter are made double and revolvable, and the generation of oxygen continuous by the periodic reversal of the retorts and alternate raising and lowering of their temperatures.

576,915—February 9, 1897. A. SWEETSER. *Apparatus for making oxygen.*

As a new article of manufacture for feeding into an oxygen-generating apparatus, oxygen-yielding material is formed into cakes or rods provided with a covering that is nonconductive of heat.

588,613—August 24, 1897. E. B. STUART. *Compound for separating oxygen and method of making same.*

A manganate and an alkali—as binoxide of manganese, 24 parts, and caustic soda, 76 parts—the alkali being in excess of that necessary to form a manganate, are melted; the compound being liquid and nonvolatile above the temperature at which steam forms and below that which decomposes steam.

588,615—August 24, 1897. E. B. STUART. *Process of and compound for separating oxygen.*

Atmospheric air and steam are alternately passed through a fused mixture of a manganate and an alkali salt, as a chloride of an alkaline earth capable of fusing and remaining in a permanent liquid form when fused.

588,616—August 24, 1897. E. B. STUART. *Oxygen-separating compound and method of making same.*

A nonaqueous oxygen-absorbing preparation, containing an oxygen-absorbing material, as oxide of manganese, and sufficient fusible material, as caustic soda, to cause the mass to liquefy and remain so at a temperature below that which decomposes steam, is formed by heating manganese, its oxide or salt, with fusible material, in the presence of oxygen at a temperature between that at which a manganate forms and that at which steam decomposes, and adding the fusible material until the mass becomes liquid.

588,617—August 24, 1897. E. B. STUART. *Method of obtaining oxygen and nitrogen from air.*

Air and steam are alternately passed through a fusible chemical, such as a manganate of soda, in liquid form.

NITROGEN.

207,086—August 13, 1878. G. A. TREUTLER. *Improvement in processes for the continuous preparation of nitrogen gas.*

Nitrogen gas is continuously prepared by forcing air through iron filings mixed with a hygroscopic material and moistened with ferrous sulphate, whereby the oxygen is absorbed from the air and the iron salt is converted into ferric sulphate, and the latter is then deoxidized by the action of the metallic iron.

225,730—March 23, 1880. T. B. STILLMAN. *Manufacture of nitrogen gas.*

In the manufacture of nitrogen gas, to remove all traces of oxygen, the gas is passed through melted sodium, potassium, or other metal having a high affinity for oxygen.

226,632—April 20, 1880. T. B. STILLMAN. *Manufacture of nitrogen gas.*

Nitrogen gas is purified and oxygen removed therefrom by passing it through an apparatus containing anhydrous phosphoric acid, anhydrous sulphuric acid, or anhydrous chloride of zinc, and then over or in contact with melted sodium, potassium, or other metal having a high affinity for oxygen.

281,002—July 10, 1883. J. F. BENNETT. *Apparatus for separating nitrogen from atmospheric air.*

It employs a series of annular chambers with porous walls, together with an air pump, to remove a part of the nitrogen from air by reason of its more ready diffusion through the porous walls.

NITROUS OXIDE.

87,319—March 2, 1869. W. P. BARKER. *Improvement in the use of nitrous oxide as an anæsthetic agent.*

Nitrous oxide is mixed with chloroform, or other anæsthetic.

120,978—November 14, 1871. W. F. & W. A. JOHNSTON. *Improvement in methods of compressing and liquefying nitrous oxide and other gases.*

Claims the apparatus of process No. 120,977; a hydraulic pump with one or more tanks or series of tanks.

SULPHUR DIOXIDE.

127,008—May 21, 1872. N. P. AKIN. *Improvement in the manufacture of sulphurous acid.*

Sulphur or pyrites is burned in a closed water-jacketed chamber under pressure, which is maintained likewise in the washing chamber and condenser. Liquid sulphurous acid and an aqueous solution of sulphurous acid from the unliquefied gases are simultaneously produced.

187,413—February 13, 1877. R. P. PICTET. *Improvement in processes of producing artificial cold by means of anhydrous sulphurous oxide.*

Anhydrous sulphurous oxide is used as a refrigerating agent.

191,778—June 12, 1877. R. P. PICTET. *Improvement in manufacturing sulphurous anhydride.*

Sulphur and sulphuric acid are heated, the product passed through a cleansing medium and a dehydrating medium, and liquefied by pressure, in a continuous operation.

376,883—January 24, 1888. E. HÄNISCH AND M. SCHROEDER. *Process of obtaining sulphurous acid.*

Liquid sulphurous acid is produced by passing the furnace gases through a spray of water, heating the resulting solution of sulphurous acid to evaporate the sulphurous-acid gas therefrom, cooling the separated gases, and converting the same into liquid form by compression and condensation.

CARBON DIOXIDE.

55,038—May 29, 1866. J. S. BALDWIN. *Improved method of collecting and separating carbonic acid from mixtures of gases.*

Water is sprayed through mixed gases in a chamber under pressure, taking up the carbonic-acid gas; the surcharged water then passing into a second chamber under a partial vacuum, where the gas is set free.

359,996—March 29, 1887. S. CABOT. *Process of and apparatus for making carbon dioxide.*

Limestone is alternately heated to redness by gaseous products of combustion at a high temperature, and with superheated steam with exclusion of air, until its carbon dioxide is expelled, the steam being condensed and removed from the carbon dioxide evolved. A reduced atmospheric pressure is produced and maintained in the closed furnace pending the passage of superheated steam.

383,957—June 5, 1888. H. LEFFMANN. *Manufacture of carbonic acid and heavy magnesia.*

Native magnesite, or magnesium carbonate, is decomposed by heat in a closed retort, producing carbonic acid and extra-heavy magnesia.

496,546—May 2, 1893. W. WALKER. *Process of and apparatus for recovering carbon dioxide.*

Impure carbonic-acid gas is passed through retorts containing a solid carbonate, as carbonate of soda, which absorbs the carbonic acid with the production of a bicarbonate. The nitrogen and other gaseous impurities are thus removed by exhaustion and the temperature raised to cause the pure carbonic-acid gas to pass off. Water is sprayed upon the carbonate and the solution obtained removed, and the carbonate crystallized out for reuse.

523,651—July 24, 1894. E. W. ENEQUIST. *Process of obtaining carbonic acid, sodium sulphate, and magnesium sulphate, etc.*

A solution of niter-cake (containing 24 to 28 per cent of free sulphuric acid) or an alkaline acid sulphate is employed as a solvent for magnesite in the production of carbonic acid. Iron and other impurities are precipitated and removed, sodium carbonate is added, and the resulting magnesium carbonate separated from the sodium sulphate.

APPARATUS.

17,394—May 26, 1857. W. A. ROYCE. *Reissued December 24, 1872. No. 5,201—Improvement in machinery for compressing gaseous bodies. No. 5,202—Improvement in machinery for compressing gaseous bodies.*

Reissue 5,201 relates to the compression of gaseous mediums with means for absorbing the evolved heat and for holding and transmitting the power; the metallic reservoir, pipes, etc., are coated on the inside with close-grained metals, vegetable gums, resins, or oils to retain the gas. Under reissue No. 5,202, serial compression is employed with refrigeration.

120,977—November 14, 1871. W. F. & W. A. JOHNSTON. *Improvement in apparatus for liquefying nitrous oxide and other gases.*

Gaseous or aeriform matter is liquefied by pressure transmitted from a pump by means of a liquid.

214,161—April 8, 1879. F. LITTMANN. *Improvement in apparatus for preparing water for ice machines.*

The process consists in converting water into steam, freeing the steam from impurities, then condensing the steam, and finally heating the water resulting from such condensation by means of a succeeding current of steam to drive off any remaining air.

320,310—June 16, 1885. J. J. SUCKERT. *Method of and apparatus for separating a liquefiable gas from a condensable vapor.*

The process consists in first reducing the temperature of a solution of the gas by the vaporization of a liquefied gas, and then passing the liquefiable gas and intermingled vapor through such cooled solution, thereby liquefying the vapor and separating it from the gas.

389,521—September 11, 1888. E. LUHMANN. *Apparatus for removing gases from liquids.*

A vacuum pan having a spiral channel for the liquor, forms, with two vertical pipes, a siphon, the pipes connecting with the respective ends of the spiral channel.

491,699—February 14, 1893. E. B. CUTTEN. *Preparing liquid chlorine.*

Chlorine gas is dehydrated by steps of cooling, by contact with calcium chloride, and by contact with anhydrous sulphuric acid, and is then liquefied by pressure. The noncondensed gases are then separated, and flasks are charged with liquid chlorine by drawing off from the bottom of the chlorine vessel to the bottom of a flask coupled thereto, causing the air in flask to compress until it attains the pressure of chlorine liquefaction, and then allowing the compressed air in the flask to escape.

503,556—August 15, 1893. E. SOLVAY. *Apparatus for treating pulverulent material with gases.*

Apparatus for process No. 503,558.

503,558—August 15, 1893. E. SOLVAY. *Treating pulverulent material with gases.*

The gas is passed from top to bottom through a body of the material contained in a closed vessel; then the ends of the vessel and the body are reversed and fresh material is added at the temporary top and treated material removed from the temporary bottom, when the vessel with the body of material is returned to its normal position and the passage of gas from top to bottom resumed.

506,639—October 10, 1893. R. KNIETSCH. *Process of and apparatus for making liquid chlorine.*

Chlorine gas is forced through a body of heated sulphuric acid into a confined space and is liquefied by pressure transmitted through the sulphuric acid. The sulphuric acid is cut off from the parts of the apparatus exposed to the air by a body of mineral oil.

575,714—January 26, 1897. C. HEINZERLING. *Process of recovering volatile substances from air or other gases.*

The air or gas (as gases from coal distillation, distillation of peat and bituminous shale to obtain oils, distillation of wood, preparation of water-proof texture or tissue and in the production of smokeless powder, and in the production of chloroform, carbon bisulphide, or carbon tetrachloride) is compressed; indirectly cooled by water while compressed; further cooled by indirect contact with previously expanded portions of the air or gas, a portion of the volatile substances being separated by the latter reduction of temperature; and finally the air or gas is permitted to expand to substantially normal pressure, whereby the remaining volatile substances are separated.

625,759—May 30, 1899. E. C. HARGRAVE. *Liquid air conveying conduit.*

The liquefied air is piped from one point to another, a portion being allowed to evaporate, and conveyed through an annular space around the main body of the air or gas to maintain said body in a liquefied state and prevent undue pressure therefrom.

650,608—May 29, 1900. T. J. McTIGHE. *Method of cooling gases.*

A compressed gas, with the heat of compression removed, is caused to act expansively in elevating within a heat-insulated tube a suitable liquid cooler than itself, thereby doing work and falling in temperature in proportion to the work done, the expanded and cooled gas cooling a further body of compressed gas.

GROUP XVIII—FINE CHEMICALS—INORGANIC.

BROMINE AND IODINE.

12,077—December 12, 1854. E. STIEREN. *Reissued June 1, 1869. No. 3479—Improved process of treating the mother-water of salines to obtain useful products. No. 3480—Improved apparatus for obtaining bromine and other products from the mother-water of salines.*

Sulphate of magnesia is obtained from bittern water of saline springs by evaporating to 36° Baumé, treating with lime, filtering, washing the precipitate, treating with sulphuric acid, concentrating and crystallizing. Iodine is obtained from the lye separated from the hydrate of magnesia by treating with soda sulphate, removing the sodium chloride, treating the liquor with sulphate of copper and iron, and the precipitate thereof with manganese and heat. Bromine is obtained from the liquor after heating with soda carbonate or caustic soda.

62,464—February 26, 1867. D. ALTER. *Improved apparatus for the manufacture of bromine and iodine.*

The retort consists of a stone box and lid with a leaden heating flue.

62,988—March 19, 1867. D. ALTER. *Improvement in the distillation of bromine and iodine.*

The fumes of bromine and hydro-bromic acid are absorbed by an alkali.

82,309—September 22, 1868. G. A. HAGEMANN. *Improvement in the manufacture of bromine from bittern.*

A sandstone trough or vessel is used, furnished with a bore, for the introduction of steam to dispense with the insertion of metallic pipes into the liquor. Naked steam is introduced into the body of the liquor to combine the mechanical action of the steam with the physical effects of its heat.

110,662—January 3, 1871. J. J. JÜHLER. *Improvement in apparatus for the manufacture of bromine.*

Stills are made of wood, or with a lining of wood, which chars to a certain depth, and then the destructive action of the bromine ceases.

217,076—July 1, 1879. J. N. J. DUBREUIL. *Improvement in manufacture of iodine and bromine.*

To prepare green seaweed for the extraction of its useful salts, the weeds are first disintegrated, then lime is mixed with the pulped mass and the liquid extracted by straining or pressing. The salts are then precipitated from the solution.

219,004—August 26, 1879. R. MÜLLER AND H. BÖCKEL. *Improvement in the manufacture of iodine and bromine.*

To obtain iodine and bromine from bittern or other liquids containing them, the liquor is subjected in a finely divided and heated state to the action of chlorine gas.

356,291—January 18, 1887. F. C. PHILLIPS. *Process of obtaining iodine from bittern.*

Iodine is first set free from its chemical combination in the bittern and is then absorbed with dead-oil or equivalent oily or tarry substance, and the iodine extracted from the oil by means of an alkali and distillation. The resulting bittern liquor is distilled to extract the bromine therefrom.

356,292—January 18, 1887. F. C. PHILLIPS. *Extracting bromine and iodine from bittern.*

Bromine and iodine are first set free from the chemical combination in which they occur in salt-water bittern, and dead oil, or heavy oil from coal tar, is then mixed therewith to absorb them; the oil is then separated from the bittern, and the bromine and iodine extracted from the oil by means of an alkali, as caustic soda.

447,926—March 10, 1891. H. H. WING. *Process of obtaining bromine and iodine.*

Bittern, concentrated to a sirupy consistency, is mixed with silicious material and calcined, producing fumes of chlorine, bromine, and iodine, which fumes are brought in contact with bittern water in a tower, whereby the bromine and iodine of the latter are liberated by the chlorine, and the iodine and bromine collected.

448,541—March 17, 1891. T. PARKER AND A. E. ROBINSON. *Process of making iodine by electrolysis.*

See Group X, Electro-chemistry.

456,183—July 21, 1891. H. H. WING. *Process of obtaining iodine.*

The mother-liquor resulting from the purification of sodium nitrate is mixed with silicious material and calcined, and the sublimed iodine collected from the fumes. The uncondensed vapors are brought in contact with a further quantity of said mother-liquor to effect a further purification of iodine.

460,370—September 29, 1891. H. H. DOW. (*Reissue: 11,232—April 12, 1892.*) *Process of extracting bromine.*

Bromine in brine or bittern water is first freed from its chemical combination, the bromine is then separated from the brine by means of an air blast, and the bromine-laden air is forced through a metal or substance that will combine with the bromine, producing a bromide, which is boiled to dryness out of contact with the air.

461,681—October 20, 1891. J. C. KAUTZ. *Process of purifying bromine.*

The bromine vapors, before condensation, are passed through a solution of the bromide maintained at the proper temperature.

SODIUM AND POTASSIUM.

342,897—June 1, 1886. H. Y. CASTNER. *Manufacture of sodium and potassium.*

The reduction of the alkali is effected by the carbide of a metal diffused through the alkali in a state of fusion at moderate temperatures. An easily reducible metal or its oxide mixed with a hydrocarbon and coked will serve as a carbide.

380,775—April 10, 1888. O. M. THOWLESS. *Process of obtaining sodium, etc.*

The substance containing the sodium or potassium, as caustic soda, is heated and gradually supplied to heated carbonaceous matter, and the vapors condensed.

380,776—April 10, 1888. O. M. THOWLESS. *Apparatus for obtaining sodium, etc.*

Apparatus for the practice of process No. 380,775.

391,110—October 16, 1888. H. S. BLACKMORE. *Manufacture of sodium.*

A mixture of calcium hydrate, 27.5 pounds; ferric oxide, 31.1 pounds; sodium carbonate, 30.9 pounds; and carbon, 10.5 pounds; is heated and the vapors collected and condensed.

460,985—October 13, 1891. C. NETTO. *Process of making sodium or potassium.*

Caustic alkali is brought into contact with reducing carboniferous matter at such a low temperature that only the caustic alkali is reduced to a metallic state, while the alkali carbonate simultaneously formed remains undecomposed and is withdrawn out of reach of the carboniferous matter without interruption of the reducing process.

SELENIUM.

235,616—December 21, 1880. A. G. BELL AND S. TAINTER. *Process of treating selenium to increase its electric conductivity.*

To increase the electrical conductivity and sensitiveness to light of selenium it is gradually heated to a point where the selenium is beginning to fuse and then allowed to cool, the proper moment for stopping the heating being shown by the ceasing of the increase of deflection of a galvanometer needle, and also by a change from a leaden color to blackish or nearly black.

RARE EARTHS.

87,477—March 2, 1869. C. M. TESSIÉ DU MOTAY. *Improvement in preparing zirconia for use in producing light, and for other purposes.*

The silicate of zirconium is treated with chlorine in the presence of charcoal, transforming it into the double chloride of zirconium and of silicum; the latter is volatilized off and the chloride of zirconium is then converted into an oxide; the zirconia is then moistened and molded; an agglutinating agent can be used; the pencils, disks, etc., are then highly heated and annealed.

377,701—February 7, 1888. C. A. VON WELSBACH. *Process of obtaining salts of cerium, etc.*

Compounds of the rarer metals—cerium, lanthanum, and didymium—are obtained from their earths by heating the mineral earth, plunging the heated earth into water, crushing, dissolving the fragments in a mineral acid, as concentrated hydrochloric acid, and precipitating by oxalic acid, washing and filtering the precipitate, heating it and afterwards dissolving it in nitric acid, digesting the solution with excess of the earth, separating the precipitate and the solution, dissolving the precipitate in nitric acid, and so producing cerium nitrate, concentrating the solution and heating it with nitric acid and ammonium nitrate, and then separating by fractional crystallization the ammonium double nitrates of lanthanum and of praseodymium and neodymium.

396,300—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

396,301—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

396,302—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

306,303—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

396,304—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

396,305—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

396,306—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

396,307—January 15, 1889. J. L. STEWART AND J. L. HASTINGS. *Plastic mineral composition, etc.*

See Group XV, Plastics, Other Plastics.

396,693—January 22, 1889. J. L. HASTINGS. *Process of producing refractory compounds.*

A refractory crystalline compound, available for incandescent illumination, is produced by forming a base from two or more pulverized mineral substances—such as oxides, carbonates, or sulphates of metals, e. g., an intimate mixture of strontium oxide (caustic) and carbonate, calcium oxide and carbonate, and magnesium oxide and carbonate—mixing said base with a flux composed of one or more haloid salts—such as chlorides, iodides, fluorides, or bromides of metals, e. g., a mixture of calcium iodide, magnesium chloride, strontium chloride, and calcium fluoride—moistening the mixture with perchloric acid, molding and drying, and finally exposing to a high temperature.

400,335—March 26, 1889. J. L. HASTINGS. *Plastic mineral composition.*

See Group XV, Plastics, Other Plastics.

400,336—March 26, 1889. J. L. HASTINGS. *Plastic mineral composition.*

See Group XV, Plastics, Other Plastics.

409,584—August 20, 1889. J. L. HASTINGS. *Plastic mineral composition.*

See Group XV, Plastics, Other Plastics.

409,653—August 20, 1889. C. A. VON WELSBACH. *Process of obtaining zirconium nitrate.*

Zirconium nitrate in a form suitable for an incandescent body is produced by first converting the zirconium into a sulphate, and after treating with ammonia dissolving the same in nitric acid, thereby obtaining a precipitate which is digested with ammonia, dissolved in nitric acid, and evaporated.

410,865—September 10, 1889. F. THIELE. *Process of making zirconium nitrate.*

Water-soluble nitrate of zirconium is produced by subjecting zirconium ores to the action of hydrochloric acid, heating the residue with sulphuric acid for several hours to form zirconium sulphate, and adding a concentrated solut on of barium nitrate to form by reaction therewith zirconium nitrate, barium sulphate being precipitated.

571,531—November 17, 1896. R. LANGHANS. *Process of producing coatings composed of earthy oxids.*

See Group X, Electro-chemistry.

571,532—November 17, 1896. R. LANGHANS. *Process of producing coatings composed of earthy oxids.*

See Group X, Electro-chemistry.

617,636—January, 10, 1899. W. BUDDEUS. *Process of obtaining thorium oxids.*

Monazite sand is comminuted and introduced into molten alkali hydrate; the resultant mass dissolved in hot water; the resultant alkali phosphate crystallized out; the mother liquor evaporated; water added to the residue, stirred, and the liquor containing the oxides of thorium and of the cerium bases is decanted or otherwise removed from the heavy sediment of ferrous titanate and zircon. The mixture of the oxides of thorium and of the cerium bases is treated with sulphurous acid to dissolve out the oxides of the cerium bases and leave the thorium oxide.

PLATINUM METALS.

241,216,—May 10,1881. J. HOLLAND. *Process of fusing and molding iridium.*

The metal is subjected to a high heat and then about one-fourth its weight of phosphorus is added, when it quickly fuses and is cast in highly heated molds. As soon as set it is placed in a crucible with lime, and again highly heated to eliminate the phosphorus.

HYDROCARBONS.

CARBON COMPOUNDS.

130,909—August 27, 1872. H. J. FENNER AND F. VERSMANN. *Improvement in the manufacture of anthracene.*

Anthracene is obtained by the distillation of coal-tar pitch by a regulated temperature of from 315° to 425° C. from heat externally applied. A partial vacuum assists the distillation.

173,862—February 22, 1876. C. LOWE AND J. GILL. *Improvement in processes for separating mixed coal-tar products.*

Carbolic acid is crystallized from mixed tar acids by successive steps of refrigeration, crystallization, and dehydration, the mixed tar acids being in a state of partial or complete hydration.

227,538—May 11, 1880. F. SALATHÉ. *Manufacture of anthracene.*

Anthracene tar, produced by treating petroleum or its derivatives in the presence of charcoal at a dull red heat (400° to 550° C.), and condensing the tarry matter produced.

372,243—October 25, 1887. J. VAN RUYMBEKE. *Aniline tar.*

Tar containing about 7 per cent of nitrogen and available for the direct production of aniline by treatment with acid is obtained from concentrated tank waters by distillation.

386,830—July 1, 1888. W. KELBE. *Process of obtaining retene.*

Retene ($C_{18}H_{18}$) is produced by heating resin-oil—a product of the dry distillation of colophony—with sulphur until the formation of hydrogen sulphide is finished. The raw retene obtained by distillation of the residue. or by extraction by a solvent, is purified by repeated crystallizations.

563,528—July 7, 1896. T. L. WILLSON. *Process of manufacturing hydrocarbon gas.*

See Group X, Electro-chemistry.

588,230—August 17, 1897. E. F. MACKUSICK. *Process of generating gas from carbides.*

The carbide is treated with a mixture of water and glycerine, or other nonvolatile, noninflammable, and recoverable fluid which does not react upon the carbide, the whole mass of carbide being exposed to the action of the liquid, which is compounded in accordance with the desired strength of the current of gas.

596,139—December 28, 1897. W. BOLTON. *Process of generating acetylene gas.*

Calcium carbide is impregnated with a substance substantially insoluble in water—such as stearine, the rate of gas generation being regulated by the degree of impregnation.

625,479—May 23, 1899. F. ULLMANN. *Process of purifying acetylene gas.*

Impure acetylene gas is treated with oxidizing chromic compounds in which the chrome is present as an acidifier—for instance, with chromic acid or aqueous or acidified chromic-acid solution or acidified bichromate solution—for the purpose of oxidizing the impurities.

635,017—October 17, 1899. C. B. JACOBS. *Process of making benzine and homologues.*

Hydrocarbons are produced by mixing together a metallic carbide and a fusible metallic hydrate of molecular equivalent weights—as barium carbide and barium hydrate—and subjecting the mass to a heat sufficient to fuse the hydrate, forming an oxide and benzene and its homologues, anthracene, napthalene.

638,175—November 28, 1899. E. S. DOLAN. *Method of generating acetylene gas.*

Small quantities of calcium carbide are tightly wrapped in a plurality of thicknesses of pliable, porous material—as coarse cheesecloth—and several of the packages are placed within a gas-generating chamber in contact with each other and water is applied.

641,444—January 16, 1900. E. DE FAZI. *Manufacture of gas.*

A mixture of calcium monoxide, colophony, and calcium carbide—as calcium monoxide, 80 parts; colophony, 10 parts; and calcium carbide, 5 parts—is treated with water.

646,019—March 27, 1900. E. DE FAZI. *Manufacture of gas.*

A mixture of calcium monoxide, bitumen, and calcium carbide—as calcium monoxide, 80 parts; bitumen, 10 parts; and calcium carbide, 5 parts—is treated with water.

647,295—April 10, 1900. O. ERNST AND A. PHILIPS. *Material for purifying acetylene gas.*

A solid, highly porous metal containing a salt of hypochlorous acid; as bleaching powder stirred into a sludge with slacked lime and calcium chloride and dried at such a temperature that the salt of hypochlorous acid does not decompose.

647,559—April 17, 1900. J. A. DEUTHER. *Process of producing ethylene gas.*

Ethylene gas, C_2H_4, is produced by decomposing water in the presence of a compound composed of a metal capable of decomposing water, and the carbide of such metal, whereby the nascent hydrogen transforms the generated acetylene into ethylene.

648,638—May 1, 1900. J. H. GREEN. *Process of manufacturing gas.*

Calcium carbide and liquid hydrocarbons, as gasoline, are placed in a vessel and water fed at intervals to the mixture, whereby the generated gas will pass through the liquid hydrocarbons and collect gas from the same.

659,448—October 9, 1900. M. P. E. LETANG. *Process of generating acetylene gas from carbide of calcium.*

Calcium carbide and glucose, or like substance, which will render lime soluble or fluid, are simultaneously subjected to the action of water.

661,401—November 6, 1900. E. FOUCHÉ. *Process of storing explosive gases.*

The receiver is filled with a porous substance provided with numerous separate small bores or perforations, filled with a suitable fluid, and the compressed gas is charged into the receiver where it is absorbed by the liquid and stored in isolated quantities; or the gas itself is compressed into liquid form and stored thereby in isolated quantities in the porous substance.

622,258—November 20, 1900. E. N. DICKERSON. *Process of storing acetylene gas.*

Liquefied acetylene gas is mingled, in miscible proportions, with a solvent, such as fusel oil, and maintained under a reduced pressure.

HALOID COMPOUNDS

CHLORIDES

218,671—August 19, 1879. J. F. GESNER. *Improvement in manufacture of ethyl-chloride.*

A current of hydrochloric-acid gas is passed through a boiling alcoholic solution, the water and alcohol separated from the resulting gas, and the chloride-of-ethyl vapor purified and condensed as a continuous operation.

220,397—October 7, 1879. J. W. MALLET. *Improvement in the manufacture of chloroform and allied products.*

Chlorine, or other analogous element, and methane, ethane, or other hydrocarbon gas, are passed through a body of porous material not acted upon by the chlorine, as prepared carbon. The temperature should be between 30° and 90° C.

322,194—July 14, 1885. G. MICHAELIS. *Manufacture of chloroform and of purified acetates.*

Crude acetates are subjected to dry distillation at high temperatures to remove the fluid products therefrom, which are subjected to the action of a hypochlorite and the chloroform condensed, the residual products of the dry distillation being suitable for conversion into acetic acid or purified acetates.

383,992—June 5, 1888. G. RUMPF. *Manufacture of chloroform from acetone.*

Acetone in a dilute state is periodically introduced into the bottom of a still containing cloride of lime solution with agitation of the solution. The chloride of lime employed is more than five times the weight of the acetone, resulting in the chloroform produced equaling the acetone in volume.

427,744—May 13, 1890. T. F. COLIN. *Process of obtaining chlorine compounds from natural gas.*

See Group X, Electro-chemistry.

435,862—September 2, 1890. E. G. SCOTT. *Process of making carbon tetrachloride.*

Chlorine is passed into iodine and carbon bisulphide and the resultant mass fractionally distilled, whereby the tetrachloride is separated from the sulphur bichloride, the latter being left as a by-product. The iodine is separated from the tetrachloride by caustic alkali, and a mixture or compound of carbon sulphide and iodine is produced, suitable for use in the first step.

489,592—January 10, 1893. R. P. PICTET. *Process of purifying chloroform.*

Commercial chloroform is cooled to −80° to −82° C. and the solid bodies removed by filtration. It is then cooled below −80° C. and the noncrystallizable parts, which contain impurities, removed. The chloroform is then distilled at a very low temperature and the middle 80 per cent of the product taken as chemically pure.

535,270—March 5, 1895. R. AUSCHÜTZ. *Process of obtaining chloroform.*

Chemically pure chloroform is produced by decomposing by heat double compounds of chloroform and lactid-like condensation products, derived from ortho-phenol carbonic acids, as salicylid, and condensing the pure chloroform. Salicylid-chloroform is prepared by boiling salicylid in chloroform.

551,131—December 10, 1895. P. MONNET. *Process of making toluenesulphochlorids.*

Liquid or ortho-toluenesulphochloride is produced by the direct action of chlorsulphonic acid on toluene at a temperature not exceeding 5° nor below 0° C., in the presence of a large excess of said acid and with constant agitation.

554,974—February 18, 1896. H. BAUM. *Process of making orthohalogenphenol.*

Orthohalogens of phenol, particularly the bromine and chlorine combinations, are produced by the action of the desired halogen upon phenol heated to about 150° C. It is purified by binding a portion of the product to an alkali base and the ortho compound is separated in a pure state by distillation.

573,483—December 22, 1896. O. PORSCH. *Process of making chloroform and apparatus therefor.*

Vapors from the dry distillation of an acetate, and chlorine gas, are continuously discharged, in opposite directions, under pressure, in an aqueous bath of an alkaline earth, as milk of lime, subjected to heat. The hydrochloric acid is separated from the resultant vapors and the chloroform vapors condensed.

578,839—March 16, 1897. B. R. SEIFERT. *Process of making aromatic nitrosulfo chlorids.*

Aromatic nitro compounds are heated with chlorhydrin sulphuric acid in excess of one molecule. The liquid mass is then poured onto ice and the precipitated nitrobenzenesulpho-chloride strained off. The acid in the mother-lye is converted into sodium salt, and then treated with the chloride of a mineral acid to obtain a further quantity of the chloride.

603,195—April 26, 1898. W. MAJERT. *Process of purifying orthotoluenesulfochlorid.*

A part of the orthotoluene-sulpho-chloride is distilled out from a mixture of the ortho and para-chlorides; the residue is then cooled to crystallize out a part of the paratoluene-sulpho-chlorides, when the liquid is again distilled and again cooled.

606,470—June 28, 1898. P. P. MONNET. *Process of making chlorin derivatives of toluene.*

The ortho or paratoluene-sulpho-chloride when heated to 150° C. is treated with a current of dry chlorine gas and the reaction maintained at 150° to 200° C. until the required chlorine has been absorbed.

BROMIDES.

462,544—November 3, 1891. F. H. FISCHEDICK AND C. E. KOECHLING. *Bromine compound.*

Bromamid, (tribrom bromanilid), a new compound for use as an antiypyretic, of the formula $C_6H_2B_3$, NH. HBr; m. p. 115° C. It is formed by the action of bromine on a solution of aniline in alcohol.

621,319—March 21, 1899. J. BREDT. *Bromin derivative of phthalimid, and process of making same.*

A new compound, $C_8H_4NO_2$ Br, a white crystalline powder, m. p. 206° to 207° C., yielding bromine when strongly heated, is produced by dissolving phthalimid in dilute caustic lye, stirring the solution into an ice-cold aqueous solution of bromine, and filtering and drying at a low temperature.

IODIDES.

322,940—July 28, 1885. T. KEMPF. *Manufacture of iodoform, bromoform, and chloroform.*

See Group X, Electro-chemistry.

436,250—September 9, 1890. J. MESSINGER AND G. VORTMANN. *Substitute for iodoform.*

A new product; a red brown odorless powder; m. p. 225° C. It is derived from iodine and salycylic acid.

446,875—February 24, 1891. J. MESSINGER AND G. VORTMANN. *Compound of iodine with thymol.*

A new iodine substitution product of thymol; an amorphous odorless brown-red powder; m. p. 110° C. It is produced by the action on an aqueous solution of thymol to which soda lye has been added, of a solution of iodine in an alkaline iodide at a temperature of 15° C.

454,223—June 16, 1891. E. OSTERMAYER. *Compound of antipyrine and iodine.*

A new compound for medicinal purposes, having the formula $C_{11}H_{11}IN_2O$; m. p. 160° C. It is formed by the action of potassium carbonate and iodine upon a solution of antipyrine.

472,828—April 12, 1892. L. SCHOLVIEN. *Iodine derivatives of acetyl paramidophenetole.*

Tri-iodine-diacetyl paramidopenetole, or "iodophenin," is a new product of the formula $C_{20}H_{25}N_2O_4I_3$; M. P. 130°. It is produced by combining a solution of acetyl paramido-phenetole with a solution of iodine.

509,617—November 28, 1893. F. GOLDMANN. *Pharmaceutical compound.*

A new compound, of the formula $C_7H_6OI_3$, a white crystalline powder, m. p. 121.5° C., soluble in ether, etc., but with difficulty in alcohol, is produced by treating one molecular proportion of creosotinic acid with three of iodine.

561,531—June 2, 1896. L. C. URBAN. *Carvacrol iodid.*

A new product, an amorphous yellowish-gray or buff powder, m. p. 153° C., insoluble in water and alkali, is produced by dissolving in water a mixture of carvacrol 1 part, and sodium hydroxide 2 parts, and adding an aqueous iodine solution with constant stirring at 15° C.

575,175—January 12, 1897. A. SCHUFTAN. *Iodoform substitute.*

A new product, a yellow, light powder, insoluble in water, soluble in alcohol, etc., decomposing at 127° C., is produced by dissolving methylenebisphenyldimethylpyrazolon in hydrochloric acid and adding bromine water to the solution.

576,494—February 2, 1897. A. CLAUS. *Metaiodinorthoöxyquinolinana-sulfonic acid.*

A new product, m. p. 285° C, with separation of iodine, sparingly soluble in water; is produced by subjecting an alkaline solution of orthoöxyquinolinana-sulphonic acid to the action of an iodine, and then to the action of hydrochloric acid.

618,167—January 24, 1899. A. CLASSEN. *Sodium salt of iodin compound.*

See Group X, Electro-chemistry.

618,168—January 24, 1899. A. CLASSEN. *Iodin derivatives of phenols and bismuth salts thereof.*

See Group X, Electro-chemistry.

627,981—July 4, 1899. A. CLASSEN. *Iodin compound and process of making same.*

New compounds, odorless, derived from phenolphtalein in the form of powders, of the general formula $C_{20}H_{10}I_4O_4$, in which the hydrogen atoms of the hydroxyl groups may be replaced by metallic atoms, as tetraiodophenolphtalein. They are produced by reacting with iodating agents upon a solution of phenolphtalein. The product is treated with an acid; the precipitate dissolved in sodium hydrate, and treated with a metallic salt.

627,982—July 4, 1899. A. CLASSEN. *Iodin derivatives of aromatic amins and process of making same.*

New odorless compounds are produced by treating a secondary aromatic amin, as diphenylamin, with iodine, and absorbing the hydroiodic acid formed with mercury oxide. The product is combined with a substance, such as acetyl chloride, adapted to form a derivative containing the iodine atoms in the nucleus.

641,491—January 16, 1900. A. BISCHLER. *Iodochloroxyquinolin.*

A new product, a greyish-yellow, scentless powder, almost insoluble in water, is obtained by treating an aqueous solution of an alkaline salt of the chlor-5-oxy-8-quinolin with potassium iodide and hypochlorites.

143,144—February 13, 1900. L. LEDERER. *Process of preparing haloid derivatives of acetone.*

A halogen is caused to react with acetone dicarbonic acid in the presence of a substance adapted to act on the corresponding halogen hydrogen acid

FLUORIDES.

643,835—February 20, 1900. F. VALENTINER. *Process of making fluoroform.*

An intimate mixture of iodoform, fluoride of silver, and inert granular material, as sand, is warmed.

ALCOHOLS AND PHENOLS.

252,782—January 24, 1882. A. LIEBMANN. *Manufacture of the higher homologues of phenol, naphthol, and resorcin.*

Phenol, naphthol, and resorcin are transformed into their higher homologues by subjecting them in a suitable still to the action of the corresponding fatty alcohols in the presence of chloride of zinc.

407,442—July 23, 1889. E. MEYER. *Process of obtaining methyl alcohol from wood-pulp lyes.*

Lyes produced in the manufacture of wood pulp are concentrated, mixed with charcoal, briquetted, distilled, and the methyl products condensed. The charcoal is revived for further use by lixiviation. The distillate is free from formic, acetic, and other tar acids.

427,620—May 13, 1890. K. SCHOLZ. *Obtaining permanent hydroquinone.*

Permanent or durable hydroquinone in citron yellow crystals is obtained by recrystallizing in the presence of sulphuric acid.

466,913—January 12, 1892. B. R. SEIFERT. *Carbonate of guaiacol and creosol.*

New medical compounds obtained by the action of phosgene on guaiacol or the homologue creosol. Carbonate of guaiacol, having a m. p. of 85° C., is of the formula CO $(OC_6H_4OCH_3)_2$. If creosol is used, the homologous carbonate has a m. p. of 145° C.

479,781—August 2, 1892. C. W. BRUNSON. *Process of purifying liquids.*

See Group X, Electro-chemistry.

482,101—September 6, 1892. B. R. SEIFERT. *Process of making disinfectants.*

Phenols difficultly soluble in water, as cresol or crude carbolic acid, are converted into soluble disinfecting mixtures by mixing with water and a metallic salt of an aromatic compound of the classes of aromatic acids and phenols, as salicylate of soda.

495,204—April 11, 1893. J. MESSINGER, G. VORTMANN AND H. JANSSEN, *Compound of cresol, etc.*

A new compound, para-isobutyl-ortho-cresoliodide, a yellow powder, insoluble in water and caustic alkalis, decomposing above 60° C., is produced by treating para-isobutyl-alpha-cresol in alkaline solution with iodine.

501,235—July 11, 1893. B. R. SEIFERT. *Creosote compound.*

A new compound, creosote chemically united with carbon dioxide, being a semi-fluid oil, not caustic, is produced by treating creosote dissolved in soda lye with phosgene, or by heating creosote with ethers of carbonic acid.

516,358—March 13, 1894. B. R. SEIFERT. *Phenol-bismuth compound.*

New antiseptic compounds of phenols in chemical combination with bismuth, nearly non-poisonous, neutral and insoluble in water, alcohol and ether, are produced by treating the poisonous phenols in an acid, neutral or alkaline solution with bismuth salts, filtering and washing.

526,786—October 2, 1894. O. MANASSE. *Process of making phenol alcohol.*

Formaldehyde is caused to act on phenol or phenol-like substances in the presence of alkaline or neutral condensing agents, such as soda lye, potassa lye, potassium cyanide, etc.

541,096—June 18, 1895. E. R. KOBERT. *Process of precipitating blood by pyrogallic acid.*

A blood-forming iron preparation is formed by treating blood with pyrogallic acid and washing the precipitate with alcohol.

543,214—July 23, 1895. W. MAJERT. *Aromatic glycocol derivative.*

Glycocol derivatives, crystalline or crystallizable, and having but one acetamid remainder bound to one nitrogen atom, and containing the group $NHCOCH_2NH_2$, are produced by treating a glycocol ether or glycocolamid, preferably the hydrochlorides, with primary aromatic amins, and separating the derivative by means of an excess of ammonia.

548,719—October 29, 1895. P. P. MONNET. *Process of making rhodinol.*

Raw rhodinol, obtained by fractional distillation of oil of geraniums, is treated with acetic acid; the acetic ether of rhodinol is purified by washing and distillation, and the rhodinol regenerated by saponification of this acetic ether of rhodinol by digesting it with alcoholic caustic alkali. The product is then subjected to several fractional distillations, with the separation as a by-product of a mixture of licaréol and an acetone, having an odor of menthene.

554,938—February 18, 1896. L. LEDERER. *Process of obtaining phenols.*

Substances containing phenols, as crude cresols, etc., are subjected to the action of choloracetic acid in the presence of soda lye. The alkaline salt produced is then treated with a suitable dilute mineral acid to produce free phenoxacetic acids, which are treated with mineral acids to produce phenols.

563,975—July 14, 1896. L. LEDERER. *Process of obtaining oxybenzylic alcohol.*

An aromatic phenol is caused to react with formic aldehyde in the presence of a nonacid condensing agent: the free phenol is removed by steam, and the oxybenzylic acid extracted with ether.

574,421—January 5, 1897. L. O. HELMERS. *Process of obtaining aqueous solutions of phenols.*

A new product, of a viscid brown color, smelling of phenol, consisting of a phenol and the sulphonic-acid compound of ichthyol or thiol (a chemical combination of a sulphureted hydrocarbon compound, containing at least 5 per cent of sulphur and sulphuric acid) and soluble in water, is produced by the reaction of the said constituents in a solvent, and evaporation.

577,302—February 16, 1897. A. HESSE. *Terpene alcohol.*

A new product, $C_{10}H_{20}O$, (b. p. at air pressure 226° C.), noncombining with calcium chloride, is produced from volatile saponified oils, particularly African, Reunion, and other geranium oils, by heating with an acid anhydrid, removing the nonalcoholic ingredients by distillation with steam, saponifying the residual esters with alkalies, also under pressure, and distilling the terpene alcohol with steam.

607,494—July 19, 1898. G. TOBIAS. *Process of making pyrocatechin.*

Salts of the phenoltrisulpho-acid are heated with caustic alkali to above 200° C., and the alkaline salt of the pyrocatechindisulpho-acid thus obtained is heated with water in a closed vessel to about 160° C. for several hours.

625,480—May 23, 1899. H. VIETH. *Process of rendering ichthyol odorless.*

Ichthyol compounds are distilled with steam under a pressure less than an atmosphere.

651,061—June 5, 1900. A. WEINBERG. *Diamidonaphthol.*

A new diamidonaphthol, having the constitution $NH_2:NH_2:OH=2:8:7$, melting at 220° C. while decomposing, is produced by the combination of the 2-7-amidonaphthol with diazo bodies in an alkaline solution, and reduction of the thus obtained azo dyestuffs.

ALDEHYDES AND THEIR PRODUCTS.

483,290—September 27, 1892. I. ROOS. *Process of making salicylaldehyde-alpha-phenylmethyl hydrazone.*

A new compound, being a white crystalline powder, insoluble in water, of m. p. 73° C. It is produced by combining salicylaldehyde and alphamethylphenyl hydrazine in a solvent, such as methyl alcohol.

504,626—September 5, 1893. J. SCHMID. *Medical compound.*

A new compound, crystallizing in yellowish flat needles, m. p. 90°–91° C., and insoluble in water, is produced by the action of salicylaldehyde on paraphenetidin.

543,193—July 23, 1895. A. SCHMIDT. *Production of protocatechuic aldehyde-meta-alkyl ethers.*

A new group, as protocatechuic aldehyde-meta-ethyl-ether, which crystallizes out of water in small glittering scales and has a m. p. of 77.5° C., is produced by the reaction of a compound of the type of benzenesulpho chloride upon a mono-metallic salt of protocatechuic aldehyde, alkylating a salt of the so-formed compounds of the type of para-benzene-sulphoprotocatechuic aldehyde, and splitting off the ether product from the compounds of the type of para-benzene-sulphoprotocatechuic aldehyde-meta-alkyl ether obtained in that way by means of saponification agents, such as potassium or soda lye.

545,099—August 27, 1895. A. SCHMIDT. *Protocatechuic aldehyde-meta-alkyl ethers and process of making same.*

The ethers are produced by causing a suitable compound of the type of benzyl chloride to act upon a mono-metallic salt of protocatechuic-aldehyde, alkylating a salt of the so-formed compounds of the type of para-benzyl-protocatechuic-aldehyde, and separating from the product the protocatechuic-aldehyde-meta-alkyl ether by decomposition, as by hydrochloric or hydrobromic acid.

575,237—January 12, 1897. B. HOMOLKA. *Process of manufacturing aromatic aldehydes.*

Monobenzylanilin, its homologues or nitro products, is oxidized in the presence of a dilute mineral acid, such as an acidulated bichromate solution.

581,053—April 20, 1897. F. ACH. *Process of obtaining cinnamic aldedyde.*

Benzaldehyde and acetic aldehyde are dissolved in alcohol, cooled to 10 C., and treated with concentrated soda lye with agitation.

598,914—February 15, 1898. E. H. C. DÜRKOPF. *Formaldehyde tannin.*

New compounds, methylene-di-tannins—as methylene-di-gallotannic acid, $C_{29}H_{20}O_{18}$,—a reddish-white light powder, decomposing at 230° C.—are produced by reacting upon tannin with formic aldehyde in the presence of a condensing agent, as hydrochloric acid, the formic aldehyde being molecularly equivalent to one-half the amount of tannin.

601,072—March 22, 1898. E. H. C. DÜRKOPF. *Formaldehyde proteids containing iodin.*

New compounds, reddish-yellowish powders, liberating iodine on decomposition, are produced by allowing iodine or an iodine solution, as that of potassium iodide, to act upon a formaldehyde-proteid—as for instance casein—combination.

602,697—April 19, 1898. A. CLASSEN. *Formaldehyde starch and method of making same.*

New chemical compounds of formaldehyde and starch, not decomposed by heating to 180° C., are produced by heating the said substances together under pressure to about 100° C., the compounds obtained being again treated with formaldehyde, and excess of formaldehyde removed.

613,460—November 1, 1898. P. P. MONNET. *Process of making aromatic aldehydes.*

The methyl group in compounds of the aromatic hydrocarbon series is aldehydized by treating the compound, such as nitrotoluene, with an oxidizing agent, such as manganese binoxide (Weldon mud) and sulphuric acid, in such a proportion that the agent is insufficient for the oxidation of the total methyl to aldehyde, and then separating out the aldehyde produced.

636,994—November 14, 1899. B. HOMOLKA AND A. STOCK. *Process of obtaining ortho and para nitro benzaldehyde.*

Nitrobenzylidenanilinsulphonates, where the nitro group is in ortho or para position to the CH group, are made to react with the salts of a primary aromatic base, and the nitrobenzyliden bases thus obtained are treated with dilute mineral acid.

640,564—January 2, 1900. B. HOMOLKA AND A. STOCK. *Process of making amidobenzaldehyd.*

The elements of water are linked to the amidobenzylideneanilin compounds, and the mixture of aniline base and aldehyde thus obtained separated in the usual manner.

650,022—May 22, 1900. H. OPPERMANN. *Volatile chloral compound, and process of making same.*

Bromine is first treated with menthol, slowly and while keeping them cool, and then chloral is added.

VANILLIN.

151,119—May 19, 1874. W. HAARMANN. *Improvement in the manufacture of artificial vanillin.*

Artificial vanillin is produced by treating a solution formed of coniferin or the cambium of coniferous woods, with chromate of potassa and sulphuric acid, heating, distilling, and treating the residuum with ether.

192,542—June 26, 1877. F. TIEMANN. *Improvement in manufacture of vanillin.*

The process consists, first, in adding to an etheric solution of oil of cloves, hydrate of sodium (or potassium) and acidulating with sulphuric or hydrochloric acid, eliminating the ether by distillation; second, heating the eugenol so obtained with the addition of acetic anhydride, adding warm water to the cooled liquid, and permanganate of potassium, eliminating therefrom the manganese dioxide; third, adding an excess of hydrate of sodium to the filtered liquid, and evaporating; and, finally, adding sulphuric or hydrochloric acid to the concentrated solution, agitating the same with an addition of ether, and purifying the vanillin so obtained by any of the known methods.

457,863—August 18, 1891. G. DE LAIRE. *Process of making isoeugenol.*

Isoeugenol, for use in the production of vanillin, is made by heating eugenol or essence of cloves with hydrate of potassa and alcohol, expelling the alcohol with steam, and separating the isoeugenol by treating the mass with acid and decanting it. It is an oily substance, boiling at from 252° to 262° C.

457,864—August 18, 1891. G. DE LAIRE. *Process of making compounds of isoeugenol.*

Monomolecular derivatives of isoeugenol are obtained by heating a mixture of isoeugenol and an organic anhydride acid, as anhydrous acetic acid. Acetyl isoeugenol melts at 80° C., benzoyl isoeugenol at 104° C.

487,167—November 29, 1892. F. ACH. *Eugenol benzyl-ether and process of preparing same.*

A new compound, a colorless oil, solidifying in thick prisms, m. p. 29° to 30° C., is produced by dissolving eugenol in rectified spirits, adding caustic potash and benzyl chloride, heating the mixture, and then distilling off the spirits, and precipitating eugenol benzyl-ether with water. It is purified by shaking with dilute alkali and distilling in a partial vacuum.

487,204—November 29, 1892. F. ACH. *Process of preparing vanillin.*

The process consists in the following steps: First, dissolving eugenol in alcohol, adding thereto alkaline hydrate and a halogen compound of benzyl, and heating the mixture; second, dissolving the resulting eugenol benzyl-ether in alcohol, adding thereto alkaline hydrate, keeping the same at the boiling point for some time, then partially distilling off the alcohol, and adding water to the residue; third, adding to the resulting isoeugenol benzyl-ether a mixture of sodium chromate, sulphuric acid, and water; and, finally, adding hydrochloric acid to the resulting vanillin benzyl-ether.

Vanillin benzyl-ether, a new compound, has a m. p. of 63° to 64° C. and a formula of C_6H_3, CHO, OCH_3, $OCH_2C_6H_5$.

487,205—November 29, 1892. F. ACH. *Isoeugenol benzyl-ether and process of preparing the same.*

A new compound, crystallizing in fine felted needles, m. p. 58° to 59° C., and used in the preparation of vanillin, is produced by dissolving eugenol benzyl-ether in rectified spirits, adding caustic potash, keeping at the boiling point for from sixteen to twenty-four hours, and then partially distilling off the alcohol and adding water to the residue. The isoeugenol benzyl-ether is purified by pressing and recrystallizing from alcohol.

497,546—May 16, 1893. G. DE LAIRE. *Process of making vanilloyl-carbonic acid and vanillin.*

Crude vanillin is first treated with bisulphite of soda in water; alcohol is then added little by little until the latter takes up the vanillin salts; when the alcoholic and aqueous solutions are separated and the aqueous liquor is treated with sulphuric acid to set free the vanilloyl-carbonic acid, which is dissolved out with ether and the solvent evaporated. Vanilloyl-carbonic acid is heated above 134° C., its M. P., when it separates into vanillin and carbonic acid; the fused mass is dissolved in ether, agitated with an aqueous solution of carbonate of magnesia, and the ether which holds the vanillin in solution evaporated.

519,693—May 15, 1894. J. BERTRAM. *Process of making vanillin.*

Vanillin and its isomers are produced by treating the metallic compounds of protocatechuic aldehyde, such as sodium protocatechuic aldehyde, with haloid compounds of methyl, as methyl-iodide, or methyl sulphates.

553,039—January 14, 1896. M. OTTO AND A. VERLEY. *Process of obtaining vanillin, etc.*

A carbon compound, as isoeugenol, having a benzene nucleus with a lateral chain C_3H_5, in order to produce its corresponding aldehyde, as vanillin, is oxidized by ozone (as by passing a current of ozone through it), and the resulting aldehyde is then isolated.

553,583—January 21, 1896. M. OTTO AND A. VERLEY. *Manufacture of vanillin.*

See Group X, Electro-chemistry.

560,494—May 19, 1896. W. HAARMANN. *Process of obtaining vanillin.*

Isoeugenol is oxidized in a strong alkaline solution by means of a peroxide, as sodium peroxide.

561,077—June 2, 1896. F. ACH. *Process of obtaining vanillin.*

Vanillin benzyl ether is decomposed by treating it with an acid in the presence of an alcohol, then distilling off the alcohol, driving off the benzyl-ethyl-ether and separating the vanillin.

565,918—August 18, 1896. J. L. NOVARINE. *Process of obtaining vanillin.*

A solution of eugenol in a suitable solvent, such as a carbon bisulphide, is subjected to the action of a solution of chromylchloride, the dichlorochromyl-eugenic compound thus obtained is decomposed by water, the products extracted, and the vanillin isolated. The dichlorochromyl-eugenic compound, a new product, is a brown or greenish brown powder, more or less crystalline and easily decomposed by water.

565,919—August 18, 1896. J. L. NOVARINE. *Process of obtaining vanillin.*

A solution of eugenol, or its ether in glacial acetic acid, is subjected to the action of chromyl-chloride in the same solvent; the solution diluted with water; the products extracted, saponified, and the vanillin isolated.

571,917—November 24, 1896. C. BERGMANN. *Process of obtaining vanillin.*

Paraoxybenzaldehyde is changed into the meta-nitro and meta-amido combination, and the latter is then transformed into metamethoxy-paraoxybenzaldehyde (vanillin) by the action of nitrous acid in alcoholic solution.

572,890—December 8, 1896. C. GOLDSCHMIDT. *Vanillin paraphenetidin.*

A new compound, $C_{16}H_{23}O_6N$, yellow crystals, m. p. 97° C., soluble in water, insoluble in ether, is produced by acting upon vanillin with paraphenetidin.

575,070—January 12, 1897. B. R. SEIFERT. *Isohomovanillin.*

New aromatic substances of the formula $C_6H_2(OC_nH_{2n}+1)1(OH)2(CH_3)4$ (COH) 5, whereby the general group $C_nH_{2n}+1$ is limited to the special cases CH_3 and C_2H_5, soluble in soda-lye, ether, and alcohol, forming colorless or yellowish scales and needles, and being especially characterized by a vanilla-like scent and taste. They may be produced by the action of chloroform on isohomopyrocatechinether of the formula $C_6H_3(OC_nH_{2n}+1)1(OH)2(CH_3)4$ or by chloroform on an alkaline solution of isocresol with successive treatment of the product by acid, ether, and sodium bisulphite.

585,584—June 29, 1897. W. MAJERT. *Process of obtaining vanillin.*

An aqueous solution of isoeugenol sodium and a sodium salt of halogen nitrobenzene sulpho-acid is boiled, producing isoeugenol-phenylether nitrosulphate of sodium; the isoeugenol phenylether nitrosulphonic acid is oxidized to a salt of vanillin phenylether nitrosulphuric acid, and the vanillin separated by means of an alkali.

631, 756—August 22, 1899. F. ACH. *Process of making iso-eugenol and derivatives thereof.*

A new compound, mono-eugenol-phosphoric acid, m. p. when hydrated 105° C., is produced by treating eugenol in a neutral condition with phosphorous-oxy-chloride; making an alkaline solution of the product, and acidifying. Treated with alkali, iso-eugenol-phosphoric acid is produced, melting in a dehydrated condition at 133° C. An acid alkali salt is prepared from the last acid, dried and heated, producing iso-eugenol.

ETHERS.

516,766—March 20, 1894. F. KRAFFT AND A. ROOS. *Process of making ether.*

Sulphonic acids, or their ethers, are heated with alcohols producing ethers; as ethyl alcohol added to benzene-sulphonic acid and heated to 135° to 145° C. produces ethyl ether.

475,640—January 19, 1897. P. FRITZSCHE. *Process of obtaining ether.*

Gases containing ethylene, after removal of tar, ammonia, benzol, and hydrogen sulphide, are washed with dilute sulphuric acid to remove hydrocarbons of condensation, then treated with concentrated sulphuric acid at from 100° to 140° C., to absorb the ethylene, and, after dilution, to distillation; the vapors of ether, alcohol, and water, according to their alcohol and ether contents, being passed through ethyl sulphuric acid of varying degrees of dilution.

580,575—April 13, 1897. F. H. HÄHLE. *Catechol ether.*

Monoethyl ether of pyrocatechin, a new substance of the formula $C_6H_4.OH.OC_2H_5$ having a b. p. of 215° C., solidifying at 26° to 27° C., and crystallizing easily into colorless, bright transparent prisms. It is easily soluble in alcohol, in ether, and in diluted aqueous soda-lye, solidifying with concentrated soda-lye into a white salt having an agreeable aromatic smell resembling thymol.

ACIDS.

332,829—December 22, 1885. H. PRINZ. *Manufacture of beta-naphthylamine sulpho-acid.*

See Group XI, Dyestuffs, Artificial, Organic.

333,034—December 22, 1885. H. VOLLBRECHT AND C. MENCSHING. *Manufacture of color-producing acids.*

See Group XI, Dyestuffs, Artificial, Organic.

518,989; 518,990—May 1, 1894. H. A. FRASCH. *Petroleum sulfo-acid.*

See Group XI, Dyestuffs, Artificial, Organic.

563,382—July 7, 1896. F. KRECKE AND I. ROSENBERG. *Amidonaphtholdisulpho-acid K.*

See Group XI, Dyestuffs, Artificial, Organic.

569,419—October 13, 1896. H. LAUBMANN. *Dinitroanthrachrysone-disulphonic acid and method of making same.*

See Group XI, Dyestuffs, Artificial, Organic.

569,425—October 13, 1896. A. PIUTTI. *Paraethoxyphenylsuccinamic acid and method of making same.*

A new product, easily soluble in alcohol and acetic acid, crystallizing in lustrous colorless plates, m. p. 160°–161° C., is produced by heating succinic acid with paraphenetidin until formation of water ceases, dissolving the product in caustic soda, and precipitating by a mineral acid.

606,437—June 28, 1898. F. BENDER. *Amidonaphtholdisulpho-acid and process of making same.*

See Group XI, Dyestuffs, Artificial, Organic.

607,056—July 12, 1898. J. KOETSCHET. *Process of making aldehydo-benzoic acid.*

A new anilin salt, slightly soluble in water, m. p. 165° C., with evolution of gas, becoming on melting an insoluble body with m. p. above 250° C., is obtained by treating ortho-oxalyl-benzoic acid with anilin in aqueous solution. Anilido-benzylidene-ortho-carboxylic acid is obtained by boiling this new anilin salt with a neutral solvent, such as toluene or xylene, and the acid thus obtained is converted into aldehydo-benzoic acid by extracting with ether and vaporizing the ether.

616,123—December 20, 1898. I. LEVINSTEIN AND C. MENSCHING. *Process of making alphylamidonaphthol-sulfonic acids.*

See Group XI, Dyestuffs, Artificial, Organic.

621,679—March 21, 1899. M. H. ISLER. *Oxyanthraquinone sulfo acid and process of making same.*

See Group XI, Dyestuffs, Artificial, Organic.

625,637—May 23, 1899. H. A. MERNTHSEN. *Oxynaphthindophenolthiosulfonic acid and process of making same.*

See Group XI, Dyestuffs, Artificial, Organic.

ESTERS OR SALTS.

93,817—August 17, 1869. L. D. GALE AND I. M. GATTMAN. *Improvement in the manufacture of sugar of lead and acetic acid.*

See Group I, Acetic Acid.

172,999—February 1, 1876. J. W. HAAS. *Improvement in processes for manufacturing cream of tarter.*

Argols with hydrochloric acid, chloride of potassium, and water are treated in a closed vessel with superheated steam for about three hours and the solution then allowed to crystallize.

183,597—October 24, 1876. G. SCHNITZER. (*Reissue: 10,004—January 3, 1882.*) *Manufacture of cream of tarter.*

Argols with hydrochloric acid, chloride of potassium, and water are subjected to steam pressure for the necessary length of time, and the cream of tarter separated from the residual solution after it has crystallized. (Same as No. 172,999.)

217,235—July 8, 1879. E. MULLER. *Improvement in the manufacture of bitartrate of potassa.*

Hydrochloric acid is added to the solution of argols and water—one equivalent by weight of hydrochloric acid to the contained tartrate of lime—and after crystallization of the cream of tarter chalk is added to the mother water to precipitate the tartrates.

222,598—December 16, 1879. E. MUELLER. (*Reissue: 10,011—January 17, 1882.*) *Manufacture of cream of tartar.*

Argols are boiled in water, in the proportion of about 3 pounds to a gallon of water, under pressure of 60 pounds, by steam injected into the water and which is allowed to escape from the converter, the cream of tartar being separated by crystallization.

277,016—May 8, 1883. A. DREYFUS. *Apparatus for treating argols in the manufacture of cream of tartar.*

In the boiling of argols with steam under pressure, boneblack and china clay are successively introduced into the vessel after the boiling has commenced, but before the settling of the solution. The steam is permitted to partially escape during the boiling.

294,592—March 4, 1884. F. DIETRICH. *Manufacture of cream of tartar.*

Dissolved argols are treated with phosphoric acid or its compounds to precipitate iron and alumina, clarified and decolorized.

313,629—March 10, 1885. R. SILBERGER. *Manufacture of cream of tartar.*

The mother liquor obtained in the manufacture of tartaric acid from argols is treated with soda and potassium chlorate to obtain potassium bitartrate, and chlorate of sodium as a by-product.

335,485—February 2, 1886. E. SCHAAL. (*Reissue: 10,823—March 29, 1887.*) *Manufacture of resin-acid ethers,*

Raw resin acids are freed from volatile or soft constituents by distillation or extraction; the hard resin-acid residues are then condensed to ether by treatment with alcohols or phenol at a high temperature, with or without pressure or the addition of substances favoring the reaction, and finally the resin-acid ether is separated into softer and harder resin-like bodies by distillation *in vacuo.*

338,365—March 23, 1886. R. SCHMITT. *Manufacture of salicylic-acid compounds.*

The application of the process of No. 334,290 to the substituted phenolates results in the production of substituted salicylic salts, likewise without any separation of phenol.

348,483—August 31, 1886. H. VON PERGER. *Production of phenyl-methyl oxyquinicine.*

A new product; m. p. 122° C. It is produced by the action of hydrazobenzole upon acetylacetic ether.

350,012—September 28, 1886. M. V. NENCKI AND R. SEIFERT. *Production of salol.*

A new product; m. p. 43° C. It is produced by the action of oxychloride of phosphorous upon a mixture of salicylic acid and a phenol.

350,468—October 5, 1886. R. SCHMITT AND C. KOLBE. *Manufacture of naphthol-carbonic alkaline salts.*

They are produced by the action of dry carbonic acid at atmospheric temperature, either without pressure or with pressure, in conjunction with a cooling process, upon naphthol alkaline salts; the dry naphthol-carbonic alkaline salts thus obtained being converted into alpha or beta carbonaphthol-acid alkaline salts by heating in an hermetically closed vessel at from 120° to 140° C. Carbonaphthol-acid salts are produced direct by the reaction of carbonic acid upon the alkaline salts of alpha or beta naphthol under pressure at 120° to 145° C.

361,690—April 26, 1887. R. GNEHM. *Production of a new ethyl-ether.*

A new ethyl-ether, of the formula $C_{14}H_{24}N_2O_4$; m. p. 126° C. It is produced by the action of acetyl-acetic ether upon ethylenediamine.

366,885—July 19, 1887. E. SCHAAL. *Process of making ethers from petroleum.*

Liquid petrol acid, obtained from petroleum by the process of No. 335,962, is mingled with an alcohol, heated, and the petrol ethers, separated by distillation, are washed and purified.

377,311—January 31, 1888. C. KOLBE. *Manufacture of salicylic acid ester.*

Salol is produced from a mixture of salicylic acid and a phenol by passing a current of phosgene gas therethrough at a temperature of about 170° C.

383,306—May 22, 1888. C. KOLBE. *Manufacture of salicylic-acid esters.*

Salol is produced from a mixture of salicylic acid and a phenol, which may be melted or dissolved in a solvent—as benzole—by the action of trichloride of phosphorus.

391,248—*October 16, 1888.* P. W. HOFMANN. *Process of manufacturing salol.*

Salol is produced by heating phenolate of sodium in an atmosphere of phosgen gas. Salicylate of sodium, previously produced, may be mixed therewith.

439,805—*November 4, 1890.* A. MARTIGNIER. *Process of obtaining cream of tartar.*

Lyes, argols, tartars, and other tartarous matters are treated with an alkaline sulphate, as of soda or potash, the residuum separated from the liquid and cream of tartar precipitated from the latter with sulphuric acid.

453,035—*May 26, 1891.* J. BONGARTZ. *Guaiacol ether.*

A new product, the benzoic ether of guaiacol, having the composition $C_6H_4\left\{\begin{matrix}O.CO.C_6H_5\\O.CH_3\end{matrix}\right\}$ and m. p. 50° C. Crude guaiacol is converted into a salt, preferably its potassium salt, and purified, heated with benzoyl chloride and the benzoyl compound recrystallized from alcohol.

486,770—*November 22, 1892.* P. ERNERT. *Process of making salicylate of phenyl.*

Salicylic acid is heated at or about 230° C., with exclusion of air and vaporization of water.

492,868—*March 7, 1893.* H. JANSSEN. *Salicylic-acid compound.*

A new compound, crystallizing out of alcohol in small white scales, insoluble in cold water, m. p. 187° C., is produced by reacting upon paranitrophenol in the presence of dehydrating agents with salicylic acid, reducing the nitro phenylester of salicylic acid thus obtained, and treating the formed amido phenylester of salicylic acid with acetic acid anhydride, or acetyl chloride in such quantity as is necessary to replace one hydrogen atom of the amido group by an acetyl group.

495,497—*April 18, 1893.* A. LIEBRECHT. *Basic bismuth gallate.*

A new compound, a yellow powder, without odor, soluble in a large excess of mineral acids, and containing 55 per cent to 56 per cent of bismuth oxide—a suitable substitute for iodoform—is produced by dissolving neutral bismuth nitrate in dilute nitric acid, adding a solution of gallic acid in alcohol and water, and to the mixture adding caustic alkali, alkali carbonate or the like until the whole remains but slightly acid, and precipitating with acetate of soda or by diluting with water.

501,446—*July 11, 1893.* E. SCHAAL. *Manufacture of resin-acid esters.*

The aqueous vapors formed during the heating of a resin acid in the presence of an alcohol or hydroxyl derivative are drawn off by suction as soon as the formation of the esters begin, and the alcohols distilled off are replaced by a fresh supply until the formation of the product is completed.

503,743—*August 22, 1893.* F. GEROMONT. *Lactyl-paraphenetidid and process of making it.*

A new compound, of the formula $C_{11}H_{15}NO_3$, crystallizing in white needles, m. p., 117.5° C., and soluble in an abundance of water, is produced by heating the lactate of paraphenetidin to 130° to 180° C. until the resulting watery vapors are completely driven off. The said lactate is formed by dissolving paraphenetidin in dilute sulphuric acid, mixing with a solution of calcium lactate, precipitating the calcium sulphate with alcohol, filtering, and evaporating to dryness.

509,055—*November 21, 1893.* H. THOMS. *Salicylate of tolyldimethylpyrazolon.*

A new crystalline compound, having the formula $C_{12}H_{14}N_2O.C_7H_6O_3$, and m. p. 106.5° C., is produced by heating together aceto-acetic ether and orthotolylhydrazin, methylating the product, and combining therewith salicylic acid.

509,520—*November 28, 1893.* P. FRITSCH. *Salicylic ester of acetol.*

An alkaline salicyate, as salicylate of soda, is heated with mono-halogen-acetone and the alkaline chloride separated from the resulting acetol.

511,143—*December 19, 1893.* W. H. HIGGIN. *Process of making sodium acetate.*

Esparto-liquor and similar alkaline liquors are evaporated and the residue treated by regulated heat, so that the temperature shall exceed 200° C., but shall never reach the heat at which sodium acetate is decomposed (about 400° C.), thereby producing a mass of "char," which upon treatment with water yields a solution of acetate of sodium along with other matters.

253,018—*July 17, 1894.* C. STOEHR. *Dimethylpiperazin tartrate.*

A new compound, having the formula $C_6H_{14}N_2C_4H_6O_6$; a white powder when water free, easily soluble in water, insoluble in alcohol, and m. p. 242°-243° C.; is produced by combining tartaric acid and dimethylpiperazin in equal molecular proportions.

530,826—*December 11, 1894.* C. F. CROSS AND E. J. BEVAN. *Manufacture of cellulose acetate.*

A compound, or intimate mixture, of cellulose and zinc acetate is produced by mixing cellulose hydrate with zinc acetate solution, drying and dehydrating the compound. This product is treated with chloroform, whereby a solution of cellulose acetate is obtained free from cellulose, and the solvent is evaporated.

533,718—*February 5, 1895.* J. MEYER. *Tannin compound.*

A new compound, consisting of a mixture of mono-and diacetyl tannin, an amorphous light-yellow powder, soluble in alcohol and insoluble in water; is produced by heating tannin with a mixture of glacial acetic acid and acetic acid anhydride.

537,841—*April 23, 1895.* J. F. VON MERING. *Process of making ethers of para-oxyphenylurethane.*

New compounds, acidyl combinations of the para-oxyphenylurethans, crystallizing readily, are produced by heating para-oxyphenylurethan with an acidyl reagent.

541,489—*June 25, 1895.* J. F. VON MERING. *Acidyl compound of para-oxyphenylurethan ethers.*

New compounds, readily crystallizable and more or less soluble in alcohol and benzene, are produced by heating the ethers of para-oxyphenylurethans with reagents containing the acidyl group, as acetic acid anhydrid.

541,899—*July 2, 1895.* B. THIEME. *Process of making nitropentaerythrit.*

The pentaerythrit produced by condensation in the presence of lime of acetaldehyde and formaldehyde, is treated with concentrated nitric and sulphuric acids.

544,104—*August 6, 1895.* F. LÜDY. *Bismuth oxyiodidgallate and process of preparing same.*

A new product, a grayish-green amorphous powder, insoluble in water and ordinary solvents and decomposing slowly in moist air, is produced by the reaction of gallic acid upon bismuthoxyiodid.

549,728—*November 12, 1895.* F. KRAFFT AND A. ROOS. *Process of making esters.*

Esters are produced by the action of an alcohol and a carbon acid at a temperature above 100° C., in the presence of an aromatic sulphonic acid.

558,197—*April 14, 1896.* A. MÜLLER-JACOBS. *Process of manufacturing tannate of zirconium.*

A hot saturated solution of tannic acid is slowly added to a hot solution of a soluble salt of zirconium, and the precipitate is washed and dried.

561,730—*June 9, 1896.* B. R. SEIFERT. *Substituted salol.*

New compounds, solid, crystalline, colorless, without smell, soluble in alcohol, insoluble in water, and M. P. from 55° to 170° C., are produced by heating a mixture of a substituted phenol and salicylic acid to 140° C.; adding a dehydrating agent as phosphorous pentachloride; continuing the heating until generation of hydrochloric acid ceases; and then washing and recrystallizing from alcohol.

562,193—*June 16, 1896.* M. OTTO AND A. VERLEY. *Process of obtaining ether.*

The acid ethers of geraninol are produced by heating the natural essences which contain this alcohol with the chlorides of organic acids, as butyric chloride, and an alkaline metal, as sodium, in the presence of a neutral solvent, and separating the ether by distillation. The acid ethers are transformed into new perfumes by partial saponification by heating in an aqueous solution of calcium carbonate for some days in a closed vessel.

563,993—*July 14, 1896.* G. A. WELTER. *Amidoalkylsalicylic acid.*

It is produced by treating nitroalkylsalicylic acid with reducing agents, such as tin and hydrochloric acid. When the product is treated with an acetyl compound, such as glacial acetic acid, acetylamidoalkylsalicylic acid is produced; a new compound, characterized by antipyretic and antineuralgic properties.

569,415—*October 13, 1896.* O. HINSBERG. *Antipyrin mandelate and method of making same.*

A new product, m. p. 52° C., soluble in nearly all solvents and separating out as an oil, and solidifying as an opaque powder, is produced by the reaction of antipyrin with phenylglycollic acid.

569,429—*October 13, 1896.* R. SCHIFF. *Salicylic compound and method of making same.*

A new white crystalline product, a compound of salicylic acid and hexamethylenetetramin, easily soluable in alcohol and water, M. P. 95° C., is produced by simultaneously dissolving the constituents in benzene while heating the mixture and crystallizing.

571,352—*November 17, 1896.* E. FISCHER. *Method of obtaining tetra-alkyt uric acid.*

The salt of a dialkyl uric acid is treated with a haloid ether in an indifferent or inert diluting agent, such as ethyl ether, as by warming an alkaline solution of, a dimethyl uric acid with a solution of potassio-tartrate of copper in excess, then treating the resulting cuprous salt of dimethyl uric acid, mixed with powdered glass, with a haloid ether.

572,345—*December 1, 1896.* H. T. JARRETT. *Process of making potassium bitartrate.*

Argols are first dissolved in a solution of caustic soda and its carbonate to the point of neutralization, one-tenth of the weight of argols added in potassium chloride, filtered, a decolorizing agent added, and the potassium bitartrate precipitated directly from the mixture by an acid.

575,227—*January 12, 1897.* A. GALLINEK AND E. COURANT. *Process of manufacturing esters of diiodosalicylic acid.*

New products, as the alkyl ester of the diiodosalicylic acid, a white crystalline compound, m. p. 132° C., of the formula $C_6H_2I_2{<}\begin{matrix}OH\\COOAlk\end{matrix}$, are produced by subjecting salicylic acid esters to the action of iodine in the presence of a compound, as mercury oxide, which combines with the hydroiodic acid formed.

580,575—*April 13, 1897.* F. H. HÄHLE. *Catechol ether.*

A new product, monoethyl ether of pyrocatechin, m. p. 26°-27° C., b. p. 215° C., solidifying with concentrated soda-lye into a white salt, is produced by the ethylization of pyrocatechin by means of caustic soda and sodium ethyl sulphate.

580,630—*April 13, 1897.* G. WENDT AND J. LEHMANN. *Valeric esters of creosote.*

New products, slightly yellow oily liquids, soluble in alcohol, b. p. 260° C., and in vacuum between 117° and 121° C., are produced by boiling a mixture of the main constituents of creosote—creosol and guaiacol, respectively—with valerianic acid.

580,744—*April 13, 1897.* G. H. WEISS. *Carbonyl metadiamido salicylic acid.*

A new product, crystallizing in white laminæ, m. p. 252° C., soluble with difficulty in water and alcohol, is produced by treating nitroamido salicylic acid with phosgene and reducing the product. The diazo compound forms azo dyestuffs which are easily mordanted.

581,833—*May 4, 1897.* L. SELL. *Salicin compound and process of making same.*

An extract from the fruit of the *Aesculus hippocastanum* in combination with salicin, saligenin, glucose, and free hydrochloric acid, a stable, grayish-yellow powder freely soluble in water; is produced by subjecting salicin incorporated in the vegetable extract to the action of hydrochloric acid, and then adding more salicin.

585,068—*June 22, 1897.* A. WELLER. *Quinin-carbonic ether and process of making same.*

New products, derivatives of the levogyrate alkaloids of cinchona bark, tasteless, soluble with difficulty in water, readily soluble in chloroform and in acid; are produced by the action on the said alkaloids with an ether of chlorocarbonic acid.

588,412—*August 17, 1897.* E. FISCHER. *Trimethylbenzyl-uric acid and process of making same.*

New compounds, as trimethylbenzyl-uric acid, m. p. 171° to 173° C., crystallizing from alcohol in large crystals, insoluble in alkalis, are produced by treating a trialkyl-uric acid together with an alkali, with a haloid ether.

591,483—*October 12, 1897.* G. MERLING. *Compound of gamma-oxypiperidincarboacids and process of making same.*

New products, containing acidyl as well as alkyl groups, mostly colorless crystals, nearly insoluble in water, adapted to combine with inorganic and strong organic acids, are produced by combining triacetonamin and its analogous combinations, as, for instance, benzaldiacetonamin-vinyl-diacetonamin, with hydrocyanic acid, and then saponifying the so-obtained cyanhydrins (nitryls) Gamma-oxypiperidin-carbo acid is heated with both acidyl and alkyl reagents.

599,123—February 15, 1898. H. ENDEMANN. *Glycerol ether of aromatic compounds.*

New products, the glycerin ethers of aromatic substances containing oxygen in the form of hydroxyl, such as guaiacol, and which split and liberate a phenol-like substance and glycerin, are produced by combining the phenol-like substance with sodium hydrate and causing same to act upon monochlorhydrin in molecular proportions, generally at 140° to 150° C.

602,646—April 19, 1898. C. F. M. SCHAERGES AND P. SCHWARZ. *Process of making alkaline acetosulfanilate.*

A new product, soluble in water, is produced by acetylizing an alkaline salt of sulphanilic acid by means of glacial acetic acid, and removing free sulphanilic acid and alkaline acetate with water and alcohol.

602,834—April 26, 1898. O. DOEBNER. *Condensation product from salicylic and gallic acids.*

A new compound, $C_{14}H_{10}O_7$, a white amorphous powder, is produced by the reaction of phosphorous oxychloride on a equimolecular mixture of salicylic and gallic acids, which may be in the presence of a solvent and diluent, as toluene; subsequently removing the formed metaphosphoric acid by pouring the mixture on ice water and then washing and drying.

605,246—June 7, 1898. E. DÜRKOPF. *Bismuth methylene-di-gallate and process of making it.*

A new chemical compound, characterized by a voluminous powdery form, a blue-gray color, insoluble in water, and soluble in alkaline solutions with an orange color, is produced by precipitating bismuth hydroxid from a bismuth salt by an aqueous solution of ammonia, washing the precipitate, and acting upon it by methylene-di-gallic acid and water by gradual addition and slow digestion at a slightly elevated temperature.

606,930—July 5, 1898. L. LEDERER. *Process of obtaining hydroxylized phenyl ethers.*

Mixtures of hydroxylized phenyl ethers with phenols, such as wood-tar oils, guaiacol, etc., are mixed with potassium carbonate, and the resulting mixture is then treated with ether.

607,172—July 12, 1898. K. HOCK. *Pharmaceutical compound and process of making same.*

A new condensation product is produced by the reaction of cold concentrated solutions of one molecule of hexamethylenetetramin and of three molecules of tannin. The precipitate, of a yellowish-brown color, is rendered insoluble, odorless, and tasteless, by heating in a porcelain pan until it forms a hard lump.

610,348—September 6, 1898. A. EINHORN. *Ester of paraämidometaoxybenzoic acid.*

Obtained by heating paraämidometaoxybenzoic acid in alcoholic solution with mineral acids; a white crystalline product, m. p. 120° to 122° C.; useful as an ointment.

614,991—November 29, 1898. P. SCHIDROWITZ AND O. ROSENHEIM. *Piperidyl carbamate of piperidin and process of making same.*

A new product, $C_{11}H_{22}N_2O_2$, white, crystalline, soluble in water, alcohol, etc., m. p. 79° to 80° C., is produced by treating piperidin dissolved in a solvent, as acetone, with carbonic acid.

615,051—November 29, 1898. P. SCHIDROWITZ AND O. ROSENHEIM. *Piperidin salts and process of making same.*

New products, dicarboxylic salts of piperidin, having the form of prismatic plates and soluble in water, as tartrate of piperidin, $C_9H_{17}NO_6$, m. p. 136° to 137° C., are produced by treating piperidin with a dicarboxy fatty acid, such as tartaric acid.

615,307—December 6, 1898. H. REINHARDT. *Orexin tannate and process of making same.*

A new product, an odorless, tasteless, white, or slightly yellow powder, insoluble in water, is produced by mixing an aqueous solution of orexin hydrochlorate with an aqueous solution of tannin at 45° to 50° C., and precipitating with an aqueous solution of sodium acetate.

616,656—December 27, 1898. E. FISCHER. *Process of obtaining alkyl-uric acid.*

The ester of an acid possessing considerable electrical conductivity, such as nitric acid, is added to a solution of uric acid proper with an alkali; the solution is heated under pressure and with agitation, and after adding hydrochloric acid to the hot solution it is cooled and crystallized.

616,700—December 27, 1898. E. FISCHER. *Alkyl derivatives of uric acid and process of making same.*

New compounds, mixed alkyl derivatives of uric acid, as dimethyl-benzyl-uric acid, $C_5(CH_3)_2(C_6H_5CH_2)O_3$, m. p. 282° to 283° C., soluble only in alcohol, are produced by acting upon a mixture of an alkali solution and uric acid with a haloid ether; cooling and separating the monoalkyl derivative of uric acid; then acting upon a mixture of the said derivative and an alkali solution with a haloid ether; cooling; adding more alkali, etc., whereby the tetraälkyl derivative is obtained.

619,549—February 14, 1899. A. EINHORN. *Glycocol ester and process of making same.*

New products, as the methyl ester of diethyl-glycocol-para-amidosalicylic acid, a thick colorless oil, soluble with difficulty in water. They are produced by treating amidocarbonic-acid esters with halogen-substituted acid chlorides and allowing an amin to act upon the resulting halogen-alkyl derivatives.

620,141—February 28, 1899. H. JANSSEN. *Bismuth compound and process of making same.*

A new compound, a brown powder, insoluble in benzene and ligroin, dissolving partially in alcohol under decomposition, is produced by heating a mixture of bismuthoxyiodide and dibromgallic acid at 60° to 80° C. until development of carbon dioxide has ceased.

620,563—March 7, 1899. R. BLANK. *Process of obtaining indoxylic compounds of amido malonic esters.*

The aromatic amido malonic acid esters are heated to 200° to 270° C. until one molecule of alcohol is eliminated.

621,804—March 28, 1899. E. FISCHER. *Alkyl derivative of uric acid and process of obtaining same.*

A sufficient amount both of an alkali and a haloid-ether, such as methyliodid, is added to uric acid proper to make the ratio each of the reagents to the uric acid proper as 4 to 1, whereby tetra-alkyl-uric acid and trialkyl-uric acid are directly obtained.

621,805—March 28, 1899. E. FISCHER. *Process of making alkyl derivatives of uric acid.*

Uric acid is reacted on with an alkali and a haloid ether, as potash lye and methyl iodide, under heat and agitation, in the proportions of two molecules each of the alkali and the haloid ether to one of the uric acid.

622,456—April 4, 1899. H. C. FEHRLIN. *Process of manufacturing salol.*

Basic salicylate of soda with the necessary quantity of phenol is treated with phosphorus oxychloride at from 120° to 140° C. The product is then treated with carbonate of soda, and salol distilled off with steam.

623,789—April 25, 1899. E. KAUDER. *Process of making alkyl-ethers of morphine.*

A neutral alkyl-ester of phosphoric acid is caused to act on a suitable solution of morphine whose replaceable hydroxyl-hydrogen has been replaced by a metal whose hydroxide possesses alkaline reaction.

624,772—May 9, 1899. A. EINHORN. *Glycocolphenolester and process of making same.*

Glycocolphenolesters of the general formula alphyl—O—$COCH_2$—NX_2, wherein NX_2 represents the residue of a secondary amin, are produced by mixing halogen-aceticacidphenolesters with secondary amins, as by mixing chloracetylguaiacol with diethylanin, forming thick oils easily soluble in alcohol, ether, and benzine, little soluble in water, and with acids forming salts soluble in water, and which act as powerful antiseptics.

625,153—May 16, 1899. A. EINHORN. *Esters of para-oxy-meta-amidobenzoic acid and process of making same.*

A new product, a white crystalline compound, m. p. above 100° C., is produced by the action of mineral acids upon the alcoholic solutions of para-oxy-meta-amidobenzoic acid.

625,159—May 16, 1899. A. EINHORN. *Glycocolamidocinnamic-acid ester and process of making same.*

Alkyl-amidoacetyl-meta-amidocinnamic-acid esters produced by first combining meta-amido-cinnamic-acid ester with chloracetylchloride and then with amins; an oil soluble in alcohol, ether, and benzene, with difficulty in water, forming with acids salts soluble in water, its chlorhydrate having the M. P. 165° C.

626,910—June 13, 1899. E. KAUDER. *Process of making alkyl ethers of morphine.*

A suitable alkaline solution of morphine is acted upon by a nitric-acid ester of the desired alkyl.

627,031—June 13, 1899. C. O. WEBER AND C. F. CROSS. *Method of making cellulose tetracetate.*

The reactions of acetylchloride and acetic anhydride on a mixture of cellulose and magnesium acetate are controlled by adding regulated quantities of nitrobenzene after the reaction has started.

629,433—July 25, 1899. A. EHRENBERG. *Process of making alkyl ethers of morphin.*

A neutral inorganic oxygen-acid-ester of an alkyl, as methyl sulphate, is caused to act upon an alkaline solution of morphine.

630,522—August 8, 1899. L. SELL. *Saligenin compound and process of making same.*

A new preparation of saligenin is produced by the reaction of same with a physiological tannic acid (a tannic acid that is not reconverted into gallic acid on boiling with dilute acids) in the presence of a dilute acid at an elevated temperature.

631,761—August 22, 1899. F. ACH. *Process of preparing alkyl-uric acid.*

An oxymethylene uric acid is dissolved in an acid, as hydrochloric acid, and reduced by tin, producing 7-methyl-uric acid.

631,762—August 22, 1899. F. ACH. *Process of making oxymethylene-uric acid.*

An alkaline solution of an oxymethelene-uric acid is treated with methyl-iodide.

632,605—September 5, 1899. C. O. WEBER AND C. F. CROSS. *Process of making cellulose esters*

Structureless cellulose is mixed with a salt of a fatty acid and the mixture treated with the acid chlorides and a minimum of 10 per cent of the anhydrides of the said acid.

636,384—November 7, 1899. F. HOFMANN. *Process of making carbonates of aromatic series.*

One of the chlorocarbonyl derivatives of the pyridin base series is first made to act on an aromatic phenol, and the so-formed carbonate is then separated from the reaction mixture.

639,174—December 12, 1899. F. HOFMANN. *Ethyl ether of salicylo-carbonic acid.*

A new product, a white crystalline powder, m. p. 95° C., is obtained by the action of the ethylic ether of chloro-carbonic acid having the formula $C_2H_5O.CO.Cl$, on salicylic acid in the presence of a suitable basic compound, such as dimethyl-anilin.

642,218—January 30, 1900. H. C. FEHRLIN. *Process of making salol.*

Alkaline and earthy alkaline salts of acid-phenyl-carbonic ether are subjected to the action of phosphorus oxychloride.

643,280—February 13, 1900. A. WELLER. *Salicylates of the yttrium group.*

New antiseptic products, consist of a metal of the yttrium group, as didymium salicylate, obtained from the double earth didymium in the form of a pale pink powder, insoluble in water, of the formula $Di_2(C_6H_4(OH)COO_6)$.

646,631—April 3, 1900. A. WELLER. *Phenol ether of quinin carbonic acid.*

A further series of new products is produced according to the process of No. 585,068, a phenyloxy group taking the place of the alkyloxy group.

647,263—April 10, 1900. B. HEYMANN. *Ester of acetylphenylglycinortho carbonic acid.*

New compounds, yielding an indigo leuco compound when heated with dry caustic alkalis. They are produced by subjecting the neutral esters of phenylglycinortho carbonic acid to the action of acetylizing agents.

648,580—May 1, 1900. A. BÉHAL. *Process of making ethereal salts of formic acid.*

Equimolecular proportions of formic acid free from water and the anhydride of another organic acid are mixed at a moderate temperature.

650,408—May 29, 1900. E. MENNEL. *Process of making acidyl morphin esters.*

An alpha-mono-acidyl compound of morphine, whose acidyl constituent is of the fatty-acid series, is treated with a chloro-carboxylic ester and an alkali, producing a carboxy-alkylic ester of an acidyl-morphine.

KETONES.

275,128—April 3, 1883. J. BRONNER. *Method of purifying impure anthrachinone and alizarine.*

The solvent is vaporized and the vapor condensed and percolated through the mass, the quantity of solvent used being such as to retain the soluble impurities in solution as well as the pure anthrachinone, whereby the repeated evaporations, condensations, and percolations dissolve out the soluble impurities and the pure anthrachinone, the insoluble impurities being retained by filtration, and the soluble impurities are separated from the pure anthrachinone by the crystallization of the latter.

385,777—July 10, 1888. G. RUMPF. *Manufacture of acetone.*

An acetate is subjected to slow destructive distillation in a closed vessel at a low temperature (about 300° C.), with stirring and steam to prevent too high a temperature. The crude acetone is diluted to separate oily matters, treated with lime to remove higher ketones and other compounds, and rectified in a column still.

390,523—October 2, 1888. M. J. SCHREITER. *Process of refining camphor.*

Camphor is rectified by dissolving it with heat in camphor oil in such proportions that the camphor is separated as fine crystals; filtering the solution with animal charcoal, asbestos, or cellulose; and separating the remaining crystals by centrifugal force.

393,079—November 20, 1888. G. RUMPF. *Manufacture of acetone.*

An acetate is purified by passing it continuously through a system of externally heated tubes with stirrers, and is then subjected to destructive distillation to make acetone.

443,402—December 23, 1890. M. V. NENCKI. *Gallacetophenone.*

A new product, corresponding to $C_8H_8O_4$; m. p. 168° C. It is obtained by the action of pyrogallic acid with glacial acetic acid and zinc chloride.

444,004—January 6, 1891. H. LÜTTKE AND L. SCHOLVIEN. *Salicylate of phenyldimethylpyrazolone.*

A new compound of the formula $C_{18}H_{18}N_2O_4$; m. p. 91.5° C. It is produced by heating—preferably under pressure—phenylhydrazine, acetyl, acetic ether, and methyl-salicylic ether in the presence of a haloid hydric acid.

460,186—September 29, 1891. L. SCHOLVIEN. *Process of making dimethylphenylpyrazolone.*

Molecular quantities of methylphenylpyrazolone and sodium methyl sulphate are heated under pressure, with hydriodic acid and alcohol as a diluent.

464,861—December 8, 1898. G. EBERT. *Process of making phenylethylmethylpyrazolone.*

A new product, a homologue of antipyrine, of the formula $C_{12}H_{14}N_2O$; m. p. between 71° and 72.5° C. It is obtained by heating phenylmethylpyrazolone with iodethyl; decomposing the product by soda lye; taking up the oil with benzine; treating with hydrochloric acid and dissolving the hydrochlorate in alcohol; treating with ether, filtering and drying the product; then treating it with soda lye and separating and drying the oil as a final product, which sets in crystalline form.

503,066—August 8, 1893. H. THOMS. *Salicylate of para-tolyldimethylpyrazolon.*

A new compound, m. p. 101° C., not readily soluble in water, is produced by combining para-tolylhydrazin with acetic acid ether, heating, methylating the resulting para-tolylmethylpyrazolon, and melting the product with salicylic acid in equi-molecular proportions.

516,707—March 20, 1894. L. KNORR. *Paratolyldimethylpyrazolone.*

Paratolyldimethylpyrazolone of the formula $C_{12}H_{14}N_2O$, m. p. 137° C., crystallizing in colorless prisms soluble in water, of difficult solubility in ether, is produced by condensing paratolyl hydrazin with acetyl acetic ether, separating water and heating to eliminate alcohol, and methylizing the product of the condensation.

535,552—March 12, 1895. O. PORSCH. *Process of making acetone.*

Commercial acetate of lime mixed with calcium hydrate in excess is subjected to distillation under addition of superheated steam and constant agitation to separate the acetone vapors from the carbonated lime. The condensed vapors mixed with water are allowed to stand to separate out tar oils and sediments, and are then purified by fractional distillation and rectification.

548,352—October 22, 1895. A. BOEGLIN. *Antipyrin compound.*

A new medicinal compound, $(C_{11}H_{12}N_2O)_3 Fe_2 Cl_6$, brittle, nonhygroscopic crystals, of a reddish-brown color, soluble in water and m. p. 225° C., is produced by the combination of aqueous solutions of antipyrine and ferric chloride.

556,943—March 24, 1896. J. C. W. F. TIEMANN. *Aromatic ketone and process of making same.*

A new product of the formula $C_{13}H_{20}O$, insoluble in water, soluble in alcohol, is produced by treating a mixture of citral and acetone with alkaline agents, dissolving the product in ether, purifying by fractional distillation, and converting into a fragrant isomeric ketone by dilute acids and subsequent fractional distillation.

559,635—May 5, 1896. J. C. W. F. TIEMANN. *Process of making ketone from orris-root.*

A new product, $C_{13}H_{20}O$, insoluble in water, soluble in alcohol, etc. It is produced by distilling orris-root extract in a current of steam; treating the distillate with alkali and subsequent distillation; treating with oxidizing agents to eliminate the alkali; treating the resulting ketone with phenylhydrazin; and separating the pure fragrant ketone with a dilute acid.

574,725—January 5, 1897. J. R. FRANCE. *Process of purifying camphor.*

Crude camphor is dissolved in a hydrocarbon of less sp. gr. than water, as naphtha; the supernatant solution of pure camphor is drawn off, filtered, the solvent distilled off, and the pure anhydrous granular camphor crystallized.

579,412—March 23, 1897. F. STOLZ. *Pyrazolon compound and process of making same.*

A new product, the phenyl 2.3 dimethyl 4 dimethylamido 5 pyrazolon, a white crystallized compound, easily soluble in water and alcohol, m. p. 107°–108° C., with m. p. of its salicylate of 69° C., is produced by methylating 1 phenyl 2.3 dimethyl 4 amido 5 pyrazolon.

582,221—May 11, 1897. O. NAGEL. *Process of making artificial camphor.*

Hydrochlorinated terpene, $C_{10}H_{16}HCl$, is first produced by saturating anhydrous turpentine with anhydrous hydrochloric-acid gas while both are cooled by ice. The resulting crystals are then treated with lime to remove chlorine, and oxidized by nitric acid, producing camphor, $C_{10}H_{16}O$.

583,719—June 1, 1897. J. C. W. F. TIEMANN. *Process of making aromatic ketones.*

Citral and the homologues of acetone are treated with an alkaline condensing agent to form new ketones (methylized, ethylized, etc., ketones), which are then converted, by means of acids, into ketones isomeric with those first formed.

583,720—June 1, 1897. J. C. W. F. TIEMANN. *Fragrant ketone.*

The process of No. 583,719 is applied to citronellone, an aldehyde containing two atoms more of hydrogen than citral.

608,019—July 26, 1898. A. BAUSCHLICHER. *Process of and apparatus for making acetone.*

A dry mixture of acetate of lime and calcium hydrate is treated with superheated steam under continuous stirring and constant temperature to separate the acetone vapors, which are condensed and rectified; the crude acetone mixed with water in excess, settled, and rectified. The secondary products, or acetone oils, are injected into water under pressure and the mixture rectified.

610,361—September 6, 1898. O. MANASSE. *Oxycamphor and process of making it.*

A new product, $C_{10}H_{16}O_2$, white, crystalline, m. p. 203° to 205° C., volatile with steam vapor, and having a weak pepper-like taste, is produced by dissolving camphoquinone in acetic acid, adding zinc dust until the yellow color disappears, then treating with soda lye, and then with ether, and evaporating the ether.

610,664—September 13, 1898. W. SCHMIDT. *Process of refining camphor.*

Crude camphor is dissolved in a closed chamber in a solvent that does not mix with water and of less sp. gr., as benzine or naphtha, the supernatant solution being withdrawn and filtered in a closed filtering chamber, the solvent distilled off, and the pure anhydrous camphor crystallized.

628,293—July 4, 1899. R. WILLSTÄTTER. *Tropin ketone and process of making same.*

New products, ketones of tropin bodies, are produced by adding chromium trioxide in small installments to a tropin body, in the presence of acetic acid, with agitation; the amount just equaling two-thirds of the molecular equivalent of the tropin body; then heating to 100° C., cooling, neutralizing the acid with fixed alkali, and separating.

648,389—May 1, 1900. H. O. CHUTE. *Process of making acetone.*

The pulverulent material is continuously conveyed in a thin film or layer over a heated surface maintained at the proper temperature, and the acetone is removed by a current of oxygen-free gas moving in the opposite direction, under a partial vacuum, the gas being reheated and reused.

650,347—May 22, 1900. A. VERLEY. *Process of making ozonized terpinol.*

Ozone is caused to act upon terpinol and the ozonized terpinol is isolated with ether.

SULPHUR COMPOUNDS.

318,662—May 26, 1885. E. W. R. SCHRÖTER. *Topical remedy.*

Icthyolsulphur acid, a new product, applicable for medicinal uses, is an oil containing sulphur and sulphuric acid chemically combined, formed by the action of sulphuric acid on an oil containing sulphur.

319,082—June 2, 1885. C. FAHLBERG. (*Reissue: 10,667—December 1, 1885.*) *Manufacture of saccharine compounds.*

A new saccharine compound, benzoic sulphinide, of the formula $C_7H_5O_3SN$; sweeter than cane sugar; m. p. 200° C. It is made from the derivatives of coal-tar by converting toluene into toluene-sulphonic acid, oxidizing said acid or its salts into sulphobenzoic acid or its salts, then evaporating the latter and treating it with phosphorpentachloride and caustic or carbonate of ammonia, and finally separating the pure saccharine from the ammonia salts thus obtained.

Toluene is regenerated and hydrochloric and sulphurous acids generated at the same time from the solid toluene-mono-sulphochloride by the action of carbon, water, and superheated steam under pressure. Chlorine is generated for the preparation of phosphor-pentachloride from phosphor-oxychloride, bleaching powder, and water, respectively, hydrochloric and phosphoric acids, or one of them.

391,875—October 30, 1888. E. A. BAUMANN. *Medical compound.*

Diæthylsulphondimethylmethan, a new product of general composition of $C_7H_{16}S_2O_4$; m. p. 126° C., b. p. 300° C. It is formed by the oxidation of acetonæthylmercaptol with an aqueous solution of potassium permanganate.

393,388—November 27, 1888. E. OSTERMAYER. *Production of iodized sulpho-acids of phenols, etc.*

Iodinized phenol, cresol, or thymol sulpho-acids are produced by treating the respective sulpho-acids or their salts with iodine or a salt of iodine in presence of an oxidizing agent.

396,526—January 22, 1889. E. BAUMANN. *Sulphur compound.*

Diethylsulphonemethylethylmethane, a new product, of the formula $C_8H_{18}S_2O_4$; m. p. 76° C. It is produced by the oxidation with potassium permanganate to a sulphone of a new mercaptol formed from a mixture of methylethylketone with ethylsulphohydrate, with addition of hydrochloric acid.

401,500—April 16, 1889. F. KRÜGER. *Medical compound.*

A new product having the formula $C_6H_5CH(SO_2C_2H_5)_2$, m. p. 133° C., which is formed by the oxidation of the ethylmercaptol of the benzaldehyde $C_6H_5CH(SO_2H_5)_2$ by means of permanganate of potassium.

401,501—April 16, 1889. F. KRÜGER. *Medical compound.*

A new product, tetramethyl-disulphonmethane, having the formula $(CH_3)_2C(SO_2CH_3)_2$, m. p. 120° C., is produced by the action of gaseous hydrochloric acid on a mixture of methylmercaptan and acetone well cooled, the methylmercaptol formed being transformed into the disulphonate by oxidation with permanganate of potassium.

431,472—July 1, 1890. M. LANGE. *Process of making thio-oxydiphenylamine.*

A new product, useful as a medicament: m. p. 155° C. It is formed by heating together a salt of metaoxydiphenylamine, water, and sulphur. The reaction is promoted by adding an alkali or alkaline carbonate in excess.

442,094—December 9, 1890. E. A. BAUMANN. *Sulpho compound.*

A new product, diethylsulphone-diethyl-methane, of the formula $C_9S_2O_4H_{20}$; m. p. 87° C. It is obtained by the action of diethylketone with ethyl-mercaptan in the presence of hydrochloric acid, the product being oxidized with permanganate.

495,124—April 11, 1893. A. SPIEGEL. *Sulphur compound.*

Hydrocarbons, such as mineral oils, are first treated with caustic soda, then with sulphuric acid, the product then washed with water and brine successively, neutralized with alkaline lye, and the salt and sulphones separated by treatment with a solvent of the sulphones.

495,343—April 11, 1893. E. JACOBSEN. *Sulphur compound of hydrocarbon.*

New compounds, being neutral hydrocarbon bodies, nonhygroscopic, of a foliated or pulverulent form, soluble in water, nearly devoid of taste or smell, and consisting of unsaturated paraffins, or mixtures containing unsaturated paraffin, combined with sulphur, are produced by combining sulphur by means of heat with a hydrocarbon free from sulphur, treating with sulphuric acid, separating the crude soluble product, and purifying, neutralizing, and drying.

496,112—April 25, 1893. C. FAHLBERG. *Process of making pure saccharin.*

Saccharin, or anhydro-ortho sulphamin-benzoic acid, is purified by introducing the dry crude product—a mixture of the said acid with para sulphamin-benzoic acid—into an aqueous solution of an alkali, as caustic potash, containing such quantity of the alkali as will neutralize and dissolve only the said ortho-acid—e. g., 55 parts by weight of caustic potash for 185 parts of ortho-acid—filtering, and adding to the filtrate an acid, as a mineral acid, stronger than the ortho-acid, whereby pure saccharin is precipitated.

496,113—April 25, 1893. C. FAHLBERG. *Process of purifying saccharin.*

A solution of a mixture of the alkaline salts of anhydro-ortho sulphamin-benzoic acid and para-sulphamin-benzoic acid is treated with an acid, as hydrochloric or oxalic, which is stronger than the para-acid, in such quantity as is requisite to separate out the para-acid only; heated, cooled, and then filtered, when the ortho-acid, or pure saccharin, is precipitated from the filtrate by the addition of a stronger acid, preferably a mineral acid.

497,740—May 16, 1893. J. ZIEGLER. *Quinolin compound.*

A new antiseptic, oxyquinolin phenol sulphonate of oxyquinoline, soluble in water and forming amber-colored hexagonal crystals, is produced by digesting a mixture of phenol, oxyquinolin and sulphuric acid, then treating the so-obtained oxyquinolin-phenolete with a solution of sulphuric acid in water at a temperature near the boiling point.

513,204—January 23, 1894. E. W. R. SCHRÖTER. *Process of making pure sulfonic compounds.*

A hydrocarbon containing sulphur in chemical combination is treated with concentrated sulphuric acid; and the crude sulphonic compound obtained is several times treated with hydrochloric acid and the acid eliminated.

564,784—July 28, 1896. C. FAHLBERG. *Process of making saccharin.*

Toluene is treated with sulphuric acid, and the ortho and para toluene-sulphonic acids are converted into their magnesium salts by means of a magnesium salt. The greater part of the para-magnesium salt is separated from the ortho by crystallization of the former, and the ortho salt and the remainder of the para salt are converted into salts of sodium or potassium by treatment with carbonate of sodium or potassium and oxidized into the corresponding neutral ortho and para sulphobenzoates of sodium or potassium. The neutral salts are treated with acid, and the acid salts treated with alcohol and hydrochloric acid gas and converted into ortho and para ester-acids, which are neutralized with sodium carbonate and treated with phosphorous pentachloride to convert them into ester-benzosulphochlorides. These are transformed into their amids by ammonia and saponified into para-sulphaminbenzoates and a salt of saccharine, which is then separated out.

579,898—March 30, 1897. G. L. SCHAEFER. *Medical compound.*

New compounds, comprising an alkaloid base, such as quinine and guaiacol sulphonic acid, are produced by heating guaiacol with concentrated sulphuric acid, diluting, neutralizing with a carbonate or hydrate, as potassium carbonate, and treating the salt with a mineral acid, and thus forming guaiacol sulphonic acid and then dissolving the alkaloid therein.

584,471—June 15, 1897. L. O. HELMERS. *Water-soluble compound of ethereal oils.*

A new compound, consisting of an ethereal oil or a camphor and the sulphonic-acid compound of ichthyol and thiol—and the process applies to like insoluble substances—is produced by causing the constituents to react, said sulphonic-acid compound being soluble in water.

602,682—April 19, 1898. W. DIETERLE. *Process of producing orthotoluene sulfonic acid.*

Orthothiocresol is subjected to the action of an oxidizing agent, as potassium permanganate, producing orthotoluene sulphonic acid. A continuance of the oxidation converts the latter into orthobenzene sulphonic acid.

602,942—April 26, 1898. L. O. HELMERS. *Iodin derivative of ichthyol and thiol.*

A new compound, soluble in water, is produced by reacting upon iodine with a sulphonic-acid compound of a sulphureted hydrocarbon that is soluble in water.

622,854—April 11, 1899. B. HOMOLKA AND A. STOCK. *Nitrobenzyliden sulfonic acid and process of making same.*

New products, as the ortho or para-nitro-benzylidenanilin-sulphonic acids and their homologues, are produced by oxidizing the ortho or para-nitrobenzylanilin sulphonic acids or their homologues. They are soluble in water, with a yellowish color, insoluble in alcohol, ether, etc., and give, on decomposition with diluted mineral acids, nitrobenzaldehyde.

624,027—May 2, 1899. L. O. HELMERS. *Tasteless compound from sulfureted hydrocarbons, and process of making same.*

New products, pulverulent neutral salts, insoluble in water and devoid of taste and smell, consist of an alkaline-earthy and metallic base, and a sulphonic-acid compound derived from sulphureted hydrocarbons combined with sulphuric acid. They are produced by extracting the salts with a solvent, such as alcohol, adapted to dissolve only the bitter substances.

624,028—May 2, 1899. L. O. HELMERS. *Tasteless compound from sulfureted hydrocarbons, and process of making same.*

New products, sulphonic-acid salts of alkaline-earthy metals and metals proper derived from sulphureted hydrocarbons combined with sulphuric acid, devoid of taste and smell, are produced by heating the salts up to 130° to 140° C.

625,332—May 23, 1899. L. O. HELMERS. *Deodorized compound of mineral oils, and process of making same.*

Sulphonized compounds derived from sulphureted mineral oils by treatment with sulphuric acid are made odorless, or nearly so, by treating aqueous solutions thereof, while cool, with an oxidizing agent, and then concentrating by heating.

628,503—July 11, 1899. E. TWITCHELL. *Fatty aromatic sulfo compound and process of making same.*

A new compound, a sulpho-fatty-aromatic acid, a combination of the sulphonic radical with the stearic radical and one of the aromatic radicals of the general formula $R(HSO_3)C_{18}H_{35}O_2$, a stable, viscous, nonvolatile oil. It forms water-soluble salts with the alkali metals, and insoluble salts with the other metals, and is produced by mixing any member of the fatty-acid series with a member of the aromatic series and treating with sulphuric acid.

628,881—July 11, 1899. G. WENDT AND J. LEHMANN. *Process of making sulfo-acids of aliphatic creosotesters.*

The esters, under continuous stirring, are subjected to the action of concentrated sulphuric acid at below 150° C., the mixture allowed to stand for two hours, neutralized, and the sulpho-acids separated out.

646,772—April 3, 1900. A. VERLEY. *Process of making sulfonates.*

Pyridin and chloro-sulphonic acid are caused to react in a neutral solvent; a phenol is added; the solvent removed, and the resulting mixture is treated with potash and the pyridin driven off, and the potassium salt obtained is saturated with an acid.

647,237—April 10, 1900. F. SCHMIDT. *Diamidodiphenylamin sulfonic acid and process of making same.*

A new product, yielding dyestuffs, is produced by condensing molecular quantities of para-chlornitrobenzenesulphonic acid or its salts with para-phenylenediaminsulphonic acid or its salts and subsequent reduction.

648,261—April 24, 1900. B. HOMOLKA AND A. STOCK. *Nitrobenzylanilin sulfonic acid and process of making same.*

A new product, where the nitro group is in the ortho or para position, being a yellow powder, is produced by heating nitrobenzyl-chloride—where the nitro group is in ortho or para position—with an aqueous solution of a salt of anilin-sulphonic acid in the presence of alkaline substances.

648,568—May 1, 1900. J. KOETSCHET. *Process of making toluene sulfochlorid.*

Toluene is treated with three or more parts by weight of chloro-sulphonic acid free from sulphuric anhydride, the temperature being maintained between 5° and 35° C. or about 10° C.

650,218—May 22, 1900. E. BARELL. *Orthoguaiacol sulfo-acid and process of making same.*

A new product, crystallized in small laminæ which do not melt up to 270° C., is produced by treating pure guaiacol with concentrated sulphuric acid at from 70° to 80° C., isolating a solution of the barium salt thus formed, decomposing same with sulphuric acid, concentrating and crystallizing out by refrigeration.

651,045—June 5, 1900. J. LAGUTT. *Process of making saccharin.*

Orthosulphamidobenzoic acid is dissolved in a dehydrating agent, as sulphuric acid, and after standing at ordinary temperature it is poured upon ice and water, thereby causing the precipitation of saccharine.

NITROGEN COMPOUNDS.

NITROSUBSTITUTION COMPOUNDS.

252,473—January 17, 1882. J. A. KENDALL. *Manufacture of dinitro-benzole from gas obtained by distillation of coal.*

It is obtained from benzole or nitro-benzole existing in gas produced from carbonaceous substances, by passing the gas through a mixture of nitric and sulphuric acids, the latter being in excess.

412,680—October 8, 1889. C. SAVIGNY. *Process of treating the mother liquors of phenol nitrates.*

The mother liquors resulting from the manufacture of nitro-phenols are heated, and nitric acid distilled therefrom; then cooled, and picric or nitro-cresylic acid precipitated; then heated, and the sulphuric acid concentrated, and nitrates added to effect the nitrification of phenols, cresols and the like.

650,332—May 22, 1900. M. MANDT AND R. HOLDMANN. *Process of oxidizing orthonitrotoluene.*

Ortho-nitro-toluene is oxidized in the side chain by treatment with sulphuric acid and maganese peroxide at a temperature above 100° C.

SUBSTITUTED AMMONIAS.

296,825—March 25, 1884. Z. H. SKRAUP. *Manufacture of parachinanisol.*

A new product; an oily liquid. It is obtained from the methylic ether of phenol by heating mixtures of nitro and amido anisol with glycerine and sulphuric acid.

308,286—November 18, 1884. Z. H. SKRAUP. *Production of tetrahydro-parachinanisol.*

A new product; m. p. 43° C., b. p. 283° C. It is obtained from parachinanisol by the action of nascent hydrogen, and develops an intensely green color by the action of perchloride of iron, bichromate of potash, or an aqueous solution of chlorine upon the free base or its saline compounds; hence it is also styled "thalline."

343,803—June 15, 1886. C. FAHLBERG. *Medicated benzoic sulphinide compound.*

A medicated compound, consisting of benzoic sulphinide and an organic alkaloid, as quinine, produced by dissolving benzoic sulphinide and the alkaloid in alcohol or water and crystallizing out the salt.

400,086—March 26, 1899. O. HINSBERG. *Phenacetine.*

A new product of the general composition $C_{10}H_{13}O_2N$; m. p. 135° C. It is obtained by reducing nitrophenetole and fusing the phenetidin-chlorhydrate thus formed with dried sodium acetate and glacial acetic acid.

422,251—February 25, 1890. S. RADLAUER. *Process of preparing a hypnotic.*

Chloral-urethane and alcohol are caused to act upon each other in a vacuum at a temperature of 100° C, and the product, having the formula $C_7H_{12}Cl_3O_3N$, with m. p. 42° C., is crystallized in water.

422,334—February 25, 1890. T. CURTIUS. *Hydrazin.*

A new product, expressed by the formula N_2H_4, which, in the form of a gas, is set free from its hydrate by metallic sodium. The hydrate is formed by the action of sodium nitrite on the chlorhydrate of glycocoll ether, the diazo-acetic ether produced being converted into the triazo acetate and the salt of hydrazin derived therefrom and converted into the hydrate of this hydrazin.

425,039—April 8, 1890. J. F. VON MERING. *Chloralformamide.*

A new product, having anæsthetic properties and m. p. 115°-116° C., of the formula $C_2HCl_3O{:}CHO.NH_2$.

425,040—April 8, 1890. J. F. VON MERING. *Chloralformamide.*

The process of producing the same (No. 425,039) consists in treating chloral with formamide, in the proportion of their molecular weights.

428,286—May 20, 1890. C. PAAL. *Phenyldihydroquinazoline.*

A new medical compound, having the formula $C_{14}H_{12}N_2$, and m. p. 95° C. It is produced by acting with reducing agents upon the formyl derivative of the orthonitrobenzyl analine.

489,728—January 10, 1893. J. BERLINERBLAU. *Paraphenetol-carbamide and process of making same.*

A new compound, having a sweet taste, crystallizing in white needles and soluble in hot water and the ordinary solvents, is produced by treating paraphenetidine or para-anisidine with phosgene, each in a solvent, as benzole, filtering, adding ammonia to the filtrate, distilling off the solvent, and crystallizing.

502,504—August 1, 1893. H. THOMS. *Process of making para-phenetol carbamide.*

A compound having a strong sweet taste, and a m. p. of 170° C., is produced by boiling an aqueous solution of para-phenetidin-hydrochloride (three molecules) with common urea (two molecules), or the carbamide salt of ammonia or ammonium carbonate may be used.

503,748—August 22, 1893. L. LEDERER. *Amido-crotonylanilid and process of making it.*

A new compound, of the formula $C_{10}H_{10}(NH_2)NO$, moderately soluble in most solvents, crystallizing in colorless needles, and having a m. p. of 146°-147° C., is produced by treating acetylacetanilid with ammonia and allowing it to stand twenty-four to thirty hours.

526,258—September 18, 1894. S. RADLAUER. *Salicyl-anilid.*

A new compound, soluble in alcohol, but not in water, m. p. 100° C., is produced by heating acetanilid with salicylic acid in molecular proportions.

535,846—March 19, 1895. J. F. VON MERING. *Substitution product of phenetidin.*

New compounds, antipyretic bodies, difficult of solution in water, are produced by heating together phenetidin, a suitable acid such as propionic or butyric acid, and a condensation product, such as zinc chloride, in such proportions that one hydrogen atom of the amido group in the phenetidin is replaced by an acid remainder of greater molecular weight than acetyl.

536,524—March 26, 1895. W. HERZBERG. *Amidotriazin.*

See Group XI, Dyestuffs, Artificial, Organic.

540,732—June 11, 1895. M. FREUND. *Hydrastinin.*

A new product, $C_{11}H_{13}NO_3$, m. p. 116°-117° C., combining with one equivalent of an acid, is produced by subjecting hydrastine to the action of an oxidizing agent.

543,579—July 30, 1895. L. LEDERER. *Process of producing phenoxacetic anilids, etc.*

The anilids of the phenoxacetic acids, as phenoxacet-para-phenetidids, are produced by reacting on phenoxacetic acids with aromatic amido-compounds, as para-phenetidin, and crystallizing out with alcohol.

558,863—April 21, 1896. F. VALENTINER. *Process of making acetophenonphenetidin.*

Molecular weights of acetophenon and para-phenetidin are heated together.

563,009—June 30, 1896. A. BISCHLER. *Methoxy-acetphenetidin.*

A new product, crystallizing in white needles, m. p. 102° C., of general formula $C_{11}H_{15}NO_3$, and soluble in cold water. It is formed by heating the alkyloxy-fatty acids or the chlorides of the amids thereof, with primary and secondary aromatic amins, as by heating para-phenetidin with methoxy-acetic acid.

567,968—September 22, 1896. A. EICHENGRÜN. *Iodoform combination with hexamethylentetramine.*

New compounds, crystalline inodorous additive combinations of iodoform with hexamethylentetramine, or its haloidalkyl derivatives, which are not soluble in water and are decomposed by acids or alkalis, liberating iodoform, are produced by the reaction of the constituent in a solvent, as iodoform and hexamethylenamine in absolute alcohol.

569,416—October 13, 1896. O. HINSBERG. *Ester of alkoylamidophenols and method of making same.*

Carbonic esters of alkoylamidophenol, colorless compounds, m. p. 80° to 161° C., easily soluble in hot water or alcohol, are produced, together with their derivatives, by treating alkoylamidophenols, and their derivatives, the nitrogen atom of which is alkylated, in the form of their salts with esters of chlorcarbonic acid.

574,395—January 5, 1897. R. W. CORNELISON AND W. H. WARREN. *Process of obtaining aceto derivatives of aromatic amins.*

They are produced directly by the reaction of an acetic-acid salt and an aromatic-amin salt upon each other; the acetic-acid radical being replaced with another acid radical, such as a sulphuric-acid radical, and the acetic-acid radical thus liberated caused to react finally with an aromatic amin, as anilin.

574,396—January 5, 1897. R. W. CORNELISON AND W. H. WARREN. *Process of obtaining aceto derivatives of aromatic amins.*

They are produced by the reactions of an acid salt of acetic acid with the desired aromatic amin.

574,874—January 12, 1897. H. BAUM. *Paraphenetidin compound.*

New medicinal paraphenetidin compounds, as meta-alkyloxy, salicylidenparaphenetidin, are produced by condensing gentisinaldehyde with paraphenetidin, and alkylating the product of condensation.

576,379—February 2, 1897. I. ROOS. *Salicyl paraphenetidin.*

New products, as the orthoöxybenzyliden-alkyl derivative of amido phenol, insoluble in water, soluble in alcohol, etc., m. p. 94° C., of the formula Alk. $OC_6H_4N(CHC_6H_4OH)$ are produced by condensing salicylaldehyde with an alkyl derivative of amidophenol.

578,384—March 9, 1897. P. T. AUSTEN AND H. C. TUTTLE. *Process of making acetanilid, etc.*

Acetanilid or the acetoluids are formed by heating anilin or the toluidins with dilute acetic acid, or even with crude pyroligneous acid, under pressure.

586,551—July 20, 1897. F. W. FRERICHS. *Process of manufacturing acetanitid.*

Acetic acid and anilin oil are subjected to distillation with agitation under reduced pressure until most of the free anilin oil and acetic acid has been removed; the last traces are then removed by distillation under the action of live steam.

586,854—July 20, 1897. W. MAJERT. *Process of making ammoniacal casein.*

A new compound, in dry solid form, easily soluble in water, is produced by treating finely-powdered dry casein with ammonia gas.

595,897—December 21, 1897. H. R. VIDAL. *Process of making paramidophenol.*

Oxyazobenzol is reduced by sodium sulphide in the presence of a caustic alkali.

596,797—January 4, 1898. E. TAUBER. *Process of making amidins.*

New products, the amidins of amidophenol ethers, as ethenylparaparadiethoxydiphenylamidin, m. p. 121° C., are produced by heating the acetyl compounds of amido-phenol ethers with amidophenol ethers themselves and a dehydrating agent, such as a halogen compound of phosphorus, phosphorous sulphide, and hydrochloric acid.

602,109—April 12, 1898. I. ROOS. *Process of making salts of paramidophenol.*

New products, the primary salts of citric acid with alkyl ethers of paramidophenol, white or crystalline compounds, m. p. 186°-187° C., soluble in water and less so in alcohol, are produced by dissolving molecular quantities of citric acid and amidophenol alkyl ether in a solvent, as alcohol, and crystallizing.

602,690—April 19, 1898. C. F. M. SCHAERGES AND P. SCHWARZ. *Acetyl derivative of phenetidin.*

New products, the acetyl derivatives of alkaline phenetidin sulphonates, as sodium acetyl phenetidin sulphonate, a reddish-white microcrystalline, hygroscopic body, soluble in water, are prepared by treating phenetidin with concentrated sulphuric acid, converting the phenetidin-sulphonic acid into a salt, and acetylizing this salt by means of glacial acetic acid and acetic anhydrid.

605,977—June 21, 1898. B. R. SEIFERT. *Oxyphenyl-guanidin and process of making same.*

Certain new oxyphenyl-guanidins adapted to cause anesthesia, are produced by melting or dissolving together a carbodiimid with an amidophenol body.

615,828—December 13, 1898. H. C. FEHRLIN. *Process of purifying acetanilid.*

Crude acetanilid is distilled, preferably under diminished pressure, by a current of superheated vapors of acetic acid of a temperature not lower than the boiling point of acetanilid at the vacuum used.

615,829, December 13, 1898. H. C. FEHRLIN. *Process of making acetanilid.*

A current of superheated vapors of acetic acid at 185° C. is passed through anilin oil heated to 160° C., and the water simultaneously removed, until the conversion of the anilin-oil into acetanilid is satisfactorily completed.

618,809—January 31, 1899. H. R. VIDAL. *Process of making amidophenols.*

An amido-sulphonic acid of the aromatic series in a concentrated sulphuric acid solution is reacted upon by an oxidizing agent, as manganese peroxide.

629,099—July 18, 1899. F. VALENTINER. *Process of making acetophenonphenetidid.*

Acetophenone and paraphenetidin in molecular proportions are heated in a vacuum to the combination temperature, when the desired product is distilled off in vacuum.

640,563—January 2, 1900. B. HOMOLKA AND A. STOCK. *Process of making amidobenzyliden anilin compounds.*

Nitrobenzylanilins are subjected to the action of alkali sulphids while heated.

641,100—January 9, 1900. H. GUSSMANN. *Process of making para-oxy-para-amido-ortho-oxydiphenylamin.*

Para-oxy-para-amido-diphenylamin-ortho-sulphonic acid is heated with caustic alkalis at 150° to 200° C.

641,870—January 23, 1900. L. KNORR. *Naphthalanmorpholin.*

New products, as ethylnaphthalanmorpholin, a thick oil, distilling at 320° C., forming crystals, m. p. 237° to 238° C., are produced by the action of ethanolamins upon dihydronaphthalene oxide, and heating of the naphthol product with acids.

647,075—April 10, 1900. W. H. CLAUS, A. RÉE, AND L. MARCHLEWSKI. *Process of making compounds of paraphenetidin.*

A solution of paraphenetidin and glucose in a solvent is heated, the solvent thereafter separated, and the uncombined constituents dissolved out with solvents.

PURINS AND DERIVATIVES.

Purins.

559,347—April 28, 1896. E. FISCHER. *Chloro-theophyllin and process of preparing it.*

A new compound, $C_5H\,(CH_3)_2ClN_4O_2$; m. p. 300° C., soluble in hot alcohol. It is produced by heating 1 part dimethyl-uric acid with 2 parts phosphorus pentachloride and 4 parts phosphorus oxychloride to 150° C. for several hours.

571,353—November 17, 1896. E. FISCHER. *Bromotheophyllin and process of making same.*

A new compound, $C_5H\,(CH_3)_2BrN_4O_2$, m. p. 315° to 320° C., soluble with difficulty in alcohol and water, is produced by heating a mixture of theophyllin, 1 part, and bromine, 5 parts, under pressure; driving off the excess of bromine, and purifying the residue.

598,502—February 8, 1898. E. FISCHER. *Process of making purins.*

A new product, trichloropurin, $C_5HN_4Cl_3 + H_2O$, m. p. 184° to 188° C., is produced by heating dichloroxypurin, 1 part, with phosphorus oxychloride, 70 parts; and agitation; then evaporating *in vacuo.* To purify the crude product ether is added, the ether removed, and the residue boiled in water.

607,028—July 12, 1898. E. FISCHER. *Process of making purin derivatives.*

New crystalline compounds, amido purin derivatives which have the amido radical bound to the alloxan nucleus of the purin residue, are produced by the action of ammonia upon a chlorine derivative of purin having chlorine bound to the alloxan nucleus. They dissolve with difficulty in alcohol or water and decompose at high temperature before or while melting.

607,029—July 12, 1898. E. FISCHER. *Adenin and process of making same.*

A new compound, methyl-adenin, m. p. 347° C., is produced by agitating amido dichloropurin with hydriodic acid and phosphonium iodide for several hours at ordinary temperature, then heating to the boiling point and until a clear solution results; filtering and treating with ammonia.

617,985—January 17, 1899. E. FISCHER. *Alkyl-purin and process of making same.*

A new compound, 7-methyl-2-6-dichloropurin, m. p. 196° to 197° C., is prepared by heating theobromine with phosphorus oxychloride under pressure, then removing excess of phosphorus oxychloride, adding water, and treating with dilute soda lye. Methylized oxypurins are prepared by treating methyldichloropurin with an alkali, and paraxanthin by subsequent treatment of the foregoing with a mineral acid.

625,441—May 23, 1899. E. FISCHER. *Thio derivative of purin and making same.*

New compounds, a thiopurin having the group SH bound to one or more of the carbon atoms of the purin molecule, as 1-3-7-trimethyl-2-6-dioxy 8-thiopurin or thiocaffein, crystallizing in fine flexible needles, m. p. 308° C. They are produced by heating under pressure a halogen-purin derivative with the solution of an alkaline sulphydrate and then acidulating the solution.

631,705—August 22, 1899. E. FISCHER. *Process of making theobromin.*

3-7-dimethyl-6-amido-2-8-dioxypurin is treated with phosphorous-oxy-chloride, the resulting oxychloropurin is isolated and treated with a reducing agent, and the then resulting 3-7-dimethyl-6-amido-2-oxypurin, a new product, is isolated and acted upon with nitrous acid.

631,706—August 22, 1899. E. FISCHER. *Oxypurin and process of making same.*

Trichloro-purin is acted upon with an alcoholic alkali; the 2-8-dichloro-6-alkyl-oxypurin is then acted upon with hydrochloric acid and the resulting dichloro-oxypurin alkalized; the product, 1-7-dimethyl-6-oxy-2-8-dichloro purin, being a new compound, m. p. between 245° and 255° C. Subsequent treatment produces alkylized hypoxanthins, etc.

631,708—August 22, 1899. E. FISCHER. *Oxypurin and process of making same.*

A new compound, 8-chloro-2-6-diethoxypurin, m. p. 205° C., is produced by heating trichloropurin with excess of sodium-ethylate. This product is dissolved in hydriodic acid and treated with phosphonium-iodide to produce xanthin.

631,709—August 22, 1899. E. FISCHER. *Oxypurin and process of making same.*

A new compound, 6-oxy-2-8-dichlor-purin, is produced by treating 2-8-dichlor-6-ethoxy-purin with fuming hydrochloric acid and heat. This product is treated with hydriodic acid and phosphonium iodide to obtain hypoxanthin.

632,828—September 12, 1899. F. ACH. *Process of making uric-acid derivatives.*

An alkaline solution of a uric acid is treated with a haloid ether at a low temperature.

647,392—April 10, 1900. E. FISCHER. *Oxypurin and process of making same.*

2-8-dichloro-6-ethoxy-purin, a new compound, m. p. 200° C., is produced by dissolving trichloropurin in ethyl alcohol, treating with a sodium solution, and finally supersaturating with acetic acid. Said compound is treated with a reducing agent to produce hypoxanthins.

Xanthins.

569,489—October 13, 1896. E. FISCHER. *Process of making xanthin derivatives.*

Dialkyl uric acid is treated with a pentahalogen compound of phosphorus in the presence of a solvent, such as phosphorus oxychloride, and the resulting halogen derivative is treated with a reducing agent to convert it into a homologue of xanthin of the type of theophyllin.

569,490—October 13, 1896. E. FISCHER. *Process of making derivatives of xanthin.*

A halogen dialkyl derivative of xanthin (No. 569,489) is converted into its salt, which salt is then alkylized and the resulting halogen trialkyl derivative of xanthin reduced, whereby the homologue of xanthin of the type of caffein is produced.

588,327—August 17, 1897. E. FISCHER. *Process of obtaining xanthin derivatives.*

Tetramethyl-uric acid is heated with five times its weight of phosphorus oxychloride in a closed vessel to 160° to 165° C. for ten hours, and the crude product then subjected to the action of fuming hydrochloric acid, the solution evaporated to dryness, and t eated with soda lye. The chlorocaffein remaining is acted upon by reducing agents to obtain caffein.

617,986—January 17, 1899. E. FISCHER. *Process of making heteroxanthin.*

7-methyl-2-6-dichloropurin is heated with hydrochloric acid under pressure.

618,045—January 17, 1899. E. FISCHER. *Alkyl-hypoxanthin and process of making same.*

A new compound, methyl hypoxanthin, m. p. 353° C., readily soluble in water, assuming a brown color when heated to 340° C., is produced by heating 7-methyl-6-oxy-2-chloropurin with hydriodic acid and phosphonium iodide. The product is methylated to produce dimethyl-hypoxanthin.

631,707—August 22, 1899. E. FISCHER. *Xanthin derivatives and process of making same.*

A new product, chloroxanthin, or 8-chloro-2-6-dioxy-purin, is produced by treating an 8-chloro-2-6-dialkyl-oxpurin with hydrochloric acid. The product is subsequently alkylized and treated with methyl iodide.

631,757—August 22, 1899. F. ACH. *Xanthin derivative and process of making same.*

Certain alkyl-uric acids, as 3-methyl-uric acid, are treated with phosphorus-oxy-chloride, producing a new compound, 3-methyl-chloro-xanthin, having no melting point, but decomposing at 345° C. This compound is submitted to the action of reducing and methylating agents.

631,758—August 22, 1899. F. ACH. *Alkyl-xanthin derivative and process of making same.*

A 7-alkyl-uric acid, as 7-methyl-uric acid, is heated with phosphorus-oxy-chloride alone and the product purified and crystallized. The new compound, chloro-heteroxanthin, has no melting point, but decomposes at 340° C. It is alkylized and reduced.

631,759—August 22, 1899. F. ACH. *Alkyl-xanthin and process of making same.*

A new product, chloro-theo-bromin, m. p. 292° to 293° C., is produced by heating 3-7-dimethyl-uric acid with phosphorus-oxy-chloride alone, crystallizing, dissolving in alkali, and precipitating with acid. This product is alkylized and reduced.

631,760—August 22, 1889. F. ACH. *Alkylized xanthin and process of making same.*

A new compound, 3-methyl-xanthin, having no melting point, but decomposing at 400° C., is produced by heating 3-methyl-chloro-xanthin with hydriodic acid and phosphonium-iodide. This product is alkylized and reduced.

PYRAZOLES.

307,399—October 28, 1884. L. KNORR. *Preparation of dimethyl-phenyl-oxypyrazol.*

A new product, m. p. 113° C. Acetylacetic ether is mixed with a molecular quantity of phenyl-hydrazine, water is eliminated, and the condensed product, phenyl-hydrazine-acetylacetic ether, is heated to 100° to 150° C. and crystallized, forming methyl-phenyl-oxypyrazol. This is heated with methyl chloride, bromide, or iodide and converted into dimethyl-phenyl-oxypyrazol.

CHINOLINES OR QUINOLINES.

237,917—February 15, 1881. Z. H. SKRAUP. *Production of oxychinoline.*

A new product, for the manufacture of blue dyestuffs and other purposes, produced by the action of glycerine and sulphuric acid upon a mixture of ortho-nitro-phenol and ortho-amido-phenol.

237,918—February 15, 1881. Z. H. SKRAUP. *Production of oxychinoline.*

A new product, for the manufacture of blue dyestuffs and other purposes, produced by the action of glycerine and sulphuric acid upon a mixture of para-nitro-phenol and para-amido-phenol.

241,738—May 17, 1881. Z. H. SKRAUP. *Manufacture of artificial chinoline.*

A new product. It is produced by the action of glycerine and sulphuric acid upon a mixture of nitro-benzole and aniline.

252,846—January 24, 1882. W. PICKHARDT AND H. ENDEMANN. *Preparation of chinoline.*

Citrate of chinoline, a new product, is made by treating purified artificial chinoline (No. 241,738) with citric acid.

252,847—January 24, 1882. W. PICKHARDT AND H. ENDEMANN. *Preparation of chinoline.*

Sulphate of chinoline, a new product, is made by treating purified artificial chinoline dissolved in alcohol with sulphuric acid.

254,097—February 21, 1882. W. PICKHARDT AND H. ENDEMANN. *Medical compound.*

Hydrochlorate of chinoline, white and free from lepidine, is made by dissolving purified artificial chinoline in aqueous hydrochloric acid and evaporating.

254,098—February 21, 1882. W. PICKHARDT AND H. ENDEMANN *Manufacture of chinoline.*

The artificial chinoline of Skraup is refined and purified by treatment with tartaric acid, the acid tartrate of chinoline being separated from the solution, and the chinoline liberated by the action of caustic alkalis.

256,444—April 11, 1882. W. PICKHARDT AND H. ENDEMANN. *Salicylate of chinoline.*

A new product. It is made from purified artificial chinoline by treatment in alcohol with salicylic acid.

256,445—April 11, 1882. W. PICKHARDT AND H. ENDEMANN. *Benzoate of chinoline.*

A new product. It is made from purified artificial chinoline by the distillation of a mixture of pure benzoic acid and chinoline.

257,828—May 9, 1882. W. PICKHARDT AND H. ENDEMANN. *Tartrate of oxychinoline.*

It is prepared by the action of tartaric acid upon the oxychinoline of Skraup, (No. 237,918).

257,829—May 9, 1882. W. PICKHARDT AND H. ENDEMANN. *Hydrochlorate of oxychinoline.*

It is prepared by the action of hydrochloric acid upon the oxychinoline of Skraup.

260,317—June 27, 1882. W. PICKHARDT AND H. ENDEMANN. *Acid tannate of chinoline.*

A new product. It is prepared by evaporating a mixture of tannic acid, 5 pounds, and artificial chinoline, 1 pound, in a minimum quantity of water.

260,318—June 27, 1882. W. PICKHARDT AND H. ENDEMANN. *Neutral tannate of chinoline.*

A new product. It is prepared by evaporating a mixture of tannic acid, 5 pounds, and artificial chinoline, 2 pounds, in a minimum quantity of water.

260,319—June 27, 1882. W. PICKHARDT AND H. ENDEMANN. *Basic tannate of chinoline.*

A new product. It is prepared by evaporating a mixture of tannic acid, 5 pounds, and artificial chinoline, 3 pounds, in a minimum quantity of water.

270,045—January 2, 1883. O. FISCHER. *Method of preparing oxyquinoline.*

Oxyquinoline, a new antiseptic, is obtained by treating quinoline-sulphonic acid with caustic soda or potash, under the action of heat.

273,498—March 6, 1883. O. FISCHER. *Process of preparing oxyhydro-ethyl chinoline.*

Oxyhydro-ethyl chinoline, a new product, is made by first converting chinoline into oxychinoline, then treating the same with tin and hydrochloric acid and converting the oxyhydro-chinoline produced into oxyhydro-ethyl chinoline by treatment of the isomeric oxyhydro-chinoline with ethyl iodide by heat in a water bath, and extracting the base with water and precipitating with caustic soda.

276,796—May 1, 1883. O. FISCHER. *Preparation of oxyhydro-methyl chinoline.*

Oxyhydro-methyl chinoline, a new product, is produced by substituting methyl iodide for ethyl iodide in the process of No. 273,498.

282,488—August 7, 1883. A. BÖHRINGER. *Method of producing monalcylised hydro-bases.*

They are produced by first converting the tertiary bases (as chinoline) into salts of the ammonium bases (as chloride of methyl-chinoline) by alcylisation, and then hydrogenizing said salts to produce acid salts which liberate the monacylated hydro-bases (as mono-ethyl-hydro-chinoline).

355,842—January 11, 1887. R. SCHMITT. *Manufacture of oxychinoline carbonates.*

They are produced by treating the oxychinoline alkalies and earthy alkalies with carbonic acid under pressure and at an elevated temperature.

466,707—January 5, 1892. J. ZIEGLER. *Process of preparing phenol sulphonates of oxychinoline.*

The ortho and para phenol sulphonates of ortho-oxychinoline are formed by the production of ortho-oxychinoline by digesting orthoamido-phenolparasulphonic acid with orthonitrophenolparasulphonic acid and with glycerine and sulphuric acid; precipitating the oxychinoline from the product of the reaction by means of soda and purifying it; and then heating it with ortho or para phenol sulphonic acid in molecular proportions. The phenol sulphonate of oxychinoline is a yellow sirup, solidifying in crystals at a low degree of cold or in a vacuum chamber.

466,708—January 5, 1892. J. ZIEGLER. *Process of preparing oxychinoline sulphate.*

The substitution of sulphuric acid for the ortho or para phenol sulphonic acid of process No. 466,707 (in the proportion of two molecules of oxychinoline to one of sulphuric acid) results in the production of the sulphate of ortho-oxychinoline, a new product of the formula $C_{18}H_{14}N_2O_2.\ H_2SO_4$; m. p. 172°–173° C.

478,495—July 5, 1892. J. ZIEGLER. *Antiseptic quinoline.*

A soluble antiseptic, consisting of quinoline combined with a saponaceous solution. It is formed by saponifying oils or fats in the presence of quinoline; boiling until the solution is complete; and thereafter adding water to the solution.

486,363—November 15, 1892. J. ZIEGLER. *Chinolinchinophenol-sulphate and method of obtaining same.*

A new compound, a sulphur-yellow powder, soluble in water, m. p. 114° C., is produced from ortho-oxychinoline and chinoline by heating a mixture of one of the said substances and a sulphate of the other.

512,590—January 9, 1894. G. N. VIS. *Orthooxyethyl-alpha-benzoylamido-quinolin.*

A new compound, crystallizing in small needles, m. p. 206° C., and scarcely soluble in water, is produced by treating æthoxy amido quinoline or a hydrochloric acid salt thereof with benzoyl-chloride.

563,116—June 30, 1896. J. ZIEGLER. *Process of making quinolin compounds.*

An antiseptic disinfectant, soluble in water, is produced by boiling for ten hours two molecules O-oxyquinoline in alcohol with one molecule pyrosulphate of potassium, separating and drying the product.

CHINALDINES.

309,935—December 30, 1884. O. DOEBNER AND W. VON MILLER. *Manufacture of bases called chinaldines.*

New products applicable for the manufacture of coloring matters or for antiseptics and medicinal uses. They are obtained by combining an acid and a metallic salt, acting as a reducing agent, with aldehyde or its equivalents, and a primary aromatic base; purifying the base obtained by the reaction. Chinaldine is a fluid, b. p. 240° C.

316,248—April 21, 1885. O. DOEBNER AND W. VON MILLER. *Formation of methoxy and ethoxy chinaldine.*

New products, derivatives of chinaldine and applicable for the manufacture of coloring matters, or for antiseptic and antipyretic purposes. They are obtained from the sulpho-acid of the chinaldines by melting the same with alkali, and subsequent alkylation of the oxychinaldines formed; or by the action of aldehyde or the salts of amidophenols, amidophenol methyl, and amidophenol ethyl ethers. Methoxy-chinaldine, m. p. 125° C.; ethoxy-chinaldine, m. p. 72° C.

316,249—April 21, 1885. O. DOEBNER AND W. VON MILLER. *Formation of the hydrobase of chinaldine.*

Chinaldine bases or the oxymethoxy and althoxy chinaldines are boiled with tin and concentrated sulphuric acid, the product freed from tin, and the hydrobase separated by treatment with soda lye and distillation. They are new products applicable for the manufacture of grey coloring matter or as antiseptic or medicinal agents. Hydrochinaldine is an aromatic fluid, b. p. 246° C.; methoxy-hydrochinaldine, b. p. 270° C.

ISATINS.

310,604—January 13, 1885. P. J. MEYER. *Manufacture of isatins and substituted isatins.*

Isatins and substituted isatins, available for the manufacture of artificial indigo, are obtained from dihalogenized acids, their salts, amides, ethers, and aldehydes, or from aromatic amines or substituted amines, by directly fusing or boiling their solutions, and treating the product with a strong acid.

618,096—January 24, 1899. B. HEYMANN. *Diacetyl-indoxyl and process of making same.*

A new product, a white powder, nearly insoluble in water, m. p. 82° C., on heating with caustic lyes transformed into indoxyl, the latter yielding indigo by oxidation. It is produced by heating an alkaline salt of phenylglycinorthocarbonic acid with acetic anhydrid.

ALKALOIDS.

379,298—March 13, 1888. L. B. WELD. *Preparing hydrochlorate of quinia.*

Sulphate of quinine is dissolved in boiling alcohol with sodium chloride; sulphate of soda and excess of sodium chloride is precipitated by concentration; and the alcohol evaporated to deposit the hydrochlorate of quinine as crystals.

450,887—April 21, 1891. C. T. LIEBERMANN AND F. GIESEL. *Process of obtaining ecgonine.*

Ecgonine is produced from the amorphous alkaloids contained in coca leaves or in crude cocaine, by decomposing the amorphous alkaloids by a suitable medium, as by boiling in hydrochloric acid, into organic acids and ecgonine, separating the organic acids by filtration, evaporating the solution, and crystallizing the ecgonine with alcohol. The ecgonine is converted, by treatment with benzoyl or benzoic anhydride, into benzoyl-ecgonine, and the latter may be converted into cocaine.

501,066—July 11, 1893. E. GRIMAUX. *Process of making salts of quinine.*

Chlorhydro-sulphate or bromhydro-sulphate of quinine, double salts possessing great solubility, are prepared by adding to and incorporating with basic quinine sulphate, hydrochloric and hydrobromic acids, respectively, and removing the excess of the reagent.

584,388—June 15, 1897. J. F. F. VON MERING. *Benzyl-morphin.*

A new product, $C_{17}H_{18}NO_2OC_6H_5CH_2$, crystallizing in large brilliant prisms, but slightly soluble in water, easily soluble in alcohol, etc., is produced by heating morphin in presence of an alkali—as sodium-alkylate—a benzyl halogen and a suitable solvent, as alcohol, separating the precipitate, neutralizing it by an acid, as hydrochloric acid, and then purifying.

585,610—June 29, 1897. R. WILLSTÄTTER. *Process of making pseudotropin.*

Tropin is treated with alkalies at an elevated temperature, as by boiling with a concentrated amyl-alcoholic solution of sodium amylate.

597,804—January 25, 1898. J. U. LLOYD. *Method of and apparatus for extracting nicotine.*

A column of tobacco in a closed chamber is burned from the bottom, the products of combustion being drawn up through the mass of unburned tobacco, and the nicotine vapors absorbed in an acid solution.

605,491—June 14, 1898. E. LANGHELD. *Quinine derivative and process of making same.*

A new derivative, $C_{19}H_{20}N_2O_5$, a yellowish amorphous powder, very soluble in water, alcohol, etc., and having an acid reaction, is produced by treating a quinine solution with ozonized gas until precipitation will not be caused by an alkali.

620,406—February 28, 1899. F. D. BANNING. *Process of extracting nicotine.*

Steam and ammonia are passed through the tobacco fiber and then into reclaiming acid.

623,798—April 25, 1899. R. MACKILL. *Extracting nicotin.*

A tobacco extract is first agitated with a caustic-soda solution, then gasoline is added and again agitated, when the gasoline with the nicotine in solution is decanted and distilled.

625,075—May 16, 1899. A. WELLER. *Carbonic esters of cinchona alkaloids and process of making same.*

New, tasteless products, insoluble in water and benzene, soluble in alcohol and acids. They are produced by reacting with phosgene upon sufficient cinchona alkaloid to displace both chlorine molecules of the phosgene with the cinchona alkaloid; then adding an acid to form the corresponding salt.

629,264—July 18, 1899. F. J. VON MERING. *Process of making ethyl morphin.*

Ethyl bromide is caused to act upon an alkaline solution of morphine.

637,839—November 28, 1899. A. WELLER. *Tasteless quinin compound.*

Tasteless products, derivatives of the quinine or cinchonidin carbonic acid, are prepared by causing the cinchona alkaloids or their salts to act either upon substituted isocyanates or upon substituted carbonic chlorides.

640,977—January 9, 1900. H. THRON. *Process of making quinin carbonic ether.*

The salts of the alkaloids of the cinchona bark are acted upon with an ether of chlorocarbonic acid.

PYRAZINES AND PIPERAZINES.

471,520—March 22, 1892. W. MAJERT. *Process of making piperazin.*

It is obtained from its hydrocarbon compounds, as dinaphthylpiperazin, by isolating the piperazin by means of an alkaline solution, distilling off the piperazin into a suitable acid to form salts, and crystallizing out the salts.

482,108—September 6, 1892. P. VOLKMANN. *Process of making piperazin.*

The dinitroso compounds of diphenylpiperazin, ditolylpiperazin, dixylylpiperazin, dinaphthylpiperazin, or the sulpho acids or other substitution products thereof, are treated with sulphurous acid, sulphur dioxide, or alkaline bisulphites.

500,665—July 4, 1893. W. MARCKWALD. *Process of obtaining piperazin.*

A salt of ethylene or an aromatic amide is caused to act upon an aromatic sulpho-compound of an amide in the presence of an alkali at a temperature above the normal, producing an aromatic disulphonic piperazide. This product is mixed with water or an inorganic acid solution and heated, whereby the piperazin is split off as an acid sulphate, and the acid salt is neutralized at a temperature above the normal, whereby free piperazin is obtained.

509,087—November 21, 1893. W. MAJERT. *Process of making piperazine.*

Diphenyl or ditolyl piperazine, or a salt thereof, is subjected to the action of the fumes of anhydrous sulphuric acid, the sulpho product is treated with fuming sulphuric acid, and an alkali or alkaline earth is then mixed therewith and the mixture heated.

511,303—December 19, 1893. W. MAJERT AND A. SCHMIDT. *Piperazin.*

Anhydrous piperazine, a new compound, of the formula $C_4H_{10}N_2$, a yellowish crystalline substance, m. p. 104° to 112° C., and a strong solvent of uric acid, is produced by distilling a mixture of piperazine-hydrate and a solid alkali hydrate, several times repeated, then heating the distillate in a closed vessel with an alkali-hydroxide or barium oxide, and finally distilling the mixture over sodium.

514,632—February 13, 1894. C. STOEHR. *Dimethylpiperazin.*

A new compound, $C_6H_{14}N_2$, forming white crystals, m. p. 118° C., and b. p. 162° C., and easily soluble in water and alcohol, is produced by distilling glycerine with ammonium chloride and ammonium carbonate, or agents giving off ammonia, and then isolating the thus formed dimethylpyrazine and reducing it, as by metallic sodium alcohol.

597,454—January 18, 1898. W. B. & A. BISHOP. *Process of making piperazin salts.*

Stable salts are produced by thoroughly mixing piperazine or piperazine hydrate and an organic hydroxy acid, as citric or tartaric acid, by melting or in solution, crystallizing slowly, and afterwards heating to expel moisture.

597,745—January 25, 1898. P. SCHIDROWITZ AND O. ROSENHEIM. *Piperidin derivative.*

New products, as a derivative of piperidin with guaiacol of the formula $(C_7H_8O_2)_2C_5H_{11}N$, are produced by acting upon piperidin or its homologues with an ether of a monoxyphenol.

615,488—December 6, 1898. L. KNORR. *Morpholin and process of making same.*

A new product, the morpholin C_4H_9NO, a liquid with b. p. 128° C., soluble in water, alcohol, etc., having an odor similar to piperidin, is produced by heating certain derivatives of dioxyethylamin with acid condensation agents, then making the solution alkaline and distilling with steam.

PROTEIDS.

544,912—August 20, 1895. N. R. FINSEN. *Process of making hæmatin albumen.*

A new food product is produced by mixing defibrinated blood with nitric acid, coagulating with heat, washing and drying the albumen, heating the product *in vacuo*, and powdering.

566,280—August 18, 1896. O. SCHMIEDEBERG. *Process of obtaining iron derivatives of albumen.*

An iron derivative of albumen is extracted from the liver or other animal organ by slowly heating with water to the boiling point, separating the coagulum and treating it with dilute tartaric acid.

567,706—September 15, 1896. D. FINKLER. *Method of obtaining albumen.*

The fatty constituents of albuminous substances being first saponified and washed out, the other undesirable constituents are decomposed by boiling with a suitable reagent, as peroxide of hydrogen; the products of decomposition are washed out with a neutral salt solution, the albumen separated from the solution, and traces of the latter removed with alcohol.

632,408—September 5, 1899. W. A. HALL. *Process of producing casein.*

The curd is precipitated from milk by means of muriatic acid, and the casein thus formed is subjected to a temperature sufficient to volatilize the acid—about 120° F.—and preferably in the presence of a current of air.

GROUP XIX.—CHEMICALS NOT OTHERWISE ENUMERATED.

INORGANIC.

SULPHUR.

166,279—August 3, 1875. S. H. JOHNSON. *Improvement in methods of and apparatus for separating free sulphur.*

The sulphur-bearing substance in a dry state is mixed with carbon bisulphide and heated in a closed vessel with agitation; the agitation stopped, and the liquid contents forced through the settled granular residuum forming a filter by the vapor pressure generated. A fresh charge of carbon bisulphide is then admitted into the extractor, mixed with the residuum by agitation, settled, the liquid contents discharged into a separate receiver, and the resultant product applied to a fresh charge of sulphur-bearing material, thus securing a strong solution for evaporation.

182,362—September 19, 1876. E. J. FRASER. *Improvement in processes and apparatus for refining and packing sulphur.*

Fused sulphur is run into wet sacks.

349,981—September 28, 1886. C. F. CLAUS. *Obtaining sulphur from hydrogen sulphide.*

Hydrogen sulphide mixed with a chemical equivalent of atmospheric oxygen is passed through anhydrous oxide of iron preheated to not less than 93° C., whereby the desired heat of the oxide is maintained, and free sulphur is continuously formed.

354,393—December 14, 1886. C. F. CLAUS. *Process of obtaining sulphur from sulphureted hydrogen.*

As an improvement on the process of No. 349,981, the iron oxide is mixed with lime, magnesia, alumina, or like substances to prevent the formation of clinkers.

359,164—March 8, 1887. H. L. LIGHTNER. *Apparatus for atomizing sulphur.*

Sulphur is reduced to an impalpable powder by atomizing liquid sulphur with a jet of hot air or steam.

361,761—April 26, 1887. E. HÄNISCH AND M. SCHROEDER. *Process of obtaining sulphur from furnace-gases.*

The furnace gases are passed through water or a water-tower; which water is then heated, and the sulphurous acid gas thereby absorbed and given off is passed through or over a glowing bed of fuel, and then through a glowing mass of fire-brick in the absence of a reducing agent.

443,629—December 30, 1890. E. F. WHITE. *Manufacture of flowers of sulphur.*

Liquid sulphur, melted by a steam coil without boiling, is fed through a siphon into a retort and boiled under less than an atmospheric pressure, the vapor being passed to a condenser and the condensed sulphur forced by an air blast to a receiver. The air blast creates the partial vacuum in the retort and the flow of liquid sulphur thereinto.

493,193—March 7, 1893. C. W. STICKNEY. *Process of roasting sulphur-bearing ores.*

One portion of the ore is roasted with steam generating hydrogen sulphide, and another portion is roasted with air generating sulphurous acid gas, and the gases are mingled in contact with a solution of a sulphate of iron, copper, or zinc, resulting in the deposition of the sulphur.

502,431—August 1, 1893. H. H. EAMES. *Process of desulphurizing metallic ores.*

See Group X, Electro-chemistry.

616,391—December 20, 1898. V. DE BARANOFF AND E. HILDT. *Process of obtaining sulfur from sulfates.*

Sulphur, sulphurous acid, and sulphides are simultaneously produced direct from sulphates by reducing a metallic sulphate by means of carbon under heat, causing the carbonic acid generated to act in presence of water upon a metallic sulphide to generate hydrogen sulphide; and then treating a metallic sulphate with the hydrogen sulphide under heat and decomposing the sulphate into sulphur, sulphurous acid, and sulphides.

PHOSPHOROUS.

171,813—January 4, 1876. A. G. HUNTER. *Improvement in retorts for distilling phosphorous.*

The phosphoric-acid mixture is heated in a retort and the volatilized products are caused to pass through carbon in another portion of the retort heated to a white heat before passing to the condenser.

417,943—December 24, 1889. J. B. READMAN. *Process of obtaining phosphorous.*

See Group X, Electro-chemistry.

452,821—May 26, 1891. H. H. WING. *Manufacture of phosphorus.*

A mixture of a phosphate and a silicate is calcined by a reducing flame at a high temperature, whereby phosphoric anhydride is expelled and reduced, the fumes passing to a depositing chamber maintained at about 260° C., in which red phosphorus is deposited, the remaining fumes being conducted through water chambers in which yellow phosphorus is condensed.

527,163—October 9, 1894. A. SHEARER AND R. R. CLAPP. *Process of making phosphorus.*

A pulverized mixture of a metallic chloride—as sodium or potassium chloride—and carbon and calcined phosphate of alumina is heated in a retort in the presence of dried hydrochloric acid gas.

602,747—April 19, 1898. C. K. HARDING. *Process of smelting phosphorus.*

See Group X, Electro-chemistry.

CARBON.

90,824—June 1, 1869. J. DICKINSON. *Improvement in the preparation of mineral carbon for use in the arts.*

Black diamonds are shaped with drill points and cutting edges and faces for dressing or cutting stones, etc., and firmly setting in metal tools, by rubbing or abrading one diamond or carbon against another.

263,758—September 5, 1882. C. F. BRUSH. *Process of baking carbon rods.*

For baking, the rods are stacked in pyramidal form in a receptacle and the interspaces and spaces at ends and sides of the pyramidal pile filled with sand.

379,960—March 27, 1888. C. H. LAND. *Manufacture of refractory carbon.*

Carbonaceous matter is subjected in an open muffle, located in a furnace, to the products of combustion under pressure, whereby a counter-resistance is offered to expel oxygen from the muffle, prevent ignition of said matter, and drive off determined elements therefrom.

568,323—September 29, 1896. E. G. ACHESON. *Manufacture of graphite.*

See Group X, Electro-chemistry.

598,549—February 8, 1898. H. H. WING. *Process of manufacturing graphite.*

See Group X, Electro-chemistry.

617,979—January 17, 1899. E. G. ACHESON. *Method of manufacturing graphite articles.*

See Group X, Electro-chemistry.

645,285—March 13, 1900. E. G. ACHESON. *Method of manufacturing graphite.*

See Group X, Electro-chemistry.

HALOID COMPOUNDS.

696,573—October 8, 1867. J. E. MILLS. *Improvement in the manufacture of chloride of zinc.*

Zinc chloride is produced direct from its oxide, carbonate, or silicate ores by digesting same with muriatic acid. In the case of silicate ores the chloride is freed from the gelatinous silica by evaporating the water and excess of acid and redissolving the zinc chloride. Iron and manganese, when present, are separated by drying the digested mass, oxidizing, and redissolving the zinc chloride.

175,583—April 4, 1876. J. WYETH. *Improvement in compressed chloride of ammonium.*

Chloride of ammonium is compressed into a rod or cylinder, for convenience in use.

196,464—October 23, 1877. C. LENNIG. *Improvement in manufacture of sal ammoniac and sulphate of soda or potash.*

A mixture of sulphate of ammonia and muriate of soda, or potash, is continuously fed into and through a furnace chamber heated to a dull cherry-red heat, and sulphate of soda, or potash, continuously withdrawn; sal ammoniac being continuously condensed in a condensing chamber in the form of flaky particles.

212,596—February 25, 1879. W. GENTLES. *Improvement in manufacture of muriate of ammonia.*

Suitable ammoniacal liquor is distilled and the volatilized carbonate of ammonia passed into a solution of calcium chloride, the resultant solution heated, the remaining clear liquor treated with hydrochloric acid, and the arsenic of the calcium-chloride and hydrochloric acid precipitated as tartar-sulphide of arsenic plus a little sulphur. The clear and settled liquor is rendered alkaline with the ammoniacal liquor evolved, the iron settled, and the liquor condensed to crystallization.

220,449—October 7, 1879. W. H. WAHL AND E. Y. ELTONHEAD. *Improvement in the manufacture of chloride of zinc.*

Crude chloride of zinc is made from precipitated dross by granulating the same and treating with hydrochloric acid.

231,860—August 31, 1880. E. SOLVAY. *Manufacture of chloride of lime.*

The hydrate of lime is formed into small fragments of uniform size, as little balls.

234,595—November 16, 1880. J. F. N. MACAY. *Manufacture of ferric oxide and cupric chloride.*

See Group XIX, Inorganic, Oxides.

236,051—December 28, 1880. E. J. MALLET, Jr. *Manufacture of chloride of zinc.*

A refrigerant is applied to the surface stratum only of a solution containing zinc sulphate and a salt, such as sodium chloride, and the crystallization excited extends throughout the warmer body of the solution as well as the cold top stratum.

319,118—June 2, 1885. A. PATCHEN. *Solution of dichloride of copper, etc., for treating ores.*

A solution of sulphate of copper with sodium chloride and metallic copper is subjected to pressure and heat in a closed retort.

330,155—November 10, 1885. T. SCHMIDTBORN. *Process of making ammonium chloride.*

Ammonium sulphate and potassium chloride are brought together in an aqueous solution and heated to about 150° C. for an hour, cooled until needles begin to form, when the supernatant liquor is removed and evaporated to obtain the ammonium chloride, while the precipitate—potassium sulphate—is freed from adhering liquor.

338,061—March 16, 1886. R. GRÄTZEL. *Process of making fluorine salts.*

Fluoride of aluminium and double fluorides of aluminium and potassium, or of aluminium and sodium, are produced from fluorides of alkali metals by treatment with chloride of aluminium.

351,184—October 19, 1886. C. F. MABERY. *Producing anhydrous aluminium chloride.*

Hydrochloric-acid gas is passed over aluminium or aluminium alloy heated to from 200° to 300° C., and the vaporized aluminium chloride formed is condensed; or hydrochloric-acid gas is passed through an electric furnace where aluminium is being reduced from its ore or compounds.

356,133—January 18, 1887. G. JÁRMAY. *Separating ammonium chloride from solutions by refrigeration.*

Sodium chloride is added to the warm liquor obtained in the ammonia-soda process, containing ammonium chloride, sodium chloride, and carbonates of ammonium and of sodium, and it is then refrigerated and ammonium chloride deposited. The liquor may be then warmed, more sodium chloride added and again refrigerated with deposition of ammonium chloride; the mother liquor being then used in the ammonia-soda process instead of brine.

359,601—March 22, 1887. W. FRISHMUTH. *Process of making aluminium chloride.*

An intimate mixture of aluminium oxide, sodium chloride, and carbon, in equal parts by weight, with a carbonizable agglutinating material, as molasses, is molded into lumps and subjected to a temperature high enough to carbonize without disintegrating the lumps, and then distilled in a retort in the presence of chlorine gas.

385,345—July 3, 1888. C. A. FAURE. *Process of obtaining aluminium chloride.*

An aluminium ore is heated in direct contact with the flame to a proper combining temperature, then a mixture of hydrochloric-acid gas and hydrocarbon vapor is passed over the heated ore and the resulting vapor condensed.

386,137—July 17, 1888. G. JÁRMAY. *Separating ammonium chloride.*

To the residual liquor from the ammonia-soda process there is added at one operation the requisite quantity of sodium chloride to replace the ammonium chloride, such amount being greater than what would saturate the original ammonium chloride liquor. The salt is kept in suspension by constant agitation, and at the same time cooled, whereby ammonium chloride separates out. The mother liquor is applicable in the ammonia-soda process in the place of brine.

386,704—July 24, 1888. L. GRABAU. *Manufacture of aluminium fluoride.*

The alkali fluoride in cryolite is converted into aluminium fluoride by treating cryolite with sulphate of ammonia, evaporating the solution, heating the product to redness and finally washing the same.

393,578—November 27, 1888. L. PAGET. *Production of zinc chloride, etc.*

See Group X, Electro-chemistry.

409,668—August 27, 1889. H. Y. CASTNER. *Purifying aluminium chlorides.*

Anhydrous double chlorides of aluminium are melted with a suitable quantity of a metal, as aluminium or sodium, adapted to reduce the contained iron to a metallic state, which is then separated.

412,800—October 15, 1889. W. SHAPLEIGH. *Process of making lead chloride.*

Finely divided lead is introduced into an aqueous solution of nitric acid, a blast of air being forced through the liquor while it is undergoing chemical action. Lead chloride is then precipitated by the addition of hydrochloric acid together with a blast of air to oxidize the lower oxides of nitrogen given off, and lead nitrate is then added to remove the excess of hydrochloric acid.

414,835—November 12, 1889. F. W. A. FRERICHS. *Process of making bromides of the alkalis.*

Bromides of potassium, of sodium, and of ammonium are produced from their respective sulphates by mixing the sulphate with calcium hydroxide, calcium sulphite, or calcium bisulphite, water, and bromine. By evaporation and crystallization the pure bromides are obtained.

422,500—March 4, 1890. H. Y. CASTNER. *Process of purifying aluminium chloride.*

The anhydrous double chloride compounds of aluminium containing iron are melted and passed through a series of electrolytic tanks, the iron chlorides being decomposed and metallic iron deposited. The electric current gradually decreases in quantity proportioned to the gradually decreasing quantity of iron.

434,044—July 1, 1890. O. O. B. FROELICH. *Process of making antimony fluorides.*

A powdered mixture of antimony ore, alkaline nitrates, and fluor spar is treated with oil of vitriol, and the soluble matter then extracted with water and steam. After neutralizing with alkalis the liquor is evaporated to crystallization.

447,063—February 24, 1891. E. RICHTER. *Process of making artificial cryolite.*

Gaseous silicic fluoride, obtained in treating phosphates containing fluorine with sulphuric acid, is converted with water into a solution of hydrofluosilicic acid, and treated with alumina hydrate and a caustic alkali or an alkali carbonate to form artificial cryolite and silicic acid, which are separated by filtration.

479,925—August 2, 1892. C. WACHENDORFF. *Double salts of fluoride of antimony and sulphate of ammonia.*

A new double salt of fluoride of antimony and sulphate of ammonia having the formula $(SbFl_3)_2.1\frac{1}{4}(NH_4)_2SO_4$, is produced by pouring into not too much water the product obtained by heating crude antimony with sulphuric acid, producing a basic sulphate of antimony which is put into the theoretical quantity of ammonium fluoride in aqueous solution, heated, and then crystallized out. Also by charging fluoride of antimony with less than the theoretical quantity of ammonium sulphate for crystallization.

508,796—November 14, 1893. W. ACKERMANN. *Process of making aluminum fluoride.*

To produce an aluminium fluoride solution free from silicious bodies, calcined silicate of aluminium is treated with an acid, as hydrofluoric acid, whereby the silicon is converted into insoluble silicic acid which is removed by filtration.

509,478—November 28, 1893. T. MAYER. *Antimony compound and process of making same.*

A new series of double salts, crystalline compounds corresponding to the type $2SbF_3.M_2SO_4$, are produced by causing an alkali sulphate to act upon antimonious fluoride in quantities of two molecules of the latter to one of the former. Oxide of antimony is dissolved in a mixture of one-third hydrochloric acid and two-thirds hydrofluoric acid and then the alkali metal sulphate is added.

513,901—January 16, 1894. H. S. BLACKMORE. *Process of making alkali salts.*

Soluble non-silicious salts of the alkalis are produced from insoluble combinations or mixtures containing alkali silicates by exposing the alkali silicates (as orthoclase) to the action of the oxide and salt of an earth metal (as calcium oxide and calcium chloride) at a high temperature, say 1,100° C., in the presence of super-heated steam under super-atmospheric pressure, then cooling and separating the soluble alkali salt or salts.

513,971—February 6 1894. W. ACKERMANN. *Process of making aluminum fluoride.*

Iron is removed from solutions of aluminium fluoride by converting it into a ferrous combination by means of hydrosulphuric acid, and then crystallizing out the aluminium fluoride.

514,125—February 6, 1894. F. M. LYTE AND G. LUNGE. *Process of making caustic alkali and lead chloride.*

See Group II, Caustic Soda.

523,715—July 31, 1894. A. SOMMER. *Process of making liquid chlorides.*

Chlorides are made from solid substances by exposing the same to chlorine and allowing the liquid chloride to drain away as rapidly as formed without previous volatilization. In flowing through a cooler in a thin stream to a receiver it is subjected to the action of chlorine gas.

529,070—November 13, 1894. P. GREDT. *Process of recovering iodides, chlorides, or other salts from blast-furnace gases.*

The gases are subjected to water showered as fine rain, the same liquid being pumped up and used until a strong lye is produced, which is evaporated down, the volatile constitutents being driven off, and the solid residue containing iodide and chloride of potassium is dissolved in water and separated by fractional crystallization.

532,150—January 8, 1895. O. O. B. FROELICH. *Double salts of antimony.*

A new antimony mordant, a soluble crystalline compound of antimony fluoride with a double oxalate of antimony and alkali, is produced by combining solutions in water of antimony fluoride and of oxalate of antimony and alkali, in the proportion of one molecule of oxalic acid to three molecules of hydrofluoric acid.

535,601—March 12, 1895. C. SCHILL AND C. SEILACHER. *Double salt of antimony and process of obtaining same.*

A new compound, a double salt of antimonious fluoride, having the formula $3SbF_3.NH_4F$, forming rhombic prisms and soluble in the proportion of 10 parts of salt to 8 parts of water, is produced by dissolving 100 parts of antimonious oxide in excess of hydrofluoric acid, then adding 4 parts of ammonia, filtering and crystallizing.

558,725—April 21, 1896. F. A. GOOCH. *Process of producing hydrous chloride of aluminium.*

Aluminous material heated and under pressure is treated with dilute hydrochloric acid of half strength; the filtered solution is treated with gaseous hydrochloric acid to the point of saturation, and the resulting precipitated hydrous aluminium chloride is separated out and washed with concentrated hydrochloric acid.

558,726—April 21, 1896. F. A. GOOCH. *Process of producing hydrous chloride of aluminium.*

A suitable aluminous earth is heated with sulphuric acid until the acid fumes cease to be evolved, and the process is then proceeded with according to No. 558,725.

582,938—May 18, 1897. W. MILLS. *Process of making fluorides.*

Metallic fluorides are prepared from aqueous solutions of metallic chlorides by heating together a mixture of ammonium sulphate and calcic fluoride (fluorspar) at about 350° C., and then adding the ammonium fluoride thus obtained to the chloride solution.

599,111—February 15, 1898. F. RAYNAUD. *Process of making aluminium-sodium chloride.*

A current of hydrogen sulphide and a current of atmospheric air are passed alternately through a mass of blocks of a porous mixture of bauxite, carbon, and sea salt heated to redness until the whole of the aluminium is converted into chloride.

640,908—January 9, 1900. H. K. HESS. *Process of and apparatus for making chloride of zinc.*

Hydrogen gas is produced by heating chloride of zinc above its melting point by contact with a body of incandescent carbon in a state of combustion, introducing steam into the carbon, and reducing the zinc chloride, thereby forming hydrochloric acid and zinc, vaporizing the hydrochloric acid which passes over to a condenser, the metallic zinc passing through the carbon into a receptacle, and finally uniting the zinc and the acid, and re-forming chloride of zinc and producing hydrogen.

641,406—January 16, 1900. J. G. A. RHODIN. *Process of obtaining soluble potassium salts from feldspar.*

A pulverized mixture of feldspar (orthoclase), lime, both equal parts, and sodium chloride, one-fifth part, is heated to a bright yellow heat and maintained for a considerable time without melting or fusion. After cooling the potassium readily combines with acids to form salts. For fertilizer purposes an excess of lime is advantageous.

648,809—May 1, 1900. O. J. STEINHART, J. L. F. VOGEL, AND H. E. FRY. *Process of making anhydrous zinc chloride.*

A zinc chloride solution is boiled in a partial vacuum. A current of previously dried air is passed through and over the molten chloride.

OXIDES.

151,219—May 26, 1874. R. GUENTHER. *Improvement in the manufacture of dry soluble silica.*

Concentrated silicate of soda or potash is added to hyposulphite of soda which has been heated until the water of crystallization is nearly evaporated, causing the liquid glass to coagulate. The latter is taken out, freed of adhering hyposulphite by pressure while yet warm, and subsequently pulverized. The hyposulphite is evaporated and again used.

206,635—July 30, 1878. R. & C. STEINAU. *Improvement in preparation of peroxide of iron.*

Water is caused to alternately rise and fall through a layer or mass of iron scraps, as lathe turnings, and the peroxide formed is collected.

234,595—November 16, 1880. J. F. N. MACAY. *Manufacture of ferric oxide and cupric chloride.*

Modified hydrated ferric oxide, after being calcined, known as "colcothor" or "jewelers' rouge," and cupric chloride are produced at one operation by the mutual reaction, in the presence of air, of cupric oxychloride and solution of ferrous chloride; or ferrous or ferric sulphate and cupric oxychloride are digested in a solution of sodium chloride with access of air.

239,346—March 29, 1881. C. SCHEIBLER. *Process of obtaining magnesia.*

Dolomite or other lime and magnesia compound is burned and then treated with a saccharine solution, 10 to 15 per cent of sugar, to dissolve out the lime, the magnesia being separated from the other insoluble constituents after precipitation by decantation, filtration, or otherwise. The caustic product may be comminuted by slaking to a pulverulent hydrate and then treated with the saccharine solution.

252,982—January 31, 1882. J. WEBSTER. *Manufacture of soluble alumina.*

Aluminous material, as commercial alum, is mixed with carbonaceous material, as gas pitch, and roasted; then treated with dilute hydrochloric acid and allowed to give off sulphureted hydrogen; then steam and air is passed through the compound while heated to carry off sulphur and ferric sulphide; and finally the residuum is boiled and the liquor drawn off after cooling, leaving the soluble alumina as a precipitate. The vapors of sulphur and ferric sulphide are condensed for use in the manufacture of colors, etc.

266,115—October 17, 1882. A. K. EATON. *Preparing peroxide of lead.*

Red lead is treated with acetic acid, by which the peroxide component of the red lead is removed, producing acetate of lead and leaving the peroxide of lead as a residuum.

266,970—November 7, 1882. J. B. M. P. CLOSSON. *Manufacture of magnesia.*

Crude or artificially recarbonated dolomite is digested with a solution of chloride of calcium and the resulting solution of magnesium chloride is heated with calcined dolomite or ordinary burned lime.

267,551—November 14, 1882. C. MARCHAND. *Manufacture of binoxides of barium and calcium.*

Barium or calcium binoxide is produced by subjecting baryta or lime, heated to a red heat, to the action of ozonized oxygen or ozonized air.

285,579—September 25, 1883. J. D. DARLING. *Process of producing alumina.*

Alumina is obtained from alum salts or compounds, or from aluminum sulphate by forming a gelatinous hydrated precipitate, subjecting the precipitate to a suitable heat to convert it into a calcined oxide and expel therefrom the sulphate of ammonia contained therein, and finally leaching therefrom the remaining sulphates or other impurities.

294,051—February 26, 1884. J. K. KESSLER. *Process of making copper salts by the aid of electricity.*

See Group X, Electro-chemistry.

305,828—September 30, 1884. C. MARCHAND AND V. M. PICABIA. *Manufacture of anhydrous caustic baryta.*

Barium nitrate is subjected in a closed vessel to the direct action of gases heated to 1,000° to 1,300° C., driving off the oxide of nitrogen and liquefying the baryta. The retort has a removable top and is mounted on trunnions and, after solidification, the cake is dumped.

318,603—May 26, 1885. G. DEUMELANDT. *Process of separating basic compounds from slags.*

The free bases contained in basic slag are separated by treating the pulverized slag at the boiling temperature with a solution of a suitable ammonium salt, filtering off the solution, and treating the filtered solution with a mixture of air and carbonic acid in the presence of ammonia, to precipitate the dissolved oxides.

338,628—March 23, 1886. L. Q. & A. BRIN. *Manufacture of anhydrous oxide of barium.*

In the manufacture of anhydrous oxide of barium or baryta by calcining barium nitrate, moisture and carbonic acid are excluded from the baryta while cooling by exhausting the air of the cooling chamber, or filling same with a gas, such as nitrogen, destitute of moisture, and carbon dioxide.

359,423—March 15, 1887. A. BRIN. *Process of making barium bioxide.*

Barium nitrate is first heated to form caustic baryta, then the caustic baryta is reheated in a closed vessel with an exhaust to remove the nitrous and other gases given off, and when the vapors cease to be given off atmospheric air is admitted to form barium bioxide.

370,511—September 27, 1887. C. L. & W. J. WIGG AND M. STEELE. *Obtaining ferric oxide from the waste liquors of copper-works.*

The residual liquors obtained in the precipitation of copper by the wet process and the residual chloride-of-calcium liquor obtained in the manufacture of chlorine by the Weldon process are mixed and agitated, the precipitate and supernatant liquor separated, and the liquor treated with an equivalent of lime to precipitate the iron, which is oxidized and furnaced. The white precipitate first formed is treated with dilute hydrochloric acid, washed, pressed, and gently heated to purify and prepare the sulphate of lime for use as a by-product.

382,197—May 1, 1888. F. J. SEYMOUR. *Method of obtaining alumina from clay.*

Clay or aluminous earth mixed with a deoxidizing agent, as pulverized carbon, and a flux, such as chloride of sodium, and with copper or other metal of greater specific and atomic weight than aluminium, is heated to a temperature of 1,400° to 2,000° C., and the mixed vapors are condensed and collected in a conduit, silica first depositing, and beyond, alumina mixed with the metallic oxide.

382,273—May 1, 1888. F. J. SEYMOUR. *Method of obtaining alumina from clay.*

A modification of the process of No. 382,197, the clay being mixed with zinc, carbon, and a flux.

382,505—May 8, 1888. K. J. BAYER. *Process of obtaining alumina.*

Pure alumina compounds are obtained from bauxite and other materials containing alumina, by subjecting the aluminate lye under constant stirring and at ordinary temperature to the action of hydrate of alumina, so as to decompose said solution and precipitate hydrate of alumina, the remaining mother liquor being concentrated, mixed with bauxite or other material containing alumina, and the mixture calcined.

440,539—November 11, 1890. F. CANDY. *Process of preparing iron ore for filters.*

Argillaceous carbonate of iron is subjected in a closed retort to a carbonizing but not a fusing heat, gradually cooled and then pulverized for use for filtering purposes.

455,229—June 30, 1891. L. MOND. *Process of making compounds of nickel and carbon monoxide.*

Oxidized nickel ore is exposed to the reducing action of carbon monoxide, hydrogen, or a hydrocarbon, at from 300° to 350° C.; then the reduced oxide is cooled to below 150° C. and treated with carbon monoxide (free from uncombined oxygen and halogens) till the nickel is extracted and the vapors are condensed.

455,229—June 30, 1891. L. MOND. *Compound of nickel and carbon monoxide.*

Nickel-carbon oxide, a compound of nickel and carbon monoxide of the formula NiC_4O_4, is a colorless liquid, B. P. about 43° C., but very volatile in the presence of other gases. Solidifies at −25° C.

455,611—July 7, 1891. P. A. EMANUEL. *Process of reducing kaolins and clays to their component oxides.*

The clay, stirred in with water until in a state of suspension, is treated with sulphuric acid and heat, and the sulphate of alumina separated from the silica, iron being removed with binoxide of lead or manganese, and the solution evaporated to recover the sulphate of aluminium. Sulphate of aluminium is reduced to alumina by mixing with sulphur and heating, the fumes being conducted to sulphuric-acid chambers.

461,416—October 20, 1891. J. A. BRADBURN AND J. D. PENNOCK. *Process of obtaining alumina from bauxite.*

The iron and organic matter in ferrous bauxite is oxidized by mixing the ground mineral with a solution of hypochlorite and then passing carbonic-acid gas into the solution. The oxidized bauxite is then treated with a caustic-soda solution, filtered, and the hydrate of aluminium precipitated and calcined.

494,757—April 4, 1893. H. Y. CASTNER. *Manufacture of oxides of the alkaline metals.*

The alkaline metals, heated to about 300° C., are oxidized by the action of air with a decreasing proportionate mixture of nitrogen, the material being moved through a tubular retort in one direction with a current of air moving in the opposite direction.

514,039—February 6, 1894. H. F. D. SCHWAHN. *Process of purifying aluminous minerals.*

Minerals containing alumina are roasted, ground, and mixed with hydrochloric and nitric acids—or crude material as sodium chloride and sodium or potassium nitrate to produce the same—then sulphuric acid is added, the decomposed mass is heated, the waste nitro-hydrochloric acid and produced ferric chloride are evaporated and expelled, and the remaining soluble and insoluble impurities respectively removed by washing and floating.

515,895—March 6, 1894. K. J. BAYER. *Process of making alumina.*

Alumina is dissolved direct from bauxite by mixing pulverized bauxite in a concentrated aluminate lye formed by subjecting an aluminate lye under constant stirring and at ordinary temperature to the action of hydrate of alumina so as to decompose said solution and precipitate hydrate of alumina, then filtering off the precipitate and concentrating the remaining aluminate lye. The mixture is subjected to constant agitation at a pressure of three to four atmospheres at a temperature of 160° to 170° C.

519,704—May 15, 1894. A. G. FELL. *Obtaining lead salts from native ores.*

Ground lead ores are treated in an acid solution containing free sulphuric acid and formed of sulphuric acid, another inorganic acid, as muriatic or nitric acid, sulphate of soda, and water. The undissolved residue is separated from the solution of soluble salts, any contained silver is removed, and the residue is subjected under a moderate heat to a compound, as sal-soda, which contains an alkaline base. The insoluble lead salts are separated from this solution, nitric acid or nitrate is mixed with the residue, and it is roasted if an oxide is to be produced.

544,819—August 13, 1895. A. W. NIBELIUS. *Process of extracting aluminium oxid.*

The raw material—clay, clay-slate, anthracite-slate, minerals, and rocks, alone or mixed with pyrites—is mixed with the sulphate or bisulphate of an alkali and subjected while heated to a petroleum air flame, the acid being condensed and utilized for lixiviating the alumina, which is finally precipitated.

585,522—June 29, 1897. H. JAEGER. *Process of making tin oxid.*

Metallic tin is raised to a high temperature, 1,200° C., in the absence of air; then, when at said high temperature, abundance of air is admitted to the molten metal, and the tin oxide formed is removed.

624,041—May 2, 1899. C. B. JACOBS. *Process of manufacturing soluble barium compounds.*

See Group X, Electro-chemistry.

626,330—June 6, 1899. C. LUCKOW. *Process of producing peroxide of lead.*

See Group X, Electro-chemistry.

626,547—June 6, 1899. C. LUCKOW. *Process of producing oxid of copper.*

See Group X, Electro-chemistry.

641,550—January 16, 1900. M. E. ROTHBERG. *Process of making magnesia and plaster-of-paris.*

Limestone containing carbonate of magnesia is dissolved in hydrochloric acid producing a solution of the chlorides of calcium and magnesia; calcium oxide is added to precipitate magnesia and form additional calcium chloride; the liquor is drawn off, leaving the magnesia to be washed and dried, and sulphuric acid is added to precipitate calcium sulphate, which is separated, dried, and calcined. The hydrochloric-acid solution is reused.

644,050—February 27, 1900. H. BECKMANN. *Manufacture of lead peroxide and its application to electrical storage batteries.*

See Group X, Electro-chemistry.

647,320—April 10, 1900. S. B. NEWBERRY. *Process of making strontia.*

A mixture of strontium sulphate, or celestite, and an oxide of an alkaline earth, as lime, is calcined at a high temperature. The calcined product is leached.

650,023—May 22, 1900. H. OPPERMANN. *Process of making magnesium superoxid.*

Magnesium hydrate, 50 parts, moistened to such an extent only that it retains its powdery form, is mixed with dry, pulverized, sodium superoxide, 10 to 12 parts. An excess of dry, pulverized magnesium hydrate is added during the reaction to reduce the temperature of the mixture below that at which oxygen is liberated.

650,518—May 29, 1900. C. SAVIGNY. *Process of making dioxid of barium.*

A mixture of hydrated crystallized baryta and finely divided carbon in equal parts is heated to 150° C. to drive off the greater part of the water; the mixture is then heated in a metallic basin for two to three hours at 100° to 150° C., when the magma is transferred to and heated in a crucible lined with carbonaceous material, as cardboard, to 1,000° to 1,200° C. for from five to eight hours, producing porous anhydrous oxide of barium, which is then deoxidized.

650,763—May 29, 1900. E. RAYNAUD. *Method of obtaining alumina from its ores.*

A mixture of crushed aluminous ore, ores which resist attack wholly or partially by sulphurous acid, and a quantity of a sulphureted compound of an alkaline metal, as sodium sulphide, smaller than would be necessary for forming aluminates, is heated to a dark red heat for about two hours; then lixiviated, and the residue treated to the action of a current of sulphurous-acid gas in combination with water, the alumina dissolving as a sulphite. The solution is then filtered, heated, and the precipitate calcined, yielding alumina and sulphurous gas.

SULPHIDES.

126,275—April 30, 1872. A. K. EATON. *Improvement in the manufacture of sulphide of sodium.*

Crude sulphate of soda is melted in a heated tube and percolated through highly heated carbon, whereby it is decomposed and sodium sulphide produced.

233,680—October 26, 1880. E. C. E. & L. L. LABOIS. *Manufacture of carbon bisulphide and sulphuric acid from pyrites, and apparatus therefor.*

See Group I, Acids, Sulphuric Acid.

278,816—June 5, 1883. C. E. PARSONS. *Method of producing golden sulphuret of antimony.*

Native sulphide of antimony (antimony glance) and sulphur are separately dissolved in saturated solutions of caustic alkali, which solutions are then mixed and the mixture treated with acid.

332,736—December 22, 1885. H. J. F. NIEWERTH. *Metallic alloy or compound in producing the same.*

Heavy metals are alloyed with the sulphurets of metals by first dissolving the sulphuret of the metal in molten zinc, and then mixing the product with the heavy metals desired to form the alloy in their molten condition, and finally expelling off the zinc. In the formation of alloys of heavy metals with the sulphuret of metals, small quantities of the sulphuret of an alkaline metal are added to the heavy metals in their molten condition, so that the decomposition of the sulphuret takes place gradually, and the sulphur and nascent alkali are enabled to combine with the heavy metals.

343,674—June 15, 1886. E. W. PARNELL AND J. SIMPSON. *Process of treating ammonium sulphide to obtain hydrogen sulphide.*

A mixture of ammonium sulphide and ammonium sesquicarbonate in solution is subjected to the action of heat—or of a partial vacuum—hydrogen sulphide being evolved.

425,061—April 8, 1890. A. KEILLER. *Process of making zinc sulphide.*

In the precipitation of zinc sulphide from neutral hydrated solutions of zinc salts by means of hydrothionic acid, a precipitation of all of the zinc is secured by the addition of an alkaline sulphate which is soluble in water and indifferent to the hydrothionic acid, as potassium sulphate.

463,143—November 17, 1891. P. A. EMANUEL. *Process of, and apparatus for, preparing aluminium sulphide.*

Dry aluminium sulphate mixed with sulphur is heated in a retort, and carbon bisulphide is injected into the residual product. An angular entrance for the carbon bisulphide jet gives a rotary movement to the charge.

513,660—January 30, 1894. C. T. J. VAUTIN. *Process of making aluminum sulfid.*

Metallic aluminium, slightly in excess, and lead sulphide (galena) are melted together at a bright red heat, producing metallic lead and aluminium sulphide.

586,567—July 20, 1897. B. VON SCHENK. *Process of making polysulfids.*

A mixture of sulphur and hydrated lime in the proportions, respectively, of 60 and 40 per cent, is boiled in water and a lye formed of 10° Baumé, descanted, and reduced to about 5° Baumé, when an alkali carbonate is added, and the solution descanted and evaporated to dryness, cooled, and ground, thus producing alkaline polysulphides by a reaction between soluble polysulphides of calcium and alkaline carbonates, or sulphates.

605,378—June 7, 1898. H. S. BLACKMORE. *Process of making aluminium sulfid.*

A heated mixture of aluminium oxide and carbon bisulphide is blown into a retort containing a chemically inert molten bath capable of dissolving aluminium sulphide, as cryolite, with a mixture of potassium and sodium chlorides.

605,458—June 7, 1898. H. S. BLACKMORE. *Process of making sulfids.*

Carbon-bisulphide vapor is passed through a molten aluminate of an alkali or other metal—as sodium aluminate or a mixture of sodium and potassium aluminate—producing aluminium sulphide with sulphides of the alkali or other metals. Aluminium oxide is added to molten sodium hydroxide to saturation, and the vapor passed therethrough.

605,812—June 14, 1898. H. S. BLACKMORE. *Process of making aluminium sulfid.*

Carbon bisulphide vapor is introduced into a fused bath—a mixture of cryolite and potassium fluoride—containing dissolved aluminium oxide, transforming the latter into aluminium sulphide.

606,576—June 28, 1898. D. A. PÉNIAKOFF. *Aluminium sulfid and process of making same.*

A new substance, porous aluminium sulphide, is produced by treating heated dehydrated sulphate of aluminium, alone or mixed with other metallic sulphates, by means of bisulphide of carbon or oxysulphide of carbon at a temperature below the fusing point of aluminium sulphide.

648,772—May 1, 1900. A. MOFFATT. *Process of making hydrosulfids.*

To produce in solution a hydrosulphide of an alkaline-earth metal, such as barium, calcium, o rontium, two equivalents of the sulphide of an alkaline-earth metal are m.xed with one equivalent of a magnesium salt. A dry mechanical mixture of the ingredients is suitable for shipment and storage.

BASIC HYDROXIDES.

Ammonia.

67,447—August 6, 1867. A. PARAF. *Improvement in the manufacture of ammonia.*

Ammoniacal liquor is distilled and the vapors purified by passing through charcoal.

127,470—June 4, 1872. R. J. EVERETT. *Improvement in the preparation of ammonia, sulphur, and other products from gas-lime.*

Spent gas-purifying materials are heated in a retort, the liquefied sulphur collected, and the sulphur vapors and ammonia condensed. The condensed product is washed to obtain therefrom sulphur and a solution of the ammonia salts, which latter, on boiling, filtering, and evaporating, gives sulphate of ammonia.

132,264—October 15, 1872. H. H. & C. J. EAMES. *Improvement in treating ammoniacal liquors of gas-works, etc.*

Ammoniacal liquor is subjected to the direct action of steam or superheated steam, while flowing in a stream, to eliminate the contained volatile substances by vaporization.

137,059—March 25, 1873. T. CHRISTY, JR., AND A. BORROWNICKI. *Improvement in processes for treating sewage and ammoniacal waters for the production of fertilizers, etc.*

Ammoniacal and other liquids of gas works, sewage, etc., are treated with a solution of a hydrated silicate to agglomerate suspended or dissolved matter. Ammonia is recovered and the product may be treated to produce cyanogen and other matters.

150,007—April 21, 1874. C. M. TESSIÉ DU MOTAY. *Improvement in transforming atmospheric gases into oxygen and ammonia, etc.*

Ammonia is produced by the reaction of carbureted hydrogen upon nitride of titanium—the latter being formed by the reduction of oxides of titanium or the spent nitride of titanium from a former operation—with coke in a blast furnace. Cyano-nitride of titanium is produced by prolonging the operation in the retort. The cyano-nitride is removed and treated with a soda or potash solution, setting free ammonia and forming the cyanides of sodium or potassium and titanic acid. The cyanides are obtained by evaporation. Pure hydrogen gas combined with light carbon vapors at a low temperature—e. g., zero—may be used in place of carbureted hydrogen for producing cyanogen compounds.

156,181—October 20, 1874. J. E. SIEBEL. *Improvement in recovering phosphoric acid and purifying ammonia.*

A solution of phospate of lime obtained in the treatment of bones with phosphoric acid is saturated with ammonia, phosphate of lime precipitated, and the solution evaporated, the ammonia collected, and the phosphoric acid recovered. By using crude ammonia the same can be purified.

158,265—December 29, 1874. L. S. FALES. *Improvement in processes and apparatus for the manufacture of aqua ammonia.*

The spent liquor of gas works is heated in a closed vessel, and so long as sulphureted hydrogen escapes the gas is conducted into a vessel charged with sulphuric acid, and after sulphureted hydrogen is no longer apparent it is conducted through a cold worm into a closed receiver, from thence into the lower compartment of a filter charged with alternate beds of charcoal and caustic alkalis, from the top of the filter into an oil chamber, and from thence into an ascending series of closed vessels containing water, having communication from one to another consecutively, and also with a common branched pipe, which conducts into one or more settlers.

161,137—March 23, 1875. F. MAXWELL-LYTE. *Improvement in processes of manufacturing ammonia.*

A triad or pentad element, as antimony or bismuth, combined with a readily-oxidizable element, as potassium or sodium, is used as a body for the synthetic manufacture of ammonia from aqueous vapor and nitrogen. A temperature between 100° and 400° C. should be maintained. The alloy is regenerated by means of a reducing agent at a red heat.

193,920—August 7, 1877. S. CABOT, JR. *Improvement in processes for obtaining ammonia salts.*

Salts of ammonia and bicarbonate of soda are produced as independent products by spraying a saline soda solution through volatilized mono-carbonate of ammonia charged with carbonic-acid gas.

230,303—July 20, 1880. J. L. MARSH. *Manufacture of aqua-ammonia.*

A mixture of sulphate of ammonia, lime and water is heated and volatilized in a steam jacketed vessel, with agitation around a horizontal axis, to expose a maximum area of surface to the heat.

232,991—October 5, 1880. H. P. LORENZEN. *Method and apparatus for obtaining ammonia.*

In the recovery of ammonia from nitrogenous substances by distillation, ammonia is developed from the gases by contact with incandescent oxide of calcium. It is then subjected to a cooling agent and to the action of sulphuric acid.

253,045—January 31, 1882. H. J. E. HENNEBUTTE. *Process of treating ammoniacal salts.*

In the treatment of ammoniacal salts the liquor is acidulated to prevent the formation of froth and foam before adding lime to decompose the fixed ammoniacal salts.

258,498—May 23, 1882. O. A. STEVENS AND E. L. DU BARRY. *Combined furnace and stack for destroying noxious or poisonous gases.*

Noxious gases evolved in the treatment of gas liquor are first passed in ascending currents over moist retarding surfaces and through a spray of water, and are then burned at an intense heat.

259,145—June 6, 1882. H. J. E. HENNEBUTTE AND C. J. F. R. DE J. MENARD. *Process of treating ammoniacal liquors.*

Salts of ammonia are produced from ammoniacal liquors by subjecting the liquor to the action of the mixed chlorides of calcium and iron and evaporating or concentrating the resulting liquor. A small quantity of the double chloride of ammonium and lead is added when evaporating in sheet metal vessels to preserve the same.

263,856—September 5, 1882. H. Y. & E. B. CASTNER. *Manufacture of ammonia and bone-black.*

Boneblack and ammonia are produced by passing the bone continuously through a closed, highly heated chamber, drawing off the volatile portions and heating the same mixed with air, then passing the gases over hot slaked lime through a cooler and finally in contact with acid.

264,801—September 19, 1882. R. W. WALLACE AND C. F. CLAUS. *Utilization of by-products in the manufacture of coal-gas.*

Ammonia is separated from ammoniacal liquor by treating the liquor with sodium chloride and carbonic acid, then separating the ammonium chloride from the solution and decomposing it by lime.

265,792—October 10, 1882. T. B. FOGARTY. *Process of, and apparatus for, manufacturing gas.*

In the manufacture of water gas cyanogen and cyanides are produced and the gas freed from nitrogen by burning in a combustion chamber the carbonic oxide and hydrogen produced in a generator furnace, and then passing the incandescent products of such combustion through a mass of carbon and alkali. Ammonia is then produced by decomposing the cyanides in another chamber with steam. The charge is then returned to the cyanidizing chamber.

265,793—October 10, 1882. T. B. FOGARTY. *Process of manufacturing gas.*

The claim is for the specific production of cyanogen by process No. 265,792.

267,550—November 14, 1882. J. G. MACFARLAN. *Process of and apparatus for the manufacture of ammonia and animal charcoal.*

Superheated steam, decomposed by being passed through carbonaceous matter, is passed into the bone retorts, accelerating the carbonization and increasing the ammonia product.

269,309—December 19, 1882. L. MOND. *Manufacture of cyanogen compounds and ammonia.*

In the manufacture of cyanogen compounds or of ammonia therefrom, the materials—carbon, carbonate or oxide of barium, and a basic absorbing material, as magnesia—are mixed and molded into blocks and calcined out of contact with air before exposing them in a heated state to the action of nitrogen.

277,041—May 8, 1883. F. LORENZ. *Process of and apparatus for obtaining ammonia.*

Relates to a series of consecutive steps for treating the hot gases of bone and other furnaces; moistening, cooling, passing through towers, heating, contact with acid, reusing fluid products for collecting ammonia, etc.

278,823—June 5, 1883. J. P. RICKMAN AND J. B. THOMPSON. *Manufacture of ammonia and its salts.*

Ammoniacal salts are produced from urine or like animal excreta by mixing therewith stale urine, or a portion of similar material in a state of fermentation, and distilling the ammoniacal gases into a vessel containing acid. The impure solution thus formed is then drawn off into a still, and the ammoniacal substances volatilized through an intercepting still to remove impurities, into a vessel containing sulphuric acid, for the formation of sulphate of ammonia.

282,411—July 31, 1883. B. TERNE. *Process of treating tank-waters of slaughter-houses.*

The liquor is concentrated to a semi-solid condition and then passed into and upon the floor of a heated retort, whereby it is rapidly distilled to dryness; the ammonia being collected and the residual partly nitrogenized animal matter utilized as a fertilizing compound.

288,323—November 13, 1883. T. B. FOGARTY. *Process of and apparatus for making ammonia.*

The process involves the formation of incandescent generator gas and the decomposition of the undecomposed steam in the crude gas by the carbonic oxide contained in the gas, the conversion of the nitrogen into ammonia by contact with a falling column of pulverized carbon and alkali, and the decomposition of the cyanogen produced by steam; the temperature being controlled by an adjustment of the amount of falling cyanidized carbon and the volume of steam.

288,324—November 13, 1883. T. B. FOGARTY. *Process of and apparatus for manufacturing ammonia.*

The process consists in treating a falling shower of pulverized alkalized carbon with a current of highly-heated nitrogenous or furnace gases to form cyanogen and cyanogen salts, then transferring these compounds to separate chambers, in which they are decomposed by steam with the formation of ammonia.

291,264—January 1, 1884. J. & J. ADDIE. *Process of obtaining ammonia from furnace-gases.*

Sulphurous acid, or the gas of sulphuric acid, is mixed with the gases from blast and other furnaces to fix the ammonia, and the ammonia salts are then recovered by condensing or dissolving.

304,260—August 26, 1884. E. CAREY, H. GASKELL, JR., AND F. HURTER. *Process of obtaining ammonia from ammonium sulphate.*

Sulphate of ammonia is intimately mixed with sulphate of soda and at an elevated temperature—about 300° C.—ammonia and bisulphate of soda are produced, in which latter form the sulphuric acid may be utilized for many purposes. A current of steam is required to make the reaction complete.

337,246—March 2, 1886. C. F. CLAUS. *Process of purifying coal-gas and obtaining ammonia and other products therefrom.*

Coal gas is purified by passing it with gaseous ammonia, supplied by the process, through a mixing chamber and a series of gas scrubbers, showering the liquor successively through a series of coke towers against an ascending flow of carbonic acid, separating the sulphide of hydrogen from the carbonated ammonia liquor, and then heating the latter from 75° to 90° C.—using the carbonic acid in the coke towers—and distilling the heated liquor and condensing the carbonate of ammonia.

337,387—March 9, 1886. A. FELDMANN. *Process of manufacturing ammonia.*

In the manufacture of spirits of sal ammoniac, a liquor free from lime and lime combinations is obtained by mechanical filtration—by a filter press or a centrifugal machine—in contradistinction to precipitation and decanting.

342,237—May 18, 1886. J. VAN RUYMBEKE. *Process of obtaining ammonia.*

Ammonia compounds are produced from liquids containing organic substances in solution by showering them through forced air currents over porous substances charged with putrid ferments, and subjecting the putrefied liquor mixed with an alkali to heat in closed boilers, and collecting the gases in refrigerating and sulphuric-acid condensers.

342,722—May 25, 1886. W. C. WREN. *Process of and apparatus for distilling ammonia.*

The process consists in vaporizing aqua ammonia, cooling the vapor and discharging it into a receiver, the vapor being under constant pressure during the entire operation.

343,675—June 15, 1886. E. W. PARNELL AND J. SIMPSON. *Recovery of ammonia in ammonia-soda manufacture.*

Ammonia and sulphureted hydrogen are produced by heating alkali waste—from the Le Blanc process—with a solution of chloride of ammonium producing sulphide of ammonium, which latter is decomposed by acid sulphate of ammonia evolving sulphureted hydrogen. The neutral sulphate of ammonia is heated till it parts with a portion of its ammonia, leaving acid sulphate of ammonia available for another charge.

351,412—October 26, 1886. J. VAN RUYMBEKE. *Process of obtaining ammonia and illuminating gas from tank waters.*

Concentrated tank waters are distilled at a heat not exceeding 260° C., and the volatile products collected, whereby highly-illuminating and ammoniacal gases are obtained and decomposition of valuable substances are avoided.

351,865—November 2, 1886. C. W. ISBELL. *Process of concentrating ammoniacal liquor.*

A suitable quantity of the weak liquor is supplied to a closed heating vessel, and also a further quantity of the weak liquor to a receiving vessel submerged in cooling water, then the liquor is heated in the heated vessel, the ammonia vapor driven off passed through a cooling worm above the heating vessel, so that all aqueous vapor will be condensed and returned to the heating vessel, and finally the ammonia vapor is introduced into the weak liquor in the receiving vessel to increase the strength thereof.

352,287—November 9, 1886. J. YOUNG, DEC'D. *Process of producing currents of liquids in vacuo.*

In the separation of ammonia from sewage or other liquids in a vacuum, the force of the liquid entering the vacuum chamber is employed to operate a pump for the removal of the liquid from the chamber.

356,610—January 25, 1887. W. YOUNG AND G. T. BEILBY. *Process of and apparatus for obtaining ammonia from coal.*

The process of treating coal, shale, and other substances to obtain ammonia and ammoniacal compounds consists in heating the material to a temperature sufficient to separate its volatile matter, which latter is exhausted from the retort, passed through a condenser, and the noncondensable gases returned to the retort to aid the combustion and prevent the carrying off of air or fire gases by supplying any excess of the exhaust.

367,992—August 9, 1887. P. J. McMAHON. *Process of preparing anhydrous ammonia.*

The method consists in evaporating concentrated ammonia, separating the weaker solution resulting from said evaporation and conducting it to a receptacle, and continuously and directly conducting any aqueous vapors arising therefrom to and re-evaporating the same with the concentrated ammonia being treated. Impurities taken up by the reabsorbing liquid of a motor or other apparatus are removed and a uniform strength of liquid ammonia maintained in the system, by heating the same to expel the gases therefrom and conducting said gases to the ammonia tank, discharging the residuum, and adding to the liquid in the system water sufficient to absorb the quantity of gas collected from the reabsorbing liquid.

371,187—October 11, 1887. T. B. FOGARTY. *Process of and apparatus for making ammonia.*

Relates to modifications of No. 371,186 (Sulphites and Sulphates); as a subprocess steam is introduced in excessive volumes simultaneously with the nitrogen gas in the same superheated retort and at about the same point.

374,618—December 13, 1887. W. F. NAST. *Obtaining ammonia from manure, etc.*

Ammonia is extracted from manure or other organic matters by adding an alkaline base, treating with sodium chloride (5 per cent lime and 2 per cent sodium chloride) in a closed vessel at a high temperature—about 150° C.—and passing the vapors through an acid bath.

379,487—March 13, 1888. L. MOND. *Obtaining ammonia and hydrochloric acid.*

The vapor of ammonium chloride is passed through a vessel containing one or more salts or oxides—as the protoxide of nickel—whereby ammonia is produced and collected. The residual ammonia is then driven off by means of a neutral gas, and collected, and superheated steam is then injected to form hydrochloric acid and complete the cycle of operations. The process is then repeated.

379,488—March 13, 1888. L. MOND. *Obtaining ammonia and chlorine from ammonium chloride.*

Process No. 379,487 is modified by injecting hot, dry air in lieu of steam, producing chlorine instead of hydrochloric acid.

381,832—April 24, 1888. F. EGNER. *Process of obtaining ammonia and bone-black.*

In the manufacture of bone-black and ammonia, the gaseous products of the bone retorts are mixed with gas from a gas producer, the ammonia is then removed therefrom, and the gas is then consumed in the furnaces, to heat the retorts.

389,781—September 18, 1888. W. WEBSTER, JR. *Process of electrolyzing sewage and sea-water.*

See Group X, Electro-chemistry.

396,705—January 22, 1889. E. MEYER. *Obtaining ammonia and oxalic acid from sugar waste.*

A solution of a caustic akali is heated and a predetermined quantity of concentrated desacharized lye, or its equivalent, in the form of molasses, is gradually added at intervals with continued heat. The caustic alkali must be in excess of the organic matter—at least 8 times, but not to exceed 20. The oxalic salts are separated from the resultant mass, and the alkaline residue rendered caustic and again used.

417,777—December 24, 1889. T. B. FOGARTY. *Process of making ammonia.*

In the manufacture of ammonia by the cyanide process, incandescent gases and air to burn the gases are introduced into a moving mixture of pulverized carbon and alkali and they travel together, as in a descending column, producing alkaline cyanides and cyanates, steam being subsequently introduced to produce ammonia and other products.

417,778—December 24, 1889. T. B. FOGARTY. *Process of making ammonia.*

As a modification of the process of No. 417,777, the air is in excess of the quantity required to burn the gases.

417,779—December 24, 1889. T. B. FOGARTY. *Apparatus for making ammonia.*

Apparatus for the processes Nos. 417,777 and 417,778.

454,108—June 16, 1891. H. E. BAUDOUIN AND E. T. H. DELORT. *Manufacture of ammonia from sodium nitrate.*

Nitrate of soda is mixed with a suitable hydro-carbon, as tar or coal, and heated to a temperature sufficient to decompose the hydro-carbon, 800° to 900° C., whereby the resulting hydrogen decomposes the nitrate and forms ammonia with carbonate of soda as a by-product.

459,193—September 8, 1891. A. HENNIN. *Process of making ammonia and gas.*

Gas and ammonia are simultaneously produced from coal by injecting air and steam into a bed of incandescent fuel and controlling the temperature of the generator by regulating the proportions of steam and oxygen or air, and by regulating the supply of fresh fuel above the zone of combustion.

477,089—June 14, 1892. H. VON STROMBECK. *Process of purifying ammonia.*

Crude ammonia-gas is purified by exposing it to the action of comminuted metallic sodium, which combines with the alcholic bodies.

486,647—November 22, 1892. L. STERNBERG. *Process of obtaining ammonia or other salts from molasses.*

The waste lyes resulting from the extraction of sugar or the manufacture of alcohol from molasses are freed from any excess of lime, strontia, and baryta, and concentrated to, say, 45° Baumé, then mixed with a carrier, as granulated coke, dried, and calcined in an atmosphere of superheated steam, producing ammonia gas, which is condensed and treated for the production of ammonia sulphate or otherwise, and the potassium and other salts recovered.

488,207—December 20, 1892. P. KUNTZE. *Process of and apparatus for making ammonia.*

Nitrogenous material, such as peat, is dried and then calcined, and the aqueous and the tarry vapors conducted off separately; the latter passed through incandescent material—as calcareous porous tar coke—forming tar, ammonia, and combustible gas. The calcined material is simultaneously treated with heated air and the aqueous vapor to form ammonia and heating gases, the latter being utilized for heating the air and calcining the nitrogenous material.

500,650—July 4, 1893. T. B. FOGARTY. *Apparatus for and process of obtaining combined nitrogen and fuel gases.*

A producer gas, consisting chiefly of the oxides of carbon, free nitrogen, and hydrogen, is formed and mingled with hydrocarbon vapors and highly heated, and then passed along with a falling pulverized carbon-alkali mixture and in the same direction, producing alkali cyanides, ammonia, and fuel gas.

500,651—July 4, 1893. T. B. FOGARTY. *Method of and apparatus for producing cyanides and ammonia.*

Nitrogenous gas, hydrocarbon gases and vapors, and a suitable alkali are passed together in a falling column through an incandescent retort, and produce alkaline cyanides, ammonia, and fuel gas.

505,427—September 19, 1893. G. L. VAIL AND T. CHARLTON. *Process of purifying ammonia gas.*

The process consists in passing the gas under a pressure of nine to twelve atmospheres, approximately, through a quantity of aqua ammonia at a temperature sufficiently low, as 56° F., to remove by condensation the moisture and other impurities with which the gas is laden; the aqua ammonia containing such a per cent of ammonia gas, say from 29 per cent to 32 per cent by weight, that it has practically reached the limit of gas absorption.

515,909—March 6, 1894. H. A. FRASCH. *Art of manufacturing ammonia.*

The ammoniacal liquor is distilled, the vapors cooled and the condensed matter separated, and the cooled and dehydrated ammoniacal vapors are then passed through a saturated solution of ammonia maintained at a temperature which adapts it to take up the pyridin and kindred impurities and thus act as a washer for the ammonia gas. The vapors are then absorbed.

518,428—April 17, 1894. E. SOLVAY. *Process of purifying ammonia.*

The process of purifying a flowing stream of ammonia liquor consists in raising the temperature of separate portions of said stream to unequal heat increasing in the direction of flow, and thereby evolving carbonic anhydride and sulphureted gases from the warmer portion, passing the evolved gases through the cooler portions of said liquor for preventing the escape of ammonia, evolving similar gases from said cooler portions, passing said gases through an independent cooler portion of said liquor, and finally passing the heated vapors thereof in proximity to and in a direction opposite to the flow of said stream of liquor for heating the same unequally.

521,401—June 12, 1894. T. CHARLTON AND K. M. MITCHELL. *Process of and apparatus for manufacturing aqua ammonia.*

A superheated mixture of air and steam is passed through ammoniacal liquor and through a condenser and absorbers; the strong liquor withdrawn from the first absorber; and the residuum liquor returned in the reverse direction from the last to the first absorber.

522,357—July 3, 1894. L. STERNBERG. *Apparatus for obtaining ammonia.*

Apparatus for process No. 523,819.

523,819—July 31, 1894. L. STERNBERG. *Process of making ammonia.*

Ammonia is produced from nitrogenous organic matter by calcining such material in a retort in an atmosphere of steam and of hot nonoxidating gas or gases. The gases and vapors discharged from the retort are freed from ammonia by means of sulphuric acid and returned to the retort.

528,999—November 13, 1894. L. TRALLS. *Process of obtaining fertilizers from waste lyes.*

Lyes—obtained by leaching brown coal ashes—containing acid salts of alumina and oxide of iron, and waste ammoniacal liquor are mixed in such proportions as to convert the sulphuric acid combined with the aluminium and iron oxide into ammonium sulphate and leave the alumina in the form of a hydrate, and the peroxide of iron in the form of a hydroxide, and evaporated to dryness.

547,276—October 1, 1895. L. MOND. *Process of and apparatus for obtaining ammoniacal products.*

In the extraction of ammonia and tar from producer gases, the hot gases are cooled with water, and the air for the producer is heated by the water, the cooling and heating alternating. The free ammonia is separated by a weakly acid solution of a salt of ammonia, the tar separated from the solution, and the solution brought up to the required strength of acid and again utilized.

557,166—March 31, 1896. L. STERNBERG. *Process of obtaining ammonia from waste sugar lyes.*

Gaseous nitrogenous organic compounds are transformed into ammonia by conducting the gases over a glowing contact body composed essentially of an aluminate, as the aluminate of potassium. Waste lyes from the extraction of sugar or the manufacture of alcohol from molasses are concentrated to, say, 75 Brix, then mixed with alumina and an aluminate forming a plastic mass, molded into bricks, dried, and heated in a retort to incandescence.

578,457—March 9, 1897. C. KELLNER. *Process of and apparatus for simultaneously producing ammonia, sodium hydroxid, and chlorin.*

See Group X, Electro-chemistry.

583,262—May 25, 1897. H. J. KREBS. *Process of and apparatus for distilling ammonia.*

An aqueous solution of ammonia is continuously fed into a still and a current of high pressure steam from a steam boiler is discharged into the still; the gas is conveyed away and cooled, and the residual water and the condensed steam are fed back to the steam boiler.

586,950—July 20, 1897. F. W. A. FRERICHS. *Process of purifying ammonia.*

Commercial water of ammonia, while under pressure, is subjected to a temperature of at least 180° C. and preferably higher, to set free all of the permanent gases which can develop under conditions prevailing in ice machines, which gases are removed and the resulting ammonia gas liquefied; it may then be subjected to distillation at a low temperature, preferably from 10° to 20° C. to condense and separate out the carbon compounds.

598,195—February 1, 1898. T. F. COLIN. *Process of making cyanids and ammonia.*

Powdered heated alkali is continuously showered into a closed furnace shaft, into the base of which there is directly and separately introduced, under pressure, highly heated air and fuel gas, and above the latter a heated liquid hydrocarbon; the successive steps effected being the combustion of air and gas, the dissociation of the liquid hydrocarbon, and the dissociation of the alkali and formation of cyanides; followed, outside of the furnace, by the decomposition of the cyanides by steam, and the formation of ammonia.

598,918—February 15, 1898. T. B. FOGARTY. *Process of and apparatus for making cyanids and ammonia.*

Prior to bringing producer gas into contact with a shower of pulverized alkalized carbon to form alkaline cyanides, an adjusted quantity of highly heated air is added to effect further combustion, and pulverized anthracite coal or coke or material rich in free carbon is showered through the gases to remove all oxygen and carbonic-acid gas.

607,943—July 26, 1898. H. MEHNER. *Method of producing ammonia.*

See Group X, Electro-chemistry.

Other hydroxides.

144,517—November 11, 1873. C. M. T. DU MOTAY. *Improvement in the manufacture of baryta.*

Sulphate of barium, mixed with coal, is reduced to sulphuret of barium and then transformed into hydrated baryta, or into carbonate of baryta, the intermediate reagents used being revivified and reused.

159,446—February 2, 1875. C. H. PHILLIPS. *Improvement in manufacturing milk of magnesia.*

Magnesia hydrate is prepared by subjecting a soluble salt of magnesia—as magnesia sulphate—to the action of ammonia.

326,066—September 8, 1885. W. G. STRYPE. *Process of making hydrates of barium and of strontium.*

A solution of sulphide of barium or strontium is subjected to the action of air forced up through the solution in the presence of an oxide of iron, such as ochre or other hydrated ferric oxide.

328,478—October 20, 1885. H. C. FREIST. *Manufacture of hydrate of alumina.*

A mixture of pulverized aluminous material, sulphate of soda, carbonate of lime, coal dust, and fluorspar is subjected to a high heat; the mass leached, and the solution, either before or after removal of insoluble impurities, treated with a metallic peroxide, sesquioxide, or hyperoxide to precipitate the iron in insoluble form; which precipitate is removed and the clear liquor subjected to the action of carbonic-acid gas to form a carbonate of soda and precipitate the alumina as hydrate of alumina.

331,182—November 24, 1885. G. F. BIHN. *Method of obtaining hydrate of alumina for paper makers' use from bauxite, etc.*

To produce an artificial hydrate of alumina free from iron, an intimate mixture of bauxite, salt cake, and coal is calcined, the mass lixiviated with water, and the liquor, separated from the insoluble matter, boiled with finely divided metallic copper or a suitable copper compound. The resulting liquor, separated from insoluble matter, is then treated with carbonic-acid gas or bicarbonate of soda, precipitating hydrate of ammonia.

539,889—May 28, 1895. M. N. D'ANDRIA. *Process of making magnesium hydrate.*

Calcined and slacked dolomite is subjected to the action of water, repeatedly agitated, settled, and decanted until the residue is mainly magnesium hydrate. Large tanks into which the tide can flow are preferably used.

571,533—November 17, 1896. R. LANGHANS. *Electrolytic process of converting hydroxids of earth and earth alkali metals into indissolubte organic or inorganic salts, etc.*

See Group X, Electro-chemistry.

CHLORATES.

388,217—August 21, 1888. E. K. MUSPRATT AND G. ESCHELLMANN. *Manufacture of sodium-chlorate.*

Magnesia suspended in water by agitation is treated with chlorine, the resulting magnesian liquor boiled down to crystallize out magnesium chloride, and the liquor then decomposed by means of caustic soda or carbonate of soda, or mixtures of the same, to produce sodium chlorate.

388,997—September 4, 1888. E. K. MUSPRATT AND G. ESCHELLMANN. *Manufacture of potassium chlorate.*

In the manufacture of potassium chlorate by means of magnesia and chlorine the magnesia liquor is boiled down to crystallize out magnesium chloride, the liquor is then heated with potassium chloride, and the potassium chlorate separated from the magnesium chloride by crystallization. The mother liquor is now treated with hydrochloric acid and steam to obtain chlorine and magnesium chloride.

480,492—August 9, 1892. E. B. CUTTEN. *Method of electrolytically producing potassium chlorate.*

See Group X, Electro-chemistry.

480,493—August 9, 1892. E. B. CUTTEN. *Method of electrolytically producing potassium chlorate.*

See Group X, Electro-chemistry.

491,701—February 14, 1893. E. B. CUTTEN. *Method of electrolytically producing potassium chlorate.*

See Group X, Electro-chemistry.

492,003—February 21, 1893. H. GALL AND A. DE VILLARDY DE MONTLAUR. *Manufacture of chlorates of the alkaline metals and metals of the alkaline earths.*

See Group X, Electro-chemistry.

493,023—March 7 1893. W. T. GIBBS AND S. P. FRANCHOT. *Process of obtaining chlorates of the alkalis or of the alkaline earth metals by electrolysis.*

See Group X, Electro-chemistry.

519,400—May 8, 1894. H. BLUMENBERG, JR. *Electrolysis.*

See Group X, Electro-chemistry.

536,848—April 2, 1895. H. BLUMENBERG, JR. *Electrolysis.*

See Group X, Electro-chemistry.

537,179—April 9, 1895. H. BLUMENBERG, JR. *Electrolysis.*

See Group X, Electro-chemistry.

538,314—April 30, 1895. K. J. BAYER. *Process of producing potassium chlorate.*

Zinc oxide (used in place of lime) is treated with chlorine gas; the hypochlorite of zinc obtained is split into zinc chlorate and zinc chloride; the solution is mixed with potassium chloride, and the potassium chlorate separated by crystallization, while the zinc is obtained in the liquor in the form of zinc chloride.

543,326—July 23, 1895. K. J. BAYER. *Process of producing potassium chlorate.*

Potassium chloride is added to a mixture of zinc oxide and water up to the saturation point of the mixture, the solution is heated to near the boiling temperature, and chlorine is introduced until the zinc oxide is dissolved, when the potassium chlorate is crystallized out and the zinc chloride liquor is concentrated.

565,324—August 4, 1896. H. BLUMENBERG, JR. *Electrolysis.*

See Group X, Electro-chemistry.

587,437—August 3, 1897. F. HURTER. *Apparatus for manufacturing chlorate of potash by electrolysis.*

See Group X, Electro-chemistry.

620,683—March 7, 1899. T. A. UEHLING. *Process of and apparatus for reducing and oxidizing salts.*

See Group X, Electro-chemistry.

627,000—June 13, 1899. P. IMHOFF. *Process of making oxyhalogen salts.*

See Group X, Electro-chemistry.

627,063—June 13, 1899. P. IMHOFF. *Manufacture of oxyhalogen salts.*

See Group X, Electro-chemistry.

633,272—September 19, 1899. T. PARKER. *Process of manufacturing chlorates by electrolysis.*

See Group X, Electro-chemistry.

NITRITES AND NITRATES.

249,275—November 8, 1881. T. VARNEY. *Process of drying nitrates.*

A portion is melted and mixed with an unmelted crystalline portion, thereby expelling the water from the crystals.

400,207—March 26, 1889. C. N. HAKE. *Process of making ammonium nitrate.*

Nitric-acid vapor is combined with ammonia gas in an air chamber or ammonia-gas with fine spray of nitric acid with the temperature maintained below 120° C. Nitrate of ammonia is produced in the first case as a fine powder and in the second case as a supersaturated liquid which solidifies on cooling.

448,361—March 17, 1891. R. S. PENNIMAN. *Process of manufacturing nitrate of ammonia.*

Protected nitrate of ammonia is produced by dehydrating the nitrate and while it is in a melted condition mixing therewith a protecting medium, as any of the soft products of petroleum distillation—e. g., vaseline—then cooling and graining by agitation.

448,362—March 17, 1891. R. S. PENNIMAN. *Preparing nitrate of ammonia.*

The nitrate is dehydrated while in a melted condition by mechanical agitation accompanied with the injection of air. It is then cooled and grained by mechanical agitation and a protecting medium, as vaseline, is applied to the mass.

478,067—June 28, 1892. R. S. PENNIMAN. *Method of manufacturing nitrate of ammonia.*

Nitrate of ammonia liquefied under a high temperature is subjected to mechanical agitation together with injected blasts of air to prevent decomposition from overheating and to fully eliminate watery vapors.

500,914—July 4, 1893. J. LANDIN. *Process of making ammonium nitrate.*

Alcohol is percolated through a mixture of sodium nitrate and ammonium sulphate to produce an alcoholic solution containing ammonium nitrate plus some sodium nitrate, and a residue of sodium sulphate plus some ammonium sulphate. The alcoholic solution is treated by passing it first through ammonium sulphate, and next through ammonium chloride, producing an alcoholic solution of ammonium nitrate and a precipitate of sodium sulphate and sodium chloride, and the sodium chloride is then sublimed with the mixture of sodium sulphate, and ammonium sulphate to produce sodium sulphate and ammonium chloride.

572,819—December 8, 1896. L. G. PAUL. *Process of making nitrites.*

An alkaline nitrate is melted together with the caustic compound of the same alkali, and sulphur is gradually added to the melted mass.

573,964—December 29, 1896. G. CRAIG. *Process of purifying ammonium nitrate.*

Nitrate of ammonia is dissolved out of mixtures by percolating or digesting with anhydrous or high-strength ammonia, and then the solvent is evaporated off.

595,178—December 7, 1897. A. KNOP. *Process of making nitrites.*

A nitrite is manufactured by heating a mixture of a nitrate, a caustic alkali, and carbon. Fused caustic soda, 120 parts, and coke, 31 parts, are first mixed and cooled. Then 300 parts of saltpeter are melted with 120 parts of 90 per cent caustic soda, and the first mixture added in fragments.

597,006—January 11, 1898. R. N. LENNOX. *Process of making ammonium nitrate.*

A mixture of sulphate of ammonia, 13 parts, and a nitrate of a metal capable of double decomposition, as sodium nitrate, 17 parts, is distilled at less than atmospheric pressure, and at a temperature not exceeding 230° C.

632,394—September 5, 1899. H. K. BAYNES. *Process of decomposing alkali nitrates.*

See Group I, Acids, Nitric.

623,893—April 25, 1889. T. FAIRLEY. *Process of making ammonium nitrate.*

Bicarbonate of ammonium is subjected to the action of a saturated solution of sodium nitrate, the liquid separated from the moistened solid, and the former cooled to about 15° C. to crystallize out the ammonium nitrate.

SULPHITES AND SULPHATES.

17,830—July 21, 1857. L. GAMOTIS AND S. MARTIN. *Improved apparatus for making acid sulphite of lime.*

The fumes from burning sulphur are drawn by suction successively through a series of vats filled with milk of lime.

59,239—October 30, 1866. G. T. LEWIS. *Improvement in the manufacture of sulpho-acetate of alumina.*

Alumina (obtained from cryolite) is treated with acetic acid and sulphuric acid, or in place of the latter sulphate of alumina or alum.

82,154—September 15, 1868. W. M. PAGE AND E. B. KRAUSSE. *Improved process of preparing sulphate of barytes.*

Sulphate of baryta is first boiled in water to render it more friable, then dried, and boiled in a weak acid solution—as of sulphuric acid—followed by a weak solution of silicate of soda to purify, then boiled in a saturated alum solution to whiten, and dried and pulverized, to be subsequently mixed in distilled water and floated for a fine product.

108,177—October 11, 1870. H. PEMBERTON. *Improvement in the manufacture of paper.*

Sulphate of lime, for use in paper manufacture, is made from a solution of calcium chloride, for which bittern may be used, and a solution of impure soda sulphate or niter cake.

11,305—January 31, 1871. R. DE WITT BIRCH. *Improvement in the manufacture of copperas.*

The waste liquor from manufactures using sulphuric acid for cleaning iron is settled, the free acid neutralized with wrought iron, concentrated to from 28° to 40° Baumé, the vapors being passed over lime to a condenser, the liquor settled and crystallized on crystallizing sticks, and the crystals dried with air warmed by the hot vapors.

125,153—April 2, 1872. H. A. WHITING. *Improvement in processes and apparatus for the manufacture of sulphate of lead.*

Sulphate of lead is manufactured by the direct action of hot concentrated sulphuric acid upon an alloy of lead and zinc, 1 per cent zinc. The dried sulphate of lead is whitened by calcining at a red heat.

151,389—May 26, 1874. J. HARGREAVES AND T. ROBINSON. *Improvement in the manufacture of sulphate of soda and potassa.*

Mixed sulphurous-acid gas, air, and water vapor are used in the proportions of 2 volumes each of gas and water vapor, and air to furnish 1 volume of free oxygen, the mixture being passed through the chambers in series, each in turn being the first of the series. Sodium chloride, or potassium chloride, is used in pieces containing about three-quarters of a cubic inch, with the smaller pieces packed near the sides of the chamber, or tower.

195,998—October 9, 1877. L. S. FALES. *Improvement in treating gas-liquor for ammonia salts.*

The incoming ammoniacal liquor is heated by means of the sulphureted-hydrogen gas, and the latter thereby cooled previous to passing it into water to absorb it, in the manufacture of sulphate of ammonia.

200,134—February 12, 1878. C. FAHLBERG. *Improvement in processes for utilizing zinc sulphate.*

Zinc sulphate is treated with sodium carbonate or bicarbonate to precipitate the zinc as a carbonate, and the sodium bicarbonate is then recovered by an ammonio-soda process.

216,323—June 10, 1879. H. GROUVEN. *Improvement in the manufacture of sulphate of ammonia.*

Sulphate of ammonia is made from turf and similar material by decomposing the vapors and gases obtained from heating a mixture of turf and chalk by means of a contact mass; converting the carbonate of ammonia to sulphate of ammonia in the presence of sulphate of lime, and purifying and crystallizing the sulphate of ammonia.

220,005—September 23, 1879. Z. C. WARREN. *Improvement in the manufacture of sulphate of lime.*

Sulphate of lime, of about the specific gravity of paper pulp, is made by commingling cooled streams of milk of lime and sulphuric acid prepared in combining proportions.

224,101—February 3, 1880. W. J. MENZIES. *Process for the maufacture of sulphate of soda.*

A pure sulphate of soda is obtained from niter cake and muriatic-acid cylinder-cake, by neutralizing the free acid of the one and the free sodium chloride of the other, treating them in a reverberatory furnace, either together or singly, with the addition, respectively, of sodium chloride or sulphuric acid, and then precipitating the iron salts and impurities from a hot saturated solution of the product with an alkali or alkiline earth and bleaching-powder. An anhydrous sulphate of soda is produced, white and free from iron.

229,249—June 29, 1880. C. N. HAKE. *Manufacture of potassium sulphate from kainit.*

A solution of magnesium sulphate is added to ground kainit, the chlorides of magnesium and sodium going into solution while a residue of schönit is formed, the schönit being separated from the said chlorides by decantation. Caustic lime, baryta, or strontia is added to pulverized schönit and the product calcined, lixiviated, and concentrated to secure the potassium sulphate.

243,310—June 21, 1881. C. SCHEIBLER. *Process of separating gypsum from the solutions of starch-sugar produced by treating the latter with sulphuric acid.*

The solution is neutralized by means of lime, the bulk of the gypsum removed by filtration or decantation, and the solution then treated with an excess of barium-oxalate or other insoluble barium salt obtained from a soluble oxalate and which forms an insoluble combination with lime, the remaining gypsum being removed with the scum during concentration.

247,046—September 13, 1881. H. GROUVEN. *Process of and apparatus for making ammonium sulphate.*

As an improvement on the process of No. 216,323, the peat, or animal refuse rich in nitrogen, is charged successively into a series of retorts, and the vapors and gases are passed through all in series ending with the one longest charged.

259,150—June 6, 1882. F. HOHLWEG. *Process of obtaining magnesium sulphate from crude mineral.*

Crude mineral containing carbonate or silicate of magnesia is powdered and treated with a solution of sodium bisulphate and the magnesium sulphate separated by crystallization. With the addition of carbonate of soda the magnesia is precipitated from the solution as a carbonate in the usual manner.

267,582—November 14, 1882. R. N. R. PHELPS AND W. A. CLARK, JR. *Process of treating the waste pickle-liquor of iron-works.*

See Group I, Acids, Sulphuric.

286,735—October 16, 1883. H. RÖSSLER. *Process of making cupric sulphate.*

Gases containing sulphurous acid, as the waste gases of chemical works, are injected jointly with air and steam into an oxidizing solution of cupric sulphate containing free copper, as cement copper.

292,260—January 22, 1884. C. SEMPER. *Utilizing waste calcium chloride and sulphate.*

Waste calcium sulphate, produced in the manufacture of acetic acid from acetate of lime, is calcined at a high temperature and the impurities driven off.

318,972—June 29, 1885. E. A. FALES. *Process of making ammonium sulphate.*

In the distillation of ammoniacal liquor and the passage of the vapor through sulphuric acid, the acid is covered with a layer of coal oil to give white sulphate of ammonia crystals and avoid discoloration.

321,341—June 30, 1885. E. CAREY, H. GASKELL, JR., AND F. HURTER. *Process of making sodium sulphite.*

Salts—monohydrated carbonate of soda—are exposed to the action of sulphurous-acid gas.

329,216—October 27, 1885. E. B. RITTER AND C. KELLNER. *Process of making solutions of bisulphites.*

The carbonate of a base is first subjected to the action of sulphurous acid, whereby carbonic acid is expelled and the sulphite formed is dissolved in the weakened acid solution. The sulphite solution is then reimpregnated with sulphurous acid and a combination with the second base effected and the formation of a double salt.

338,558—March 23, 1886. E. B. RITTER AND C. KELLNER. *Process of manufacturing sulphites.*

In the manufacture of sulphites, sulphurous-acid gas is purified, prior to making a solution of the same, by passing it through a solid material, as limestone, which will combine with sulphuric acid, and a filter of solid material for dry particles, and then cooling the acid.

339,974—April 13, 1886. W. O. & W. P. CROCKER. *Producing sulphite or bisulphite of sodium.*

For the production of sulphite-of-sodium liquor from sulphate of sodium for the reduction of wood to pulp, the sulphate of sodium mixed with carbonaceous matter is roasted, leached, evaporated to dryness, and the product granulated, and heated with agitation in contact with air or oxygen until incandescence ceases, when it is made into a solution. It may be charged with an additional portion of sulphurous or other acid before introduction into the digester. By the addition of a small quantity of bisulphite of calcium any sulphide or sulphate of sodium is decomposed, sulphate of calcium being precipitated.

339,975—April 13, 1886. W. O. & W. P. CROCKER. *Process of making bisulphites.*

Bisulphite-of-sodium liquor is produced by roasting the acid sulphate of sodium to reduce it to neutral sulphate and recover one proportion of sulphuric acid, suspending neutral sulphite of calcium in the solution by agitation, and finally charging the mixture with sulphurous acid, which may be obtained by decomposition of the sulphuric acid recovered. The neutral sulphite of calcium is obtained by treating the used bisulphite-of-sodium liquor with oxide or carbonate of calcium.

365,318—June 21, 1887. W. M. PAGE AND E. B. KRAUSSE. *Process of and apparatus for treating barium sulphate.*

The crude material is subjected to successive steps of grinding, boiling with dilute acid, washing, drying, regrinding, agitation in hot water, screening, settling in water, and drying.

371,186—October 11, 1887. T. B. FOGARTY. *Process of and apparatus for making ammonium sulphate.*

Highly heated nitrogenous generator gas is mixed with adjusted volumes of superheated steam and air and mingled with a falling mass of pulverized carbon and alkali in a retort, producing cyanogen, which in turn is decomposed by the steam to ammonia, hydrogen and carbon oxides; the ammonia and carbonic acid being then treated with sulphuric acid and lime of gypsum to produce sulphate of ammonia and carbonate of lime.

373,264—November 15, 1887. H. BAUM. *Process of making pyrosulphates.*

Pyrosulphates of the alkali metals, as also of ammonia, are produced by heating the acid sulphates thereof in a vacuum to a temperature of from 200° to 400° C.

376,189—January 10, 1888. A. FRANK. *Production of sulphite solutions.*

Free as well as combined sulphurous acid is recovered from the lyes resulting from the manufacture of cellulose by the sulphite process, by converting the sulphurous acid into a monosulphite by means of calcium or a calcium salt, separating the monosulphite from the lye and purifying the same by washing in a solution of sulphurous acid or of an alkali sulphite or an alkaline earth.

376,190—January 10, 1888. A. FRANK. *Production of sulphite solutions.*

Acid sulphite solutions are produced from calcium monosulphite (a product of the process No. 376,189) with calcium sulphate as a by-product, by treating the calcium monosulphite with sulphuric acid or with acid sulphate of soda.

379,820—March 20, 1888. A. SCHANSCHIEFF. *New mercuric salt for battery-fluids.*

A new salt, yellow basic sulphate of mercury combined with bisulphate of mercury, substantially of the formula $2HgO,SO_4+HgSO_4+3H_2O$, is produced by dissolving mercury in sulphuric acid, evaporating excess of acid, adding water, separating the precipitate and treating it with acid and again with water; and so on, either retaining the solution in the liquid form or evaporating to obtain the solid salt.

392,286—November 6, 1888. H. PEMBERTON, JR. *Dehydrating sodium sulphate.*

The crystals of natural or artificial Glauber's salt are treated with a hot saturated solution of sodium sulphate until they melt; the anhydrous salt not in solution is then allowed to settle, and the saturated solution is run off or allowed to recrystallize to be used again.

395,159—December 25, 1888. W. MANNING. *Process of treating gypsum.*

In the treatment of gypsum for the production of an impalpable opaque anhydrous powder, it is given a second calcination and subsequent grinding to expel all water of crystallization.

407,925—July 30, 1889. C. J. E. DE HAËN. *Double sulphate of antimony.*

A new product, the double salt of fluoride of antimony and sulphate of ammonia, having the formula $SbFl_3(NH_4)_2SO_4$—available in the dyeing art in lieu of tartar emetic—is produced by mixing fluoride of antimony and sulphate of ammonia and evaporating the mixture.

415,739—November 26, 1889. H. A. SEEGALL. *Process of making chromium sulphates.*

Chromic or chromous sulphates are produced from chrome materials by heating the same to 600° C. in closed receptacles with the acid sulphates of any fixed alkali, such as sodium bisulphate, with the chrome materials held in suspension by agitation; and then condensing the vapors and regaining the sulphuric acid which has not entered into the reaction. The quantity of vapor is reduced by mixing with the mass a substance that does not melt or decompose at 600° C., as barium sulphate.

452,378—May 19, 1891. P. DE LACHOMETTE. *Process of making ammonium-sulphite.*

Crude ammoniacal liquor is first purified with oxide of iron and then distilled; the oxide of iron used is roasted, and the dry ammonia from the distillation and the sulphurous gas from the roasting, conducted in suitable proportions into a saturating tank, form ammonium sulphite or bisulphite.

452,386—May 19, 1891. H. PENNINGTON. *Process of making lead sulphate.*

Metallic lead in shreds or flakes is subjected to the alternate action of dilute acetic acid and of atmospheric air; the mass of lead is drained and loosened up after the acetic solution is drawn off; and the said solution is mixed with a sufficient quantity of sulphuric acid to thoroughly reduce the lead acetate to a lead sulphate without excess of free sulphuric acid, the solution being agitated to prevent the formation of acicular crystals and leave the sulphate practically amorphous.

453,137—May 26, 1891. J. VAN RUYMBEKE. *Process of makingbasic persulphate of iron.*

Pulverized iron ore—oxide of iron—is first mixed with sulphuric acid and then heated to from 190° to 260° C. until the water has been expelled and a persulphate of requisite basicity is produced.

503,900—August 22, 1893. W. E. CASE. *Process of making aluminium fluosulphate.*

Aluminium fluosulphate free from iron is produced by adding calcium fluoride to an aqueous solution of crude aluminium sulphate, then adding a quantity of the freshly precipitated white product obtained by adding a solution of an alkaline carbonate to an aluminium fluosulphate solution which has been freed from iron. The resulting ferruginous precipitate is separated from the fluosulphate solution by mechanical means.

504,324—September 5, 1893. W. E. CASE. *Process of making aluminium compounds.*

An insoluble aluminium compound is produced by combining aluminium sulphate and calcium fluoride to form an aluminium fluosulphate solution, and adding an alkali carbonate. If iron is present the alkali carbonate is added until a filtered test sample shows the solution free of iron in the ferric form; the iron precipitate is then removed and additional alkali carbonate added to precipitate the aluminium compound.

504,325—September 5, 1893. W. E. CASE. *Process of making aluminum fluosulphate.*

An aluminium alkali fluosulphate free from iron is produced by adding calcium fluoride to an aqueous solution of crude aluminium sulphate, then adding a solution of an alkaline carbonate, as of sodium carbonate, to precipitate iron, and separating the aluminium fluosulphate solution from the solid products.

512,103—January 16, 1894. W. E. CASE. *Process of making aluminum compounds.*

An insoluble aluminium compound is formed by combining aluminium sulphate and calcium fluoride to form an aluminium-fluo-sulphate solution, adding thereto a caustic alkali, as ammonium hydrate, to precipitate the iron, removing the iron, and then adding a further quantity of the caustic alkali to precipitate the aluminium compound.

514,040—February 6, 1894. H. F. D. SCHWAHN. *Process of purifying native sulfate of barium.*

The process of No. 514,039 (Group XIX, Oxides) is specifically applied to the purification of native sulphate of barium from iron, etc.

515,763—March 6, 1894. C. VON GRABOWSKI. *Process of and apparatus for purifying sulfate lyes.*

See Group X, Electro-chemistry.

526,076—September 18, 1894. M. L. GRIFFIN. *Process of making calcium bisulfite liquor.*

To prepare "lime sludge," resulting from the treatment of carbonated-soda liquors with lime in the manufacture of caustic soda, for use as a substitute for lime in the manufacture of bisulphite liquors, it is washed to remove the alkali, flowed over riffles to remove heavy impurities, and the precipitate of carbonate of lime thus purified is separated from the water by settling or filtering. The sludge is then charged with sulphurous-acid gas.

541,598—June 25, 1895. J. D. DARLING. *Process of utilizing niter-cake or other acid sulfates.*

See Group X, Electro-chemistry.

542,429—July 9, 1895. E. A. STARKE. *Process of making neutral alkaline sulfates from bisulfates.*

Neutral alkaline sulphate is made by adding a portion of sulphur to the acid sulphate and heating the mass. The sulphurous acid fumes are collected and converted into sulphuric acid.

543,002—July 23, 1895. S. H. EMMENS. *Process of making ferric sulfate.*

The gases from a sulphuret or sulphate roasting or calcining furnace are passed into water in which ferric hydrate is suspended.

565,953—August 18, 1896. E. ANDREOLI. *Apparatus for indirect electrolysis.*

See Group X, Electro-chemistry.

601,006—March 22, 1898. H. E. STURCKE. *Preparing sulfate of lime from residues.*

Residues from the manufacture of caustic soda, and comprising essentially carbonate of lime, are dissolved in muriatic acid, filtered, precipitated with sulphuric acid to form sulphate of lime, filtered, and the sulphate of lime washed and dried. The last filtrate is used for treating fresh quantities of residues. A waste calcium-chloride solution from the ammonium-soda process is filtered, precipitated with sulphuric acid to form sulphate of lime, and filtered, and the last filtrate used for caustic soda residues.

601,179—March 22, 1898. H. E. STURCKE. *Process of and apparatus for making sulfate of lime.*

Residues from the manufacture of caustic alkali, comprising essentially carbonate of lime, are made into a thin milk, the insoluble impurities are mechanically removed, and the milk of carbonate is then treated with sulphuric acid to convert the carbonate into sulphate of lime, which is separated out and dried.

605,697—June 14, 1898. R. E. CHATFIELD. *Process of utilizing acid sulfates of soda.*

Residue acid sulphate of soda solutions are acted upon by ammoniacal compounds from gas liquor or other sources to produce mixed sulphates of ammonia and soda. The solution is then evaporated to a specific gravity of 1.380 at boiling temperature to crystallize out sulphate of soda; the evaporation is then continued to crystallize out the mixed salts, which latter crystals are dissolved in cold mother liquor to a specific gravity of 1.285 and evaporated to crystallize out sulphate of ammonia.

634,751—October 10, 1899. O. HOFMANN. *Method of refining cupric-sulfate solutions.*

A cupric-sulphate solution containing salts of iron, arsenic, antimony, etc., is neutralized and heated to 75° to 80° C., when pulverized cupric oxide is added and air is injected to precipitate the impurities.

640,026—December 26, 1899. A. S. RAMAGE. *Process of and apparatus for making copperas.*

Carbonate of magnesium is added to the waste liquor of pickling vats to neutralize the free sulphuric acid, and the liquor is then filtered, evaporated, and crystallized, giving a copperas mixed with a little magnesium sulphate which improves the same for the manufacture of venetian red.

641,550—January 16, 1900. M. E. ROTHBERG. *Process of making magnesia and plaster of paris.*

See Group XIX, Oxides.

650,980—June 5, 1900. O. MEURER. *Process of making metallic sulfates.*

To produce sulphates free from iron from sulphide ores containing sulphide of iron, the ores are heated with polysulphides of the alkalis, cooled and caused to be crumbled in the air, after the addition of water; dried and subjected to spontaneous oxidation in air preferably at 205° C. The mass is then lixiviated with water and the sulphates are dissolved.

PHOSPHATES.

42,140—March 29, 1864. E. N. HORSFORD. *Improved double phosphate of lime and soda for culinary and other purposes.*

To a mixture of 5,000 pounds of water and 500 pounds of oil of vitriol there is added 700 pounds of burned bones and constant agitation is continued for sixteen to eighteen hours, when the mass is leached and lixiviated, forming a liquid acid phosphate of lime, in which about two-ninths of the lime of the original phosphate of lime remains in combination with the phosphoric acid. This is concentrated with the addition of hydrate of soda in the proportion of 0.0144 of a pound for each degree of Baumé until it becomes an emulsion of crystals. The product is rendered nonhygroscopic by diluting the emulsion of crystals with gelatinized water, and subjecting to slow crystallization, and potato starch is mixed therewith, or it is treated with a weak solution of boiled starch.

62,277—February 19, 1867. J. E. LAUER. *Improved acid compound for use in baking and cooking.*

An acid salt, obtained by treating boneblack with hydrochloric acid and then adding sulphuric acid to the liquor.

75,271—March 10, 1868. E. N. HORSFORD. *Improved preparation of acid phosphate of lime.*

Sulphuric acid is added to a solution of acid phosphate of lime in a solution of a salt of lime, the acid of which salt is volatile, as nitric acid, and the volatile acid driven off by heat, leaving acid phosphate of lime mixed with or feebly combined with sulphate of lime, which is separated by leaching.

75,328—March 10, 1868. G. F. WILSON. *Improvement in the manufacture of acid phosphates.*

Farinaceous matter is mixed with acid phosphate of lime by feeding a coarse mixture of the material between rollers, preferably of dressed granite.

75,329—March 10, 1868. G. F. WILSON. *Improvement in preparing bones for the manufacture of acid phosphates.*

Bones are distilled in horizontal retorts with condensation of the products of distillation, the remaining gases being conveyed to the furnace and burned. Each charge of distilled bone is raked from the retort into an iron cooler which is sealed and the bone cooled under exclusion of air.

75,330—March 10, 1868. G. F. WILSON. *Improvement in drying acid phosphates.*

Granulated acid phosphate of lime is exposed to continuous currents of heated air on both sides of vertical columns thereof, which are progressively fed downward.

75,332—March 10, 1868. G. F. WILSON. *Improvement in burning bones for the manufacture of acid phosphates.*

Bones are burned white by subjecting them to a steady, long-continued, uniform heat, with sufficient regulated air to secure perfect combustion without cooling off the furnace, the temperature of distillation being not for once intermitted.

75,336—March 10, 1868. G. F. WILSON AND E. N. HORSFORD. *Improvement in the manufacture of phosphates and in extracting phosphoric acid from bones.*

Burned bones are treated with sulphuric acid diluted with a weak solution of acid phosphate of lime to or beyond the point of precipitating the sulphate of lead present, and the mixture is treated with continuous agitation.

The material is leached in broad shallow pans with alternate affusion of water and tamping to secure leaching of the whole mass.

76,763—April 14, 1868. E. N. HORSFORD. *Improved method of preparing acid phosphate of lime.*

Sulphuric acid purified of sulphate of lead is employed in the manufacture of pulverulent acid phosphate of lime, to be used for raising bread.

86,289—January 26, 1869. A. DUVALL. *Improved method of mixing liquids with dust or powder for the manufacture of phosphates, and for other purposes.*

The pulverized material and the acid are fed into a blast of air or jet of steam, either or both, and thereby thoroughly mixed and projected into a receiving chamber.

110,680—January 3, 1871. N. B. RICE. *Improvement in the manufacture of acid phosphates for use in baking-powders, etc.*

To 1,000 pounds of pulverized phosphate of lime, as contained in apatite or bone, there is added 1,400 pounds of terhydrated phosphoric acid, diluted with 2,800 pounds of water, with enough more phosphoric acid to neutralize and saturate all carbonates, oxides, etc. After standing a week with frequent agitation the superphosphate of lime in solution is decanted or leached out. Part of the liquor is treated with sulphuric acid to deposit the lime in solution and leave a dilute phosphoric acid, and part is treated with alkaline sulphates depositing the lime as a sulphate and leaving a superphosphate of the base.

123,743—February 13, 1872. B. TANNER. *Improvement in the manufacture of phosphates of the alkalis.*

Monosodic, bisodic, or trisodic phosphates, or like phosphates of potash or ammonia, are produced by mixing sodium chloride, or potassium or ammonium chloride, with phosphoric acid in the proper combining proportions, and subjecting the mixture to the action of steam, superheated steam, or mixtures of hot air and steam.

123,744—February 13, 1872. B. TANNER. *Improvement in the manufacture of superphosphates of lime.*

See Group VIII. Fertilizers.

130,298—August 6, 1872. E. N. HORSFORD. *Improvement in the manufacture of phosphate of lime and yeast-powders.*

Solid monocalcic phosphate, produced by evaporating, with a current of heated air, a solution of monocalcic, orthophosphate, and free phosphoric acid, mingled with a solution of the phosphate of lime of burned bones in hydrochloric acid, in such proportions that the total number of lime atoms equals the total number of atoms of phosphoric acid. The monocalcic phosphate is mixed with starch to preserve its available strength, with alkaline carbonates to form a yeast powder, and the latter with flour for the production of self-raising flour.

137,635—April 8, 1873. F. M. LYTE AND H. STORCK. *Improvement in the manufacture of acid phosphates.*

Soluble acid phosphates are produced by attacking earthy phosphates, especially phosphate of calcium, with properly diluted phosphoric acid, precipitating the earthy matter by means of alkaline sulphates, as sulphate of ammonium, and then extracting the sulphuric acid of the residual liquor with the phosphate of barium, lead, or strontium, or the carbonates or other suitable salts of these bases. The residues are either treated with sodium carbonate, caustic soda, and the phosphoric acid precipitated from the liquid with lime, or in certain other specified ways.

140,051—June 17, 1873. J. E. LAUER. *Improvement in manufacturing crystalline acid phosphate of lime for yeast-powders.*

Boneblack is first treated with dilute sulphuric acid to deposit the sulphate of lime, and it is then treated with muriatic acid evaporated and crystallized. (See No. 62,277.)

164,457—June 15, 1875. A. JAS. *Improvement in dissolving tribasic phosphate of lime in water containing carbonic acid.*

Tribasic phosphate is dissolved in water by means of a current of carbonic acid gas, at a greater or less pressure, according to the quantity to be dissolved.

178,146—May 30, 1876. J. V. HECKER. *Improvement in acid-powders and processes of producing them.*

An acid powder consisting of monocalcic ortho-phosphate, sodium chloride, and calcium chloride: produced by treating boneblack with sulphuric acid and then with hydrochloric acid and sodium chloride, leaching and evaporating to dryness.

196,771—November 6, 1877. J. E. SIEBEL. *Improvement in processes of producing the mono or acid phosphate of ammonia.*

A mixture of ground bone-ash and sulphate of ammonia in water is subjected to a boiling heat for a sufficient length of time to form sulphate of lime and monophosphate of ammonia, which latter is leached out and evaporated to dryness. The evolution of free ammonia is avoided by replacing a proper amount of the sulphate of ammonia with sulphuric acid.

229,518—July 6, 1880. C. A. CATLIN. *Acid phosphate for baking-powders.*

An acid phosphate in which the active ingredient has an excess of base over a dihydrogen calcic phosphate, and in which both the phosphoric acid and the sulphate of lime are completely hydrated: produced by treating bone-ash or other tricalcic phosphate with oil of vitriol diluted with an excess of water under agitation and heat.

229,573—July 6, 1880. G. F. WILSON AND C. A. CATLIN. *Preparation of potassium phosphate for baking-powder.*

An acid powder containing as the active ingredient an acid potassium phosphate with an excess of base over a dihydrogen potassic phosphate, and having both the acid phosphate and the sulphate of lime completely hydrated; produced by treating tricalcic phosphate with dilute oil of vitriol under agitation and heat, decomposing the hydrogen dicalcic phosphate into hydrogen dipotassic phosphate with potassium sulphate, and converting the mass into a dry powder.

229,574—July 6, 1880. G. F. WILSON AND C. A. CATLIN. *Preparation of sodium phosphate for baking-powder.*

An acid powder in which the active ingredient is an acid sodium phosphate having an excess of base over a dihydrogen sodic phosphate, and with the acid phosphate and sulphate of lime completely hydrated: produced by decomposing tricalcic phosphate with dilute oil of vitriol, and then effecting a double decomposition with sodium sulphate under agitation and heat, and converting the mass into a dry powder.

301,406; 301,407—July 1, 1884. S. G. THOMAS. *Manufacture of alkaline phosphates.*

See Group VIII, Fertilizers.

313,369—March 3, 1885. C. V. PETRAEUS. *Solution of acid phosphates.*

A combination of free phosphoric acid with phosphate of soda, consisting of dihydrogen, sodic phosphate, phosphoric acid, and water, is produced by leaching a mixture of bone ash, 100 parts, with sulphuric acid of 49° Baumé, 100 parts, diluted to 20° or 25° Baumé; and adding to the solution 161 parts of Glauber's salts for each 28 parts of lime therein.

322,698—July 21, 1885. F. DIBBEN. *Manufacture of superphosphates.*

One part of acid soda sulphate is dissolved in 4 parts of water at a temperature of 130° F., allowed to stand until the neutral sulphate is crystallized out of the mother liquor, when 3¼ pounds of the mother liquor is added to 1 pound of phosphate of lime, and heated until the surplus water is evaporated.

324,471—August 18, 1885. L. IMPERATORI. *Extraction of phosphate soda from slags.*

Slags from phosphatic materials, as from the Thomas Gilchrist process, are smelted with sulphate of potash or soda and carbon, and subsequently treated with carbonic acid.

374,201—December 6, 1887. C. V. PETRAEUS. *Process of making acid potassium phosphates.*

Impure acid phosphate of lime, produced by decomposing bone or similar phosphate with a suitable acid and leaching, is decomposed by sulphate of potash; then carbonate of potash or caustic potash is added in excess, that is, in sufficient quantity to form in the solution an acid phosphate of potash containing an excess of potash over that in the dihydrogen potassium phosphate; and, after filtration, the solution is evaporated to crystallization.

389,566—September 18, 1888. C. GLASER. *Process of making acid phosphate.*

Insoluble phosphoric acid contained in mineral and petrified phosphates is converted into available phosphoric acid by finely pulverizing the mineral and then applying phosphoric acid directly thereto. The ground mineral may be divided into 2 parts, and the phosphoric acid extracted from 1 portion, by any method, and applied to the other portion.

412,792—October 15, 1889. J. REESE. *Crystalline calcic tetraphosphate and the process of making the same.*

Crystallized tetrabasic phosphate of lime; produced by oxidizing phosphorus at a high temperature while in the presence of lime, until the lime is charged with phosphoric acid, and then withdrawing the charged lime and subjecting it to slow cooling. It is pulverized and used as a fertilizer.

412,793—October 15, 1889. J. REESE. *Process of making phosphates.*

In the manufacture of calcium phosphate from phosphoritic iron, the molten phosphoritic iron is blown with an air blast, in a basic-lined vessel and in the presence of lime additions, until the phosphorus has been reduced to not less than one-half of 1 per cent (but little iron being oxidized when the phosphorus is in excess thereof), when the phosphate so formed is withdrawn. After lime is charged to the desired amount of phosphorus it is withdrawn and a charge of fresh lime added, whereby phosphates having any desired percentage of phosphoric acid may be produced.

417,820—December 24, 1889. C. GLASER. *Process of making acid phosphate.*

Mineral and petrified phosphates are ground and exposed to the action of dilute phosphoric acid, and the moisture subsequently evaporated; the amount of acid used is theoretically insufficient to convert all of the tricalcic phosphate (or corresponding compounds) into monocalcic phosphate, but exceeds the theoretical amount necessary to convert the same into bicalcic phosphate, thus forming a mixture of monocalcic and bicalcic phosphates, or equivalents. (See No. 389,566.)

418,259—December 31, 1889. C. E. D. WINSSINGER. *Process of making bicalcic phosphate.*

In the production of bicalcic phosphates, a mother liquor of monocalcic phosphate of lime is produced by forming a phosphoric-acid solution—by treating suitable phosphatic material with an excess of sulphuric acid—filtering, and treating the solution with carbonate of lime, or milk of lime, to convert it into a monocalcic-phosphate solution free from iron, etc. The solid residue from the filtration may be treated with a phosphoric-acid solution and sulphate of lime obtained as a by-product. The monocalcic solution is converted into a monosodic solution by treatment with sulphate of soda, which is then treated with carbonate of soda, and the resulting neutral solution is treated with lime; the phosphate of lime separated from the resulting caustic-soda solution (a by-product), and the separated phosphate treated with an aqueous monocalcic solution, and the bicalcic phosphate separated.

445,567—February 3, 1891. A. MEMMINGER. *Process of making acid phosphates.*

The drying of a compound of phosphatic material and acid is accelerated by adding thereto a fluoride compound, as calcium fluoride, and the drying period is graduated by comminuting to a definite degree and adding a greater or less proportion of the fluoride compound, or by varying the degree of comminution.

446,815—February 17, 1891. C. GLASER. *Process of making alkaline phosphates.*

Pure phosphates of the alkalis are obtained from crude commercial phosphoric acid by decomposing the salt of an alkali and an acid volatile at higher temperature (as nitrate of soda) by fusing same with crude commercial phosphoric acid in excess of the amount required to form a pyrophosphate; then dissolving the fused mass in water and boiling until conversion of meta and pyro phosphoric acid is effected; then treating with the carbonate of an alkali (or free alkali) till alkaline reaction is obtained; and finally separating the solution from insoluble impurities and crystallizing.

493,889—March 21, 1893. S. L. GOODALE. *Method of treating hydrated phosphates of alumina.*

Insoluble hydrated phosphates of alumina and iron are heated by indirect heat in suitable receptacles until all the water of constitution is expelled, or usually until the entire mass has a temperature of about 325° C., when the heat is arrested and the mass cooled before unfavorable molecular rearrangement is developed.

502,424—August 1, 1893. H. PRECHT. *Process of obtaining meta or pyro phosphoric-acid combinations.*

To produce a soluble potassium phosphate the insoluble potassium metaphosphate is melted and rapidly cooled to prevent crystallization. A basic body, as potash or soda, is added either before or during the melting, so that phosphoric acid in the form of pyrophosphate will in part be present in the molten salt.

572,512—December 8, 1896. H. ALBERT. *Process of manufacturing phosphates of alkalis.*

See Group X, Electro-chemistry.

598,182—February 1, 1898. H. POOLE. *Process of making phosphates.*

Pulverized native aluminum phosphate is mixed with a boiling solution of caustic soda to decompose the native phosphate, then filtered; then silica is added to the boiling solution while open to the atmosphere, whereby the alumina is precipitated as a silicate; the tribasic-sodium phosphate crystallized out; and finally the aluminum silicate treated with sulphuric acid, whereby aluminum sulphate is formed.

601,089—March 22, 1898. J. G. WIBORG. *Phosphate and method of making same.*

A tetra-calcium-sodium (or potassium) phosphate. See Group VIII, Fertilizers, Products.

627,267—June 20, 1899. C. LUCKOW. *Process of producing basic phosphates of copper by means of electrolysis.*

See Group X, Electro-chemistry.

CARBONATES.

200,134—February 12, 1878. C. FAHLBERG. *Improvement in processes for utilizing zinc sulphate.*

See Group XIX, Sulphites and Sulphates.

235,231—December 7, 1880. F. GUTZKOW. *Manufacture of carbonate of magnesia.*

It is obtained in a light and flocculent form by forcing carbonic-acid gas through the pulp of magnesium hydrate in a heated state.

278,283—May 22, 1883. D. SIDERSKY AND H. PROBST. *Process of obtaining carbonate of strontium.*

To recover the strontium salts from the residues of the treatment of saccharine solutions with strontium, the strontianite is dissolved in said residues with an excess of hydrochloric acid, the strontium solution filtered off, the strontium in the solution converted into a sulphate, and the latter finally reconverted into a carbonate.

280,172—June 26, 1883. H. GROUVEN. *Manufacture of strontium carbonate.*

Powdered celestine, or strontium sulphate, is mixed with a double sulphate of potassium and magnesium, and powdered carbon or coal, and the mixture furnaced in crucibles with exclusion of air. The mass is then lixiviated with exclusion of air, and the solution evaporated with introduction of carbonic-acid gas until the development of hydrogen sulphide stops. The precipitated strontium carbonate is separated from the potassium carbonate left in the solution.

301,383—July 1, 1884. E. A. MEBUS AND J. W. DE CASTRO. *Manufacture of carbonate of strontium.*

Sulphate of strontium is finely ground, mixed with water, and treated with carbonate of ammonia, or ammonia and carbonic-acid gas—water may be used—producing carbonate of strontium and sulphate of ammonia. Ammonia is recovered by distillation of the sulphate of ammonia with lime.

303,962—August 19, 1884. A. WÜNSCHE. *Method of obtaining carbonate of magnesia.*

Ammonia and carbonic acid are introduced into a solution of soluble magnesic salts, whereby ammonium-magnesium carbonate is formed, which is separated from the lye and heated to drive off the ammonia and a part or all of the carbonic acid. Caustic magnesia may be added to the compound salt of ammonia and magnesia to drive off the ammonia separately.

510,979—December 19, 1893. G. LUNGE AND C. H. M. LYTE. *Process of making basic lead salts and caustic alkali.*

Basic lead carbonate is formed and caustic soda.
See Group II, Sodas, Caustic Soda.

534,177—February 12, 1895. E. RUEFF. *Process of making light basic magnesium carbonate.*

Carbonic-acid gas is introduced with agitation into a mixture of magnesia, 1 part, and water, 25 parts, until about 1 part by weight of gas has been absorbed, when the mixture is boiled down.

534,212—February 12, 1895. H. ENDEMANN. *Process of making light magnesium carbonate.*

A mixture of magnesia, 20 parts; carbonate of ammonia, 30 parts; and water, 500 parts, is agitated and allowed to harden into a cake. The ammonia may be expelled by exposing to a temperature of 60° C. in a partial vacuum, or the cake can be broken up and washed.

534,213—February 12, 1895. H. ENDEMANN. *Process of making light carbonate of magnesia.*

A mixture of magnesia, 10 parts, and the bichromate of a fixed alkali, as of soda, 32 parts, in 250 parts of water, is subjected to agitation under a gradually-rising temperature to about 65° C., the light carbonate of magnesia then being collected.

601,007—March 22, 1898. H. E. STURCKE. *Amorphous carbonate of lime and method of and apparatus for obtaining same.*

A new product: dry powdered carbonate of lime, in extremely fine particles having a specific weight of from 78 to 94 grams per 100 c. c. when dried at not exceeding 100° C., is produced from the residues of the manufacture of caustic alkali by removing the caustic lime, mixing the residue with water, mechanically separating the impurities, then subjecting the carbonate and water to the action of a vacuum filter and drying.

603,225—April 26, 1898. H. E. STURCKE. *Process of preparing amorphous carbonate of lime from residues.*

Amorphous calcium carbonate is produced from residues by first removing the insoluble impurities from calcium oxide and alkali carbonate by mechanical separation, then causing the oxide and carbonate to react upon each other in water, and separating the calcium carbonate formed from the alkali hydrate and from all soluble impurities including calcium hydrate. The calcium carbonate is then mixed with water, passed through a mechanical separator, filtered, and dried.

603,226—April 26, 1898. H. E. STURCKE. *Process of preparing amorphous carbonate of lime from residues.*

Calcium carbonate, when made from residues according to No. 603,225 and separated from insoluble impurities, is dried, ground, and bolted.

SILICATES.

28,540—May 29, 1860. G. E. VAN DERBOURGH. *Reissue April 1, 1862. No. 1297. Reissue May 17, 1864; 1,674, (A). Improved mode of reducing silicates to a liquid or gelatinous state. 1,675 (B). Improvement in apparatus for treating silicious substances.*

Superheated steam is employed in a digester to reduce silicious and other refractory substances to a liquid or gelatinous state.

39,135—July 7, 1863. T. ELKINTON. *Improvement in the manufacture of alkaline silicates.*

The ingredients are fed through roof openings onto the sloping bed of a furnace, down which the fused silicate flows in a continuous stream to an outlet, subject to the direct heat of the furnace.

304,044—August 26, 1884. S. G. THOMAS. *Manufacture of alkaline salts.*

Alkaline chlorides are decomposed, and alkaline silicates and other nonhaloid alkaline salts and hydrates produced, together with chlorine and hydrochloric acid, by acting on sodium chloride in a Bessemer converter or Siemens or puddling furnace by the silicon contained in molten pig iron in presence of oxygen, oxide of iron, or any oxygen-yielding body. The chlorides are submitted to treatment inclosed in iron cases or compressed into shapes with or without oxide of iron to render the reaction more effective and prevent volatilization.

360,840—April 12, 1887. J. T. ADAMS. *Batch for making glass.*

A substance containing volatile hydrocarbon, as coal or sawdust, is mixed with a glass batch to clarify the bath.

376,409—January 10, 1888. A. KAYSER. *Process of making alkaline silicates and carbonates.*

The oxide of sodium or potassium is obtained from the chloride by mixing the chloride with clay, heating the mixture in a converter directly by passing highly-heated gases containing steam through the converter, smelting the converted material together with an alkali, and then extracting the sodium or potassium combinations by lixiviation.

376,410—January 10, 1888. A. KAYSER. *Process of making alkaline silicates.*

Silicate of sodium or potassium is made from the chloride thereof by mixing the chloride with silica, molding into bricks, and heating in a converter with highly-heated gases containing steam passed through the converter.

445,091—January 20, 1891. P. SIEVERT. *Process of dissolving water-glass.*

A clear solution of water glass is made by softening and partially dissolving the lumps by intimate contact with a jet of steam and treating them with a spray of alkaline lye, the solution being enriched by flowing over the glass lumps and continuously discharged as it forms.

448,772—March 24, 1891. M. W. BEYLIKGY. *Silicate compound.*

A new product, an alkaline-magnesian silicate solution, in which the silicate has the general formula, $7(Na_2O,5SiO_2)$, $2(Mg'' OSiO_2)$, insoluble after perfect drying, is produced by the action of a compound salt of fluosilicate of magnesium and hydrocarbonate of magnesia on a solution of tersilicate of soda.

590,143—September 14, 1897. W. GARROWAY. *Process of making alkaline silicates and nitric acid.*

Silica and an alkaline nitrate are heated with superheated steam passed through the retort or furnace.

633,841—September 26, 1899. F. HENKEL. *Process of making soluble alkaline silicates.*

Six parts of a solid alkaline silicate is mixed with 1 part of water and heated at from 100° to 120° C. until the water disappears and a homogeneous mass forms which is easily soluble in cold water. Or the solid alkaline silicate is mixed with a hot concentrated solution of the silicate. Sawdust, peat, or other substance may be added as a loosening agent when it is to be used as a fertilizer.

ALUMINATES.

454,137—June 16, 1891. A. KAYSER. *Process of making sodium aluminate.*

A mixture of insoluble sodium silico-aluminate—produced by process No. 376,409 (see Group II, Sodas, Sodium Carbonates)—and lime is subjected to a decomposing temperature and the product leached.

472,668—April 12, 1892. E. FLEISCHER. *Process of making aluminates of alkalies.*

In the manufacture of alkali aluminates from aluminous substances and alkaline sulphates, thiosulphates, or sulphides, the ingredients are mixed with iron and lime and heated in the presence of a reducing agent, the iron and lime being so proportioned that the sulphur present is taken up by the iron and the silicic acid by the lime, while the latter is in excess to prevent the formation of soluble combinations of sulphide of iron with the alkalis.

572,026—November 24, 1896. D. A. PÉNIAKOFF. *Process of making aluminate.*

A mixture of an alkaline sulphate and an alkaline sulphuret and a substance containing alumina is heated to incandescence, producing an alkaline aluminate. The gas mixed with heated air is passed into retorts filled with calcined alkaline chloride to produce chlorine and alkaline sulphate.

603,657—May 10, 1898. D. A. PÉNIAKOFF. *Process of making alkaline aluminates.*

Aluminates, free from sulphides of iron and the like, are produced by calcining a mixture of bauxite, alkaline sulphate, and carbon in the proportions indicated by the formula $2\ (4Al_2O_3.Fe_2O_3)+8Na_2SO_4+5C$, the proportions of the carbon being such that only one-fourth of the oxygen in the alkaline sulphate will be combined therewith.

612,364—October 11, 1898. F. RAYNAUD. *Process of making alkaline aluminates.*

Alkaline aluminates free from silicates are produced by passing steam through a heated mixture of aluminous ore and any sulphide, the base of which is capable of combining with alumina, sulphureted hydrogen being simultaneously produced. Preferably, briquets are formed of aluminous ore (alumina 640 parts); carbon, 207 parts; and an alkaline sulphate, as sulphate of soda, 900 parts; and dried for treatment.

618,772—January 31, 1899. H. S. BLACKMORE. *Process of making alkali aluminates.*

An alkali aluminate is produced by gradually introducing aluminium hydroxide, or aluminium hydrated oxide into a molten alkali salt. With sodium chloride, sodium aluminate and hydrochloric acid are produced.

MANGANATES AND PERMANGANATES.

326,657—September 22, 1885. T. KEMPF. *Process of manufacturing permanganates.*

Solutions of the manganic-acid salts are electrolyzed in the positive compartment of a cell having a porous diaphragm, producing permanganic-acid salts and free metallic hydroxides.

515,443—February 27, 1894. J. H. PARKINSON. *Porous permanganate block and process of making same.*

Permanganate of potash or soda is thoroughly mixed with kaolin—say from 10 to 12½ per cent—and formed with water into a stiff paste, which is baked hard and dry in a partial vacuum for use in the production of oxygen.

588,614—August 24, 1897. E. B. STUART. *Manganate and process of producing same.*

A double manganate of sodium and calcium, for use in extracting oxygen from air, is produced by subjecting sodium hydrate 80 parts, calcium oxide 56 parts, and binoxide of manganese 88 parts, with oxygen 128 parts, to a temperature of from 300° to 400° C. An excess of from 5 to 15 per cent of caustic soda is preferred.

631,228—August 15, 1899. R. H. REEVES. *Method of disinfecting.*

Sulphuric acid is mixed with a dry mixture of manganate of soda and carbon or wood dust to evolve gases for suppressing noxious vapors. After the gases are evolved water is added to form permanganic acid, which acts on sewage.

PROCESSES AND APPARATUS.

9,145—July 27, 1852. H. W. ADAMS. *Process for the manufacturing of metallic zinc in the form of a fine powder by the use of steam.*

Vaporized zinc is brought into contact with steam, the temperature of the steam being less than the melting point of the zinc, whereby the zinc vapor is instantly cooled and reduced to an impalpable metallic powder.

12,819—May 8, 1855. B. HARDINGE. *(Reissue; 344—January 22, 1856.) Improvement in apparatus for dissolving silica.*

The solvent is taken from the upper part of the charge in the digester, passed through a heater, and the vapor discharged into the bottom of the charge in connection with a stirrer.

45,684—December 27, 1864. E. SONSTADT. *Improvement in the manufacture and purification of magnesium.*

A solution of magnesium chloride and potassium chloride is evaporated to dryness and the residue heated to redness and acted upon by sodium, producing magnesium, which is distilled and purified, using an iron retort with exclusion of air.

54,266—April 24, 1866. C. H. WING. *Improved method of preparing magnesium for burning.*

Magnesium wire or ribbon is formed into a spiral coil.

77,987—May 19, 1868. C. KUEHN. *Improved mode of utilizing tin scrap or waste.*

The scrap is boiled in water and 25 per cent of muriatic acid and 2½ per cent of nitric acid (of weight of scrap metal) is added, and the tin dissolved. Successive charges are treated in the same bath with additions of acid until it is saturated with chloride of tin, which may be deposited on zinc plates, or the bath is evaporated and the chloride of tin is obtained.

96,524—Novmber 2, 1869. F. WILCOX. *Improved process of refining the waste from German silver and other metals.*

It is carbonized by pouring the molten waste into a crucible containing nitrate of soda, or other material supplying oxygen.

96,525—November 2, 1869. F. WILCOX. *Improved proccss of utilizing the waste formed in cleaning copper and brass goods.*

The waste is settled and the sediment dissolved with the aid of steam and the copper deposited out by means of iron plates. The liquor is then filtered, evaporated, and the sulphate of iron obtained. The deposited copper is washed, fused, and cast.

102,143—April 19, 1870. D. D. PARMELEE. *Improvement in treating tin scrap to obtain useful products.*

Tin is removed from tin scrap by treating the same in an inclosed vessel with chlorine gas, carrying off the fumes and condensing them as chloride of tin.

107,711—September 27, 1870. A. OTT. *Improvement in treating tin scrap for the manufacture of stannate of potash, etc.*

Fifty pounds of tin scrap is digested with 8 quarts of a lye of caustic soda 18° Baumé, 10 pounds of litharge, 1½ pounds of sodium nitrate, and 1½ pounds of sodium manganate along with steam. The liquor is decolorized by filtering through boneblack evaporated to 18° Baumé and cooled when stannate of soda chrystallizes. For stannate of potash in place of the soda compounds, 14 pounds of a lye of caustic potash, 2 pounds of potassium nitrate and 2 pounds of potassium manganate are used.

112,889—March 21, 1871. A. OTT. *Improvement in preparing tin salts from tinners' waste.*

Scrap tin is digested with muriatic acid and steam. The liquor is evaporated to 60° Baumé, and bichloride of tin formed by heating it with muriatic acid, sulphuric acid, and water. It is then distilled, bichloride of tin going over and chloride of iron remaining. The bichloride is reconverted into chloride by heating it with granulated tin.

119,267—September 26, 1871. F. W. DORN. *Improvement in processes of utilizing tinners' clippings.*

Scrap metal is treated with a mixture of muriatic acid gas, hyponitric-acid gas, and steam, or muriatic-acid gas and steam alone, followed by a jet of steam to wash off the muriate of tin.

121,948—December 19, 1871. C. LENNIG. *Improvement in removing tin from tin scrap.*

A solution of caustic soda or potash is poured over the scrap metal, drawn off, and then air forced through the mass of metal, and the operation successively repeated. Stannate of soda or potash is deposited out of the liquor.

128,265—June 25, 1872. T. F. WELLS. *Improvement in processes of separating tin from iron in tinners' clippings.*

Tin is separated from iron by means of hydrochloric acid to which nitric acid is gradually added in conjunction with chlorate of potash when the original bath gets exhausted. The tin is deposited out of the charged solution by zinc or otherwise, and the remaining liquor—a solution of the chloride of iron and zinc—is available for the preparation of paints, for a disinfectant, or for the preservation of wood.

129,417—July 16, 1872. D. McDANIEL, W. B. SPEAR, AND J. W. RICHARDS. *Improvement in methods of utilizing waste tin scrap and galvanized iron.*

Tin scrap is first treated with muriatic acid to dissolve the tin, and the iron metal being removed, galvanized-iron scrap is immersed in the bath. Then to the liquor is added waste sal-ammoniac skimmings, and a chemical equivalent of waste ammoniacal liquor from gas works, the iron precipitated, and the liquor cooled and crystallized, yielding a substitute for sal ammoniac as a flux for zinc coating baths.

146,286—January 6, 1874. H. SIEGER. *Improvement in recovering zinc from zinc fumes.*

The fumes of zinc and the gases evolved during the operation of treating alloys of zinc in a dry state are passed through a chamber containing carbonic oxide, and the zinc fumes condensed in a metallic state.

155,043—September 15, 1874. W. S. SAMPSON. *Improvement in methods of preserving lime.*

Lime is compressed into a solid mass, the barrel being held in an adjustable clamp. It preserves it from air slacking and reduces bulk.

160,018—February 23, 1875. J. HOLLIDAY AND H. M. BAKER. *Improvement in processes for removing tin from tin scrap.*

Tin scrap is heated in a bath of fused alkaline nitrate and then plunged into water.

190,550—May 8, 1877. C. A. CATLIN AND G. F. WILSON. *Improvement in processes of utilizing tin scrap.*

The scrap metal is sprinkled with dry chloride of sodium or potassium and nitrate of sodium or potassium, and then immersed in a caustic alkaline solution. Stannate crystals of the alkaline base are obtained from the evaporation of the saturated solution.

191,530—June 5, 1877. C. HORNBOSTEL. *Improvement in processes of applying oxygenated air in blast furnaces.*

Oxygen gas is supplied by forcing a current of air through a mixture of black oxide of manganese and sulphuric acid.

196,831—November 6, 1877. J. M. SANDERS. *Improvement in manufacture of oxide of tin.*

Scrap tinned iron is subjected to a heat that will volatilize the tin, which is oxidized by the admission of air, and the tin oxide settled in a condensing chamber.

200,587—February 19, 1878. P. C. VOGELLUS. *Improvement in separating tin from tin-scrap.*

Scrap metal is treated in a dilute nitric-acid bath, the iron being in contact with the positive pole of an electric battery, or otherwise rendered passive.

208,735—October 8, 1878. J. HOLLIDAY AND J. LAMBERT. *Improvement in utilizing tin scrap and manufacture of stannates.*

Tin scrap is treated in a bath composed of a solution of caustic soda or potash and an alkaline arsenite, nitrate or nitrite. The saturated solution of stannate of soda or potash is evaporated.

251,588—December 27, 1881. C. C. HUGHES. *Preparation of whitewash from lime.*

A whitewash free from grit is made by mixing lime with water and then grinding it. The product may be evaporated to a paste and packed in cans or barrels.

265,974—October 17, 1882. F. B. NICHOLS. *Apparatus for evaporating or concentrating liquids and saturating liquids with gases.*

Siphon slips, operating by surface attraction, are used to feed fluids out of troughs.

268,701—December 5, 1882. J. A. MATHIEU. *Process of and apparatus for evaporating liquids.*

Solid matter is separated from a heated solution thereof by showering it into a vacuum.

277,884—May 22, 1883. J. CLARK. *Method of reducing metals from their ores.*

Refractory ores or material compressed into a bar or block, is exposed to concentrated solar heat at the focus of a lens or reflector and suitable reagents applied.

277,885—May 22, 1883. J. CLARK. *Method of reducing metals from their ores.*

Ores are melted or disintegrated by concentrated solar heat and simultaneously carbonaceous reagents are applied, whereby ores containing chlorides may be reduced without the use of sodium or potassium.

298,149—May 6, 1884. C. R. A. WRIGHT. *Process of dissolving metals in ammoniacal solutions.*

Cuprammonium hydrate, or "copperized ammonia," or an analogous ammoniacal solution containing zinc, is produced by passing air through a solution of ammonia in water having fragments of the metal immersed therein.

322,157—July 14, 1885. C. A. CATLIN. *Process of recovering tin from tin-scrap.*

The tin is dissolved in an alkaline bath, and an oxide or salt, such as oxide of lime, is added, which will precipitate the tin as an insoluble stannate.

334,207—January 12, 1886. J. P. WETHERILL. *Apparatus for filtering and separating metals.*

A furnace for process No. 334,208. It has a chamber filled with refractory filtering material on which the metal to be filtered is placed, and one or more settling chambers with loosely built fire-brick division walls.

334,208—January 12, 1886. J. P. WETHERILL. *Process of filtering and separating metals.*

Metals and alloys of metals are heated to a temperature intermediate between the fusing points of the metals, and the metal having the lower fusing point is fused and passed through filtering material at the intermediate temperature.

344,575—June 29, 1886. W. HASENBACH. *Process of separating the tin from scrap or pieces of tin-plate or tinned iron by means of hydrochloric acid.*

The scrap metal is heated and treated with gaseous hydrochloric acid. The protochloride of tin formed distills off and is caught in a condensing chamber.

363,136—May 17, 1887. W. HASENBACH. *Recovery of tin from scraps of tinned plate.*

Protoxide of tin is obtained from lyes containing protochloride of tin and iron, obtained in the recovery of tin from tin-scrap by hydrochloric acid, by treating the lyes in closed vessels with pulverized carbonate of lime in excess, then separating the formed insoluble oxyprotochloride of tin from the dissolved oxyprotochloride of iron, and afterwards treating the oxyprotochloride of tin with carbonate of lime at a high temperature in a closed vessel, whereby the oxyprotochloride of tin is converted into a protoxide of tin.

363,173—May 17, 1887. G. SCHENCK. *Process of and apparatus for charging liquids with gases.*

For charging liquids with gases, as in the manufacture of bisulphites, the gases are forced into the liquor in a tank through tubes revolving therein beneath the surface of the liquor, and simultaneously the liquor, drawn from an upper to a lower tank, is discharged in spray through the gases in the top of the lower tank.

366,118—July 5, 1887. A. LAMBOTTE. *Process of recovering tin from tin-plate and other materials.*

The scrap metal is subjected to a continuous current of chlorine gas diluted with air at a temperature above the boiling point of stannic chloride, and the vapors are conducted into a stannic chloride solution. The concentrated solution is evaporated down with a current of warm air.

370,220—September 20, 1887. O. M. THOWLESS. *Process of extracting aluminium.*

Aluminium chloride is mixed with sodium-producing substances, as a mixture of aluminium chloride, 10 parts; chalk, 3 parts; coal, 10 parts; and carbonate of soda or soda-ash, 10 parts; with or without 1 part of cryolite as a flux, and heated in a vessel; then ground and washed to remove the carbon and other matter.

375,606—December 27, 1887. G. G. CONVERS. *Process of treating sal-ammoniac or flux skimmings.*

The raw skimmings of a galvanizing bath are subjected to the action of steam, which is injected into the mass, and simultaneously the condensed vapor containing the soluble chlorides of zinc is drained off. The drained skimmings are then calcined and reduced.

389,618—September 18, 1888. E. WALSH, JR. *Art of condensing metallic zinc from the vapors or fumes arising in the process of zinc-smelting.*

The zinc vapors and associated vapors from the smelting furnace are permitted to expand and separate by gravity in a condenser, the temperature of which is maintained at a point above the melting point and below the vaporizing point of zinc, whereby the fixed gases absorb heat from and liquefy the zinc vapors.

405,368—June 18, 1889. E. MENNEL. *Process of making double salts of mercury.*

A uni or multi valent phenol is treated with an acidulated solution of a persalt of mercury.

407,818—July 30, 1889. C. A. CATLIN. *Process of charging liquids with gas.*

A current of mixed gas is continuously passed through a series of tanks in one direction, while the liquid is intermittingly passed through the tanks in the opposite direction, with agitation of the liquid and gas.

409,409—August 20, 1889. C. LANGER. *Apparatus for treating solids with gases.*

It has a plurality of parallel intersecting spirals or Archimedian screws, having intersecting circles of rotation.

410,067—August 27, 1889. H. BOWER. *Process of facilitating chemical reactions.*

Two or more substances to be combined are subjected to the effect of impact and attrition from opposing jets. A finely divided solid may be used to intensify the impact and attrition.

412,247—October 8, 1889. W. W. FRANTZ. *Process of preserving lime.*

Quicklime, hot from the kiln, is pulverized and hermetically sealed in boxes in a hot state.

412,780—October 15, 1889. J. McNAB. *Process of filtering.*

A soluble salt is leached from a mixed mass of soluble and insoluble material, by grinding the mass with water into a thick homogeneous paste, adding sufficient water to dissolve the soluble portions, and forming a thoroughly-fluid homogeneous mixture in an agitating tank, and then forcing the mixture into the fibrous bags of a filter press by means of a force pump.

421,935—February 25, 1890. J. HOLLIDAY. *Process of making alkaline salts of antimony.*

Alkaline antimonites, or antimoso-antimonates, are made by treating pulverized metallic antimony in a hot aqueous solution of an alkaline nitrate or nitrite and caustic alkali.

430,653—June 24, 1890. G. KASSNER. *Process of producing plumbates of alkaline earths.*

Plumbates of alkaline earths are produced by roasting in free air a mixture of lead oxide (or a mixture of such salts of lead as are reduced to oxides by heat) and the carbonate or hydrate or caustic compound of an alkaline earth.

435,280—August 26, 1890. E. CAREZ. *Process of making ammonium nitrate.*

Barium sulphate is calcined out of contact with air, with a mixture of charcoal and a hydrocarbon, as resin-oil, and the product boiled with sulphur and water to produce polysulphide, which is transformed into barium nitrate by means of sodium nitrate, then crystallized and decomposed with ammonium sulphate to produce ammonium nitrate on the one hand and to recover the barium sulphate.

450,243—April 14, 1891. C. LIESENBERG. *Process of clarifying liquids.*

A clarifying liquid for solutions is prepared by treating a phosphate in the presence of water with sulphurous acid.

459,034—September 8, 1891. J. M. G. BONNET. *Process of recovering tin from waste tin-plate.*

Stannates are formed by agitating the plated scrap in an alkaline solution and simultaneously forcing hot air into the solution. The solution is then drawn off and sulphurous acid introduced, precipitating the tin as stannic acid.

485,035—October 25, 1892. H. C. W. HARMSEN. *Process of separating tin from tin-plate waste.*

The tin is dissolved in a bath of dilute sulphuric acid and nitric acid, and the saturated tin sulphate solution is then mixed with heated dilute nitric acid, and temperature maintained at not less than 90° C., whereby the dissolved tin is precipitated as stannic acid.

489,624—January 10, 1893. C. L. C. BERTOU. *Process of precipitating oxide of tin from solutions.*

Carbonate of lime is gradually added to the solution with the latter at a temperature near but below ebullition and exposed to the air until the precipitation of tin is complete. It is then cooled, the precipitate collected and washed with cold water and suspended in solution of a carbonate of an alkali metal, the strength of which is gradually increased until it presents a slightly alkaline reaction.

491,254—February 7, 1893. T. TWYNAM. *Process of separating tin from iron or steel.*

The metal is first coated with a film which will form a scale when heated, as by dipping in a slightly glutinous solution of calcium chloride; it is then heated until the tin is oxidized and plunged into a water bath, the film of oxide falling off. The oxides may then be treated to separate the iron and tin oxides.

497,256—May 9, 1893. M. WANNER. *Process of reducing sulphide ores and manufacturing carbon bisulphide.*

Sulphide ore, cleaned from gangue and pulverized, is mixed with carbon or hydro-carbon and subjected to destructive distillation; the carbon-bisulphide vapor is collected and condensed and the reduced metal obtained.

519,391—May 8, 1894. J. REESE. *Method of utilizing iron ore.*

The entire contents of phosphoretic iron ores are utilized by magnetically separating therefrom the larger portion of the magnetic oxide, finely pulverizing the tailings and treating with sulphuric acid to make the phosphates soluble and available for plant food.

521,444—June 12, 1894. E. A. UEHLING. *Process of and apparatus for analyzing gases.*

The percentage of a constituent of a gas—say of the waste gas of blast furnaces—is continuously indicated by means of continuous suction through minute inlet and outlet apertures and the abstraction of the constituent from the gas in its passage between said minute apertures, whereby the tension of the gas is varied and is employed as an index of the percentage of said constituent.

522,746—July 10, 1894. E. A. UEHLING AND A. STEINBART. *Process of and apparatus for analyzing gases.*

As an improvement on the process of No. 521,444, the gas is filtered and passed through a number of absorption chambers, each having a minute inlet and outlet chamber, and each abstracting from the gas a constituent, the percentages of which are severally determined by the changes from the normal tensions.

537,941—April 23, 1895. H. F. D. SCHWAHN. *Method of roasting ores and recovering vapors therefrom.*

The ores or minerals ground and mixed with nitrate of sodium or potassium—10 per cent—are roasted and sublimated, steam being injected into the chamber, and the resultant vapors are forced through one or more baths of solutions of nitric acid, hydrochloric acid, a salt of an alkali metal—preferably sodium chloride—in water of about 10° Baumé, causing reactions with the production of chlorides and carbonates of the metallic vapors and sulphates of the alkalis, which are further treated as seems advisable or profitable.

538,785—May 7, 1895. E. E. LUNGWITZ. *Process of smelting ores.*

Ores, containing a volatilizable metallic element, are smelted in a furnace under a maintained pressure higher than the pressure at which the resulting metal or regulus, or one of its constituents, would boil at the temperature obtained in the furnace.

549,596—November 12, 1895. A. ERLENBACH. *Method of utilizing tin of stanniferous materials.*

Stanniferous materials, as tin scrap, stanniferous waste of dyeing and finishing factories, etc., are heated with muriatic acid to turn the tin into solutions of perchloride of tin; the solution is concentrated, and the heating continued to distill off the perchloride of tin, and simultaneously therewith a stream of muriatic acid is introduced into the perchloride of tin.

556,568—March 17, 1896. E. WARZÉE. *Process of precipitating iron from solutions containing iron and zinc.*

Iron is precipitated as ferroso ferric oxide from solutions containing iron and zinc—as the spent electrolytes of galvanic batteries—by adding zinc in excess and blowing in air at a temperature of 90° C. to produce oxidation and agitation.

558,818—April 21, 1896. T. K. KLIMMER. *Process of making alkaline salts of metallic acids.*

For the production of alkaline salts with oxyacids of heavy metals from ores containing the heavy metals combined with oxygen, the ore—such as chrome ore—is mixed with ferric oxide and an excess of alkaline carbonate, calcined in the presence of air, and lixiviated. The residue, dried and ground, is used in a subsequent operation.

582,473—May 11, 1897. J. B. HILLIARD. *Chemical apparatus.*

To prevent gases from intermingling while passing through liquids, inclined, inverted, open channels are used for the gas, with entrance pipes connected with the lower ends of the channels and escape pipes connected with the upper ends.

593,415—November 9, 1897. S. GANELIN. *Method of treating sulfid ores as lead-zinc ores.*

Lead sulphide ores are introduced into a bath of a fused halogen salt capable of being decomposed by the sulphide—as chloride of zinc—effecting a double decomposition and the conversion of the lead sulphide into a halogen salt of lead, and of the base of the halogen salt of the bath into a sulphide.

600,347—March 8, 1898. T. HUNTINGTON AND F. HEBERLEIN. *Process of treating sulfid ores of lead, etc., preparatory to smelting.*

Sulphide ores of lead are oxidized by mixing the ore with an oxide of an alkaline earth metal—as calcium oxide—heating the mixture in the presence of air to a bright red heat (700° C.), then cooling to a dull red heat (500° C.), and finally forcing air through the mass until the lead ore, reduced to an oxide, fuses.

602,632—April 19, 1898. G. DE CHALMOT. *Method of obtaining free amorphous silicon.*

Silicon in the presence of copper is reclaimed in a free condition by heating finely pulverized silicon-copper alloy mixed with sulphur in a closed vessel to a temperature between 250° and 300° C. The silicon is set free as an amorphous powder. The amount of sulphur is regulated to form Cu_2S or CuS.

605,379—June 7, 1898. H. S. BLACKMORE. *Retort and method of making same.*

An impervious, noncorrodible retort for manufacture of carbon bisulphide is made of fire clay lined with a glaze of lead sulphide formed by coating it with fusible oxide of lead and then exposing to the action of carbon-bisulphide vapor when at a red heat.

607,497—July 19, 1898. G. M. WESTMAN. *Process of and apparatus for pyritic smelting.*

Hot air from regenerators is forced up through a column of pyritic ore free from carbonaceous fuel; the gases and volatilized products pass off, the oxides are condensed, and the remaining gases, nitrogen and sulphurous acid, produce sulphuric acid, while matte and slag are continuously drawn off from the base of the ore column.

616,821—December 27, 1898. J. BOCK. *Process of and apparatus for obtaining crystals.*

Large individual crystals are obtained from a heated saturated solution by passing it through a long, thin mass of crystals of the substance being crystalized, subjecting it to a gentle and slow disturbance and to a gradual cooling.

624,833—May 9, 1899. E. E. LUNGWITZ. *Process of roasting ores.*

The mass is opened by roasting under super-atmospheric pressure and suddenly removing the external pressure while the blast is shut off, whereby the expansion of the compressed gases within the mass break it open.

634,566—October 10, 1899. F. BALLOU. *Art of smelting ores.*

Water-saturated coke is used in the charge for a stack furnace, resulting in reduction of coke consumption due to the retarding of coke combustion until the charge has sunk to the smelting zone.

ORGANIC.

PROCESSES AND APPARATUS.

49,995—September 19, 1865. J. FRASER. *Improved method of treating oil wells for the removal of paraffine.*

Hot carbonic oxide is used for heating oil wells to redissolve the solid hydrocarbons.

80,835—August 11, 1868. F. RENZ. *Improved process of manufacturing sulphuric ether.*

The vapor from corn mash is passed through sulphuric acid at a temperature of 240° F., forming sulpho-vinic acid, which is washed at a temperature of 195° F. and then passed through sulphuric acid at a temperature of 275° to 300° F., producing sulphuric ether and water, which is then purified by means of an alkali and water baths, and the water condensed, leaving pure sulphuric ether.

136,623—March 11, 1873. W. F. SIMES. *Improvement in preparing camphor.*

Distilled or refined camphor is formed into blocks or tablets by pressure.

164,478—June 15, 1875. I. M. PHELPS. *Improvement in permanent flour of camphor.*

Pulverulent camphor is produced by subliming crude camphor in combination with glycerine. The glycerinated camphor is compressed into blocks.

169,727—November 9, 1875. C. PETERS. *Improvement in reagents for testing the strength of vinegar.*

A mixture of litmus, one-half pound; concentrated liquid ammonia, 1 pound; alcohol, 1 quart; and water enough to make in all 17 quarts, constitutes a blue testing liquid that is turned red by vinegar.

247,793—October 4, 1881. W. H. ATKINSON. *Refining camphor and apparatus therefor.*

Camphor is refined while surrounded by sheet metal or alloy, which can afterwards be stripped from the cake.

511,143—December 19, 1893. W. H. HIGGIN. *Process of making sodium acetate.*

Esparto liquor and other alkaline waste liquors containing sodium acetate are evaporated, the residue carefully heated at about 400° C., but below the heat at which sodium acetate is decomposed, and the charred mass leached.

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 211. WASHINGTON, D. C. June 25, 1902.

AGRICULTURE.

WEST VIRGINIA.

Hon. WILLIAM R. MERRIAM,

Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of West Virginia, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It also includes the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of West Virginia, June 1, 1900, numbered 92,874 and were valued at $168,295,670. Of this amount, $34,026,560, or 20.2 per cent, represents the value of buildings, and $134,269,110, or 79.8 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $5,040,420, and of live stock, $30,571,259. These values, added to that of farms, give $203,907,349, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $44,768,979, of which amount $19,072,790, or 42.6 per cent, represents the value of animal products, and $25,696,189, or 57.4 per cent, the value of crops, including forest products cut or produced on farms. The total value of farm products for 1899 is more than twice that for 1889, but a part of this increase is probably due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $8,160,860, leaving $36,608,119 as the gross farm income. The ratio which this latter amount bears to the "total value of farm property" is referred to as the "percentage of gross income upon investment." For West Virginia, in 1899, it was 18.0 per cent. As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for West Virginia.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN WEST VIRGINIA.

GENERAL STATISTICS.

West Virginia has a total land area of 24,645 square miles, or 15,772,800 acres, of which 10,654,513 acres, or 67.5 per cent, are included in farms.

From the northeast corner of the state extending south and southwest to the Big Sandy River is a belt of mountains, interspersed with narrow valleys. Clay soil is found in limited areas in the higher portions of this region, while the "stream and upland alluviums" are found on the gentler slopes and in the valleys. The sandy soil which prevails in the extreme northeastern part is the least productive of the soils of this belt.

West of the mountains is a large area of broad flat hills better fitted for grazing than for cultivation, but among the hills are many streams that enrich a naturally fertile soil. Cattle and sheep thrive on the hillsides and are shipped in large quantities to the Baltimore and Pittsburg markets.

The remainder of the state has a gently rolling surface extending to the Ohio River. The soil is rich, consisting of clay and sand loams, mingled with humus and vegetable matter and enriched by disintegrated limestone.

NUMBER AND SIZE OF FARMS.

Table 1 shows, by decades since 1870, the number of farms, the total and average acreage, and the per cent of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1870 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	92,874	10,654,513	5,498,981	5,155,532	114.7	51.6
1890	72,773	10,321,326	4,554,000	5,767,326	141.8	44.1
1880	62,674	10,193,779	3,792,327	6,401,452	162.6	37.2
1870	39,778	8,528,394	2,580,254	5,948,140	214.4	30.2

The total number of farms in West Virginia in 1900 was 53,096 greater than in 1870, and 20,101, or 27.6 per cent, greater than in 1890. The increase in the total farm acreage has not been so rapid, amounting to but 24.9 per cent since 1870 and 3.2 per cent in the last decade. These changes have involved a constant decrease in the average size of farms and an increase in the per cent of farm land improved.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year since 1870.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF PRODUCTS: 1870 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$203,907,349	$168,295,670	$5,040,420	$30,571,259	$44,768,979
1890	178,961,330	151,880,300	3,116,420	23,964,610	20,439,000
1880	153,588,725	133,147,175	2,699,163	17,742,387	19,360,049
1870[2]	120,892,738	101,604,381	2,112,937	17,175,420	[3]23,379,692

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

The gain in the last decade in the total value of farm property was $24,946,019, or 13.9 per cent. In the same time, land, improvements, and buildings increased in value $16,415,370, or 10.8 per cent; implements and machinery, $1,924,000, or 61.7 per cent; and live stock, $6,606,649, or 27.6 per cent. The value of farm products of 1899 was 119.0 per cent greater than the value reported for 1889, but it is probable that a part of this gain is due to the more detailed enumeration made in 1900 than in 1890. One important item enumerated in 1900 but not in 1890 is the value of animals sold and animals slaughtered on farms, which for 1899 amounted to $9,428,066.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	92,874	90,342	10,654,513	5,498,981	$134,269,110	$34,026,560	$5,040,420	$30,571,259	$36,608,119	$2,041,560	$405,270
Barbour	2,013	1,928	217,269	146,399	3,423,500	610,510	97,730	841,938	778,845	31,580	14,800
Berkeley	1,272	1,262	168,795	126,882	2,988,660	1,115,430	174,230	560,005	894,748	100,600	32,700
Boone	1,228	1,193	164,160	31,918	940,410	227,270	27,470	222,638	306,303	7,890	850
Braxton	2,563	2,504	261,830	121,947	2,411,250	596,370	78,050	693,711	939,819	42,280	1,180
Brooke	480	463	56,347	44,792	1,625,410	646,620	71,740	285,352	378,845	37,390	3,130
Cabell	1,903	1,847	148,387	80,852	1,421,020	419,940	67,080	367,010	649,696	36,920	4,400
Calhoun	1,674	1,653	155,046	70,321	1,277,400	407,360	57,270	369,164	552,512	25,290	1,220
Clay	960	886	69,302	22,357	420,350	122,070	12,740	154,110	220,552	8,240	100
Doddridge	1,837	1,754	197,679	118,256	2,816,130	547,250	71,710	630,872	600,444	36,020	2,020
Fayette	1,128	1,112	118,777	46,935	1,239,230	461,260	51,460	285,736	330,847	18,530	5,050
Gilmer	1,764	1,723	191,343	102,041	1,998,240	414,350	69,770	582,477	626,984	49,760	2,640
Grant	844	823	209,672	102,004	1,800,920	303,980	59,530	502,583	562,438	26,520	4,140
Greenbrier	2,434	2,383	409,080	159,728	4,373,240	924,270	153,270	1,062,432	1,034,367	74,460	28,250
Hampshire	1,616	1,605	342,180	138,391	1,704,050	592,550	96,260	514,247	752,225	48,030	16,360
Hancock	427	415	48,489	36,201	1,389,670	564,670	57,260	195,412	327,350	26,690	5,260
Hardy	840	822	256,149	79,579	1,551,090	340,180	64,480	458,786	456,328	35,350	7,990
Harrison	2,328	2,213	271,720	226,095	8,266,770	1,426,430	208,310	1,545,388	1,372,939	91,830	17,230
Jackson	3,094	2,967	283,127	184,167	3,309,900	888,390	158,350	872,980	1,164,583	61,510	6,540
Jefferson	785	774	123,307	103,798	3,494,150	1,220,450	176,000	606,291	954,819	134,770	41,160
Kanawha	3,009	2,930	251,391	125,492	2,749,500	853,700	105,820	649,510	978,879	41,290	2,650
Lewis	1,936	1,876	240,505	171,595	4,922,970	901,190	119,960	1,091,567	845,913	45,040	5,290
Lincoln	2,415	2,361	184,665	68,687	929,690	315,610	49,400	401,688	630,020	14,540	1,240
Logan	940	933	113,869	26,816	655,440	187,190	22,080	206,890	292,148	8,520	50
McDowell	780	759	135,779	18,748	1,141,080	89,770	6,000	129,086	158,928	2,200	240
Marion	2,521	2,429	190,342	148,585	5,328,920	1,270,440	152,330	785,794	969,133	39,740	11,650
Marshall	1,961	1,914	183,245	134,206	5,244,530	1,277,580	217,060	840,152	1,103,999	55,820	2,140
Mason	2,665	2,589	262,458	186,904	3,235,050	911,360	158,030	744,901	1,085,717	75,200	13,110
Mercer	1,975	1,928	217,866	91,055	1,882,590	502,090	65,970	515,538	583,004	23,650	5,350
Mineral	693	674	167,861	75,803	1,554,950	367,190	64,130	359,197	383,750	39,340	5,100
Mingo	957	939	104,597	24,271	791,670	141,670	9,590	156,586	238,598	7,900	90
Monongalia	2,259	2,171	218,114	164,306	7,835,310	1,275,490	219,000	996,016	844,159	40,890	8,960
Monroe	1,794	1,744	247,583	143,987	2,895,540	758,850	135,490	870,506	845,376	45,020	17,490
Morgan	695	690	108,933	49,316	574,280	261,430	53,970	178,558	334,788	20,330	13,330
Nicholas	1,767	1,749	192,227	80,630	1,581,430	383,660	63,660	511,566	488,174	17,070	7,580
Ohio	803	795	62,498	48,967	2,852,840	1,047,710	123,660	401,684	779,847	71,920	3,860
Pendleton	1,217	1,202	343,330	115,691	2,478,730	380,280	75,210	698,171	566,262	25,460	5,880
Pleasants	968	949	77,743	52,061	1,241,990	356,200	57,790	267,608	383,761	19,350	2,200
Pocahontas	1,051	1,034	253,806	71,667	2,212,920	452,320	90,780	598,992	528,344	32,640	5,070
Preston	2,962	2,910	327,682	176,151	3,565,970	1,214,380	207,810	993,954	1,251,706	43,900	30,220
Putnam	2,154	2,095	190,041	103,934	1,757,740	623,520	110,280	503,708	838,567	43,180	5,920
Raleigh	1,745	1,681	158,654	85,343	1,576,880	424,710	57,460	418,945	521,345	14,990	3,900
Randolph	1,787	1,742	362,382	109,891	3,299,840	953,340	99,220	769,775	739,134	47,050	9,670
Ritchie	2,315	2,267	242,946	152,628	3,321,120	794,280	113,580	782,824	844,065	44,560	7,180
Roane	2,825	2,734	284,269	166,074	2,706,030	697,060	107,880	855,337	987,109	53,690	1,610
Summers	1,838	1,802	189,390	78,517	1,375,430	466,450	56,680	431,728	493,062	15,680	5,540
Taylor	1,120	1,076	103,704	78,535	1,943,410	472,210	64,840	423,453	412,513	21,130	6,430
Tucker	768	752	93,690	35,402	692,570	182,210	28,070	221,880	251,565	8,850	1,130
Tyler	1,611	1,575	169,604	110,733	2,371,710	757,480	101,870	480,772	655,386	35,100	3,990
Upshur	2,078	1,985	203,312	125,327	2,656,270	552,300	83,240	662,633	721,258	30,480	10,630
Wayne	3,189	3,099	301,602	125,241	1,602,840	517,620	67,470	633,028	962,687	28,790	330
Webster	1,058	1,029	115,786	30,640	649,230	197,170	25,180	236,471	310,641	17,890	530
Wetzel	2,331	2,289	197,924	118,958	3,780,470	809,410	111,510	700,074	880,978	39,660	860
Wirt	1,528	1,464	123,295	72,185	1,292,880	377,720	63,080	357,787	489,869	20,010	1,930
Wood	2,767	2,661	206,625	149,762	4,214,800	1,196,340	171,580	706,383	1,045,415	49,730	9,600
Wyoming	1,202	1,188	134,136	38,210	901,100	227,280	28,030	237,365	257,375	7,290	----------

All counties report increases in the number of farms in the last ten years, except Fayette and Logan, a territorial change having occurred in the latter county in that period. Nearly all counties report increases in their total farm area, and a still greater number report increases in the area of improved land. The average size of farms for the state is 114.7 acres, and varies from 72.2 acres in Clay county to 304.9 acres in Hardy county. The largest farms are, as a rule, in the counties given principally to the raising of cereals and live stock.

For the state, the average value of farms, exclusive of buildings, is $1,446.00. Approximately three-fourths of the counties report increases in the total value of farms since 1890, while McDowell alone reports a decrease in the value of implements and machinery. The value of live stock reported was less than in 1890 in five counties—Berkeley, Fayette, Hancock, Logan, and Taylor.

FARM TENURE.

Table 4 gives a comparative exhibit of farm tenure in 1880, 1890, and 1900. The farms operated by tenants are divided into two groups, designated as farms operated by "cash tenants," who pay a cash rental or a stated amount of labor or farm produce, and farms operated by "share tenants," who pay as rental a share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer. The farms under the classification "owners" in Table 4 are subdivided in Table 5 into groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive a fixed salary from the owners for their supervision and other services.

Table 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	92,874	72,583	7,526	12,765	78.2	8.1	13.7
1890	72,773	59,858	4,275	8,640	82.2	5.9	11.9
1880	62,674	50,673	4,292	7,709	80.9	6.8	12.3

[1] Including "part owners," "owners and tenants," and "managers."

Table 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

Part 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	92,874	65,797	4,620	1,112	1,054	7,526	12,765
White	92,132	65,320	4,566	1,109	1,046	7,458	12,633
Colored	742	477	54	3	8	68	132

Part 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	70.9	5.0	1.2	1.1	8.1	13.7
White	100.0	70.9	5.0	1.2	1.1	8.1	13.7
Colored	100.0	64.3	7.3	0.4	1.1	9.1	17.8

Since 1880 the total number of farms has increased 30,200, or 48.2 per cent. Since 1890 the number of farms operated by owners has increased 12,725, or 21.3 per cent; the number by cash tenants, 3,251, or 76.0 per cent; and that by share tenants, 4,125, or 47.7 per cent. The percentages in Table 4 show that the number of farms operated by cash tenants has increased at a relatively greater rate in the last decade than the numbers operated by owners and share tenants.

Of the farms in the state, 99.2 per cent are operated by white farmers, and 0.8 per cent by colored farmers. Of the white farmers, 77.1 per cent own all or part of the land they operate, and 22.9 per cent operate farms owned by others. For colored farmers, the corresponding percentages are 72.0 and 28.0, respectively.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

Table 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	92,874	114.7	10,654,513	100.0	$203,907,349	100.0
White farmers	92,132	115.2	10,612,929	99.6	203,079,638	99.6
Colored farmers	742	56.0	41,584	0.4	827,711	0.4
Owners	65,797	117.9	7,757,841	72.8	149,916,878	73.5
Part owners	4,620	126.5	584,416	5.5	11,236,200	5.5
Owners and tenants	1,112	168.3	187,145	1.7	3,453,271	1.7
Managers	1,054	340.6	358,994	3.4	6,337,702	3.1
Cash tenants	7,526	103.0	774,933	7.3	13,039,719	6.4
Share tenants	12,765	77.6	991,184	9.3	19,923,579	9.8

Table 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,446	$367	$54	$329	$394	18.0
White farmers	1,451	368	54	331	396	17.9
Colored farmers	746	181	30	159	225	20.1
Owners	1,470	394	59	355	415	18.2
Part owners	1,635	370	60	367	440	18.1
Owners and tenants	2,018	501	85	501	549	17.7
Managers	4,341	997	77	598	595	9.9
Cash tenants	1,246	232	34	221	292	16.9
Share tenants	1,080	237	36	208	299	19.2

Colored farmers operate but 0.8 per cent of the farms of West Virginia, representing 0.4 per cent of the total value of farm property, and 0.4 per cent of the total acreage. The average values of all forms of farm property are smaller for colored than for white farmers. The higher per cent of gross income for colored than for white farmers is due to the smaller average size, and lower values, of the farms of colored farmers. Farms operated by managers have the highest average values of all forms of farm property except for implements and machinery, but the ratio which the gross income bears to the total value of farm property is smaller than for any other group.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

Table 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	92,874	114.7	10,654,513	100.0	$203,907,349	100.0
Under 3 acres	599	1.9	1,164	(1)	412,490	0.2
3 to 9 acres	5,342	6.0	81,869	0.3	2,504,745	1.2
10 to 19 acres	7,140	13.6	96,831	0.9	4,035,133	2.0
20 to 49 acres	19,306	33.5	645,963	6.0	16,421,338	8.0
50 to 99 acres	25,529	69.1	1,765,028	16.6	36,873,876	18.1
100 to 174 acres	20,164	126.2	2,544,791	23.9	51,903,108	25.5
175 to 259 acres	7,542	208.8	1,574,416	14.8	31,137,456	15.3
260 to 499 acres	5,127	339.0	1,737,835	16.3	32,202,087	15.8
500 to 999 acres	1,511	646.7	977,235	9.2	15,607,300	7.6
1,000 acres and over	614	2,083.7	1,279,381	12.0	12,809,816	6.3

[1] Less than one-tenth of 1 per cent.

Table 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,446	$367	$54	$329	$394	18.0
Under 3 acres	233	359	21	76	170	24.7
3 to 9 acres	218	168	12	71	113	24.1
10 to 19 acres	295	155	18	97	157	27.7
20 to 49 acres	493	185	26	147	217	25.5
50 to 99 acres	895	267	42	240	314	21.8
100 to 174 acres	1,666	444	73	391	473	18.4
175 to 259 acres	2,779	654	104	592	678	16.4
260 to 499 acres	4,368	914	133	866	901	14.4
500 to 999 acres	7,563	1,156	150	1,460	1,296	12.5
1,000 acres and over	16,462	1,806	197	2,398	2,183	10.5

The group of farms containing from 50 to 99 acres includes the greatest number of farms, and the group of 100 to 174 acres comprises the greatest number of acres of farm land.

With a few exceptions, the average values of the several forms of farm property increase with the size of the farms. For the group of farms of less than 3 acres each, all values are comparatively high, as this class contains many florists' establishments, market gardens, poultry farms, and city dairies. The incomes from these industries are determined, not so much by the area of land used, as by the amount of capital invested and the amounts expended for labor and fertilizers.

The average gross incomes per acre for the various groups classified by area are as follows: Farms under 3 acres, $87.51; 3 to 9 acres, $18.92; 10 to 19 acres, $11.54; 20 to 49 acres, $6.48; 50 to 99 acres, $4.55; 100 to 174 acres, $3.75; 175 to 259 acres, $3.25; 260 to 499 acres, $2.66; 500 to 999 acres, $2.00; and 1,000 acres and over, $1.05. The average gross income decreases regularly as the farms increase in size.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm; if vegetables are the leading crop, constituting 40 per cent of the value of products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40 per cent of their income from any one class of products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

Table 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	92,874	114.7	10,654,513	100.0	$203,907,349	100.0
Hay and grain	22,400	111.5	2,497,780	23.5	49,118,762	24.1
Vegetables	1,183	40.9	48,410	0.5	2,179,062	1.1
Fruits	1,381	108.5	149,841	1.4	3,052,706	1.5
Live stock	36,255	138.5	5,021,968	47.1	101,725,834	49.9
Dairy produce	1,828	94.5	172,769	1.6	5,871,460	2.9
Tobacco	365	82.6	30,147	0.3	355,876	0.2
Sugar	10	77.7	777	(1)	9,152	(1)
Flowers and plants	20	9.2	185	(1)	124,060	(1)
Nursery products	11	142.1	1,563	(1)	52,603	(1)
Miscellaneous	29,421	92.8	2,731,073	25.6	41,417,834	20.3

[1] Less than one-tenth of 1 per cent.

Table 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,446	$367	$54	$329	$394	18.0
Hay and grain	1,494	377	55	267	379	17.3
Vegetables	1,196	454	47	145	314	17.0
Fruits	1,485	435	47	244	487	22.0
Live stock	1,840	432	68	466	469	16.7
Dairy produce	2,013	682	82	435	584	18.2
Tobacco	574	181	29	191	416	42.6
Sugar	583	126	32	174	133	14.5
Flowers and plants	3,390	2,505	225	83	2,032	32.8
Nursery products	3,462	991	111	218	4,852	101.5
Miscellaneous	905	253	36	214	297	21.1

The average values per acre of products not fed to live stock are: For farms deriving their principal income from flowers and plants, $219.63; nursery products, $34.15; vegetables, $7.67; dairy produce, $6.18; tobacco, $5.03;

fruit, \$4.49; hay and grain, \$3.40; live stock, \$3.38; miscellaneous, \$3.21; and sugar, \$1.71.

The wide variations in the averages and percentages of gross income are due, largely, to the fact that in computing gross income no deductions are made for expense involved in operation. For florists' establishments and nurseries, the average expenditures for such items as labor and fertilizers represent a far greater percentage of the gross income than in the case of "live-stock" and "miscellaneous" farms. If it were possible to present the average net income, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	92,874	114.7	10,654,513	100.0	\$203,907,349	100.0
\$0	433	89.0	38,555	0.4	503,220	0.3
\$1 to \$49	3,512	36.5	128,166	1.2	1,680,800	0.8
\$50 to \$99	7,708	43.8	337,478	3.2	4,634,260	2.3
\$100 to \$249	30,463	65.0	1,978,662	18.6	29,781,339	14.6
\$250 to \$499	29,248	105.7	3,091,087	29.0	53,310,550	26.1
\$500 to \$999	15,583	179.7	2,799,928	26.3	58,131,410	28.5
\$1,000 to \$2,499	5,177	315.8	1,634,779	15.3	41,517,550	20.4
\$2,500 and over	750	861.1	645,858	6.0	14,348,220	7.0

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	\$1,446	\$367	\$54	\$329	\$394	18.0
\$0	872	137	10	143		
\$1 to \$49	326	90	7	56	27	5.6
\$50 to \$99	385	123	12	81	70	11.7
\$100 to \$249	616	177	22	163	169	17.3
\$250 to \$499	1,159	310	49	305	345	18.9
\$500 to \$999	2,459	614	101	556	664	17.8
\$1,000 to \$2,499	5,515	1,278	191	1,036	1,399	17.5
\$2,500 and over	13,651	2,775	333	2,372	4,186	21.9

Of the total number of farms in West Virginia, 433 report no income. Some of these farms are summer homes, some are farms partially abandoned in 1899, while others had changed owners or tenants, and the persons in charge, June 1, 1900, were unable to give definite information concerning the products of the preceding year. To this extent the reports fall short of giving a complete exhibit of farm income in 1899.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	134,107	\$1,102,228	\$8.22	2,397
Steers	1 and under 2	79,972	1,425,903	17.83	346
Steers	2 and under 3	71,088	1,930,457	27.16	173
Steers	3 and over	43,780	1,774,300	40.53	269
Bulls	1 and over	8,096	244,303	30.18	29
Heifers	1 and under 2	60,288	990,655	16.44	572
Cows kept for milk	2 and over	205,601	5,694,302	27.70	11,937
Cows and heifers not kept for milk.	2 and over	36,870	896,279	24.31	39
Colts	Under 1	11,947	264,857	22.17	149
Horses	1 and under 2	12,963	501,504	38.69	173
Horses	2 and over	160,278	9,610,189	59.96	17,775
Mule colts	Under 1	711	24,293	34.17	10
Mules	1 and under 2	852	41,149	48.30	59
Mules	2 and over	9,791	659,692	67.38	3,426
Asses and burros	All ages	116	15,234	131.33	58
Lambs	Under 1	396,104	867,571	2.19	751
Sheep (ewes)	1 and over	497,247	1,554,696	3.13	995
Sheep (rams and wethers).	1 and over	75,492	242,289	3.21	90
Swine	All ages	442,844	1,389,808	3.14	22,185
Goats	All ages	847	2,123	2.51	672
Fowls:[1]					
Chickens[2]		2,759,585	963,805		
Turkeys		105,265			
Geese		129,948			
Ducks		58,273			
Bees (swarms of)		111,417	375,622	3.37	
Value of all live stock.			30,571,259		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The value of all live stock on farms, June 1, 1900, was \$30,571,259. Of this amount 33.9 per cent represents the value of horses; 27.4 per cent, that of neat cattle, other than dairy cows; 18.6 per cent, that of dairy cows; 8.7 per cent, that of sheep; 4.5 per cent, that of swine; 3.2 per cent, that of poultry; 2.4 per cent, that of mules; and 1.3 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of live stock not on farms was \$1,777,189, and the total value of live stock in the state, exclusive of poultry and bees not on farms, was \$32,348,448. There were about one-ninth as many horses two years old, and over, employed in towns and cities as in agricultural operations.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1870 in the numbers of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1870 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	205,601	434,181	185,188	11,470	572,739	442,884
1890	188,492	377,574	154,722	7,390	785,063	411,018
1880	156,956	301,488	126,143	6,226	674,769	510,613
1870	104,434	197,246	90,479	2,189	552,327	268,031

[1] Lambs not included.

Every class of domestic animals shows a considerable increase in numbers since 1870, that of dairy cows, other neat cattle, horses, and mules being greatest and of uninterrupted progress. The number of sheep increased each decade except from 1890 to 1900, for which period a decrease of 27.0 per cent is shown. The numbers of swine show regular increases, except for an unusually large report in 1880.

Compared with the census of 1890, the present census shows the following increases in the numbers of live stock: Dairy cows, 9.1 per cent; other neat cattle, 15.0 per cent; horses, 19.7 per cent; mules and asses, 55.2 per cent; and swine 7.8 per cent. The large increases in the numbers of mules and horses are due to the development of oil fields and mines which require additional work animals.

In comparing the poultry report of 1900 with that of 1890, it should be borne in mind that in 1900 the enumerators were instructed to report no fowls under three months old, while in 1890 no such limitation was made. This fact explains to a great extent the apparent decrease in numbers of fowls of all kinds. Compared with the figures for 1890, the present census shows decreases in the numbers of fowls as follows: Ducks, 56.5 per cent; turkeys, 51.0 per cent; geese, 26.5 per cent; and chickens, 13.7 per cent. The large increase in the number of eggs produced indicates conclusively that the decrease in the numbers of fowls is only apparent.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the animal products for 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	3,123,455	$636,012
Mohair and goat hair	Pounds	140	43
Milk	Gallons	[1]83,861,660	[2]5,088,153
Butter	Pounds	16,913,129	
Cheese	Pounds	74,243	
Eggs	Dozens	17,242,400	1,877,675
Poultry			1,843,752
Honey	Pounds	1,673,120	199,089
Wax	Pounds	30,180	
Animals sold			6,533,034
Animals slaughtered			2,895,032
Total			19,072,790

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of milk sold and consumed, and of butter and cheese made.

The value of animal products for the state in 1889 was $19,072,790, of which 49.4 per cent represents the value of animals sold and animals slaughtered on farms; 26.7 per cent, that of dairy products; 19.5 per cent, that of poultry and eggs; 3.3 per cent, that of wool, mohair, and goat hair; and 1.1 per cent, the value of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms, $9,428,066, is 25.8 per cent of the gross farm income. Of all farms reporting live stock, 72,705, or 81.6 per cent, report animals slaughtered, the average value per farm being $39.82. Animals sold were reported by 53,294 farmers, or 59.8 per cent of all reporting live stock, the average receipts per farm for animals sold being $122.58. In obtaining these reports the enumerators were instructed to secure from each farm operator a statement of the amount received from sales in 1899 less the amount paid for animals purchased during the year.

DAIRY PRODUCE.

In 1899, 1,828 farmers, or 2.0 per cent of the total number in the state, derived their principal income from the sale of dairy products. There were 24,412,594 gallons more milk produced in that year than in 1889, a gain of 41.1 per cent. Cheese was produced on farms in about the same quantities for both years, but 20.3 per cent more butter was made on farms in 1899 than in 1889.

Of the $5,088,153 given in Table 16 as the value of dairy products, $3,688,346, or 72.5 per cent, represents the value of such products consumed on farms, and $1,399,807, or 27.5 per cent, the receipts from sales. Of the latter amount, $841,147 was received from the sale of 5,520,784 pounds of butter; $531,127, from 3,391,523 gallons of milk; $21,559, from 38,855 gallons of cream; and $5,974, from 60,842 pounds of cheese.

POULTRY AND EGGS.

Of the $3,721,427 given as the value of poultry and eggs, 50.5 per cent represents the value of eggs produced and 49.5 per cent that of poultry raised. The number of eggs produced in 1889 was 9,919,974 dozens, and in 1899, 17,242,400 dozens, an increase of 73.8 per cent.

WOOL.

The production of wool for 1899 was 3,123,455 pounds. This was the largest showing ever made for the state, and a gain of 22.0 per cent over the production of 1889. This increase is more apparent than real, owing to the fact that the fleeces of at least 217,049 sheep were omitted from the table in 1890 but included in a general estimate of wool shorn after the census enumeration.

HONEY AND WAX.

The production of honey in 1899 was 1,673,120 pounds, and of wax, 30,180 pounds. For 1889 there were 1,218,686 pounds of honey, and 22,109 pounds of wax. More than one-fourth of all farms in the state reported apiarian products.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	74,254	185,188	2.5	80,477	205,601	2.6
White farmers	73,709	184,123	2.5	79,972	204,727	2.6
Colored farmers	545	1,065	2.0	505	874	1.7
Owners[1]	60,118	151,840	2.5	64,425	172,410	2.7
Managers	797	2,831	3.6	833	2,777	3.3
Cash tenants	4,914	10,721	2.2	5,589	11,726	2.1
Share tenants	8,425	19,796	2.3	9,630	18,688	1.9
Under 20 acres	5,783	8,829	1.5	8,643	11,927	1.4
20 to 99 acres	36,302	69,733	1.9	38,952	77,738	2.0
100 to 174 acres	18,312	50,450	2.8	18,949	55,831	2.9
175 to 259 acres	7,029	24,263	3.5	7,161	26,692	3.7
260 acres and over	6,828	31,913	4.7	6,772	33,413	4.9
Hay and grain	17,812	44,375	2.5	17,037	39,566	2.3
Vegetable	730	1,390	1.9	650	1,093	1.7
Fruit	1,089	2,439	2.2	1,081	2,258	2.1
Live stock	32,398	89,316	2.8	33,552	99,215	3.0
Dairy	1,574	4,461	2.8	1,828	10,201	5.6
Tobacco	286	565	2.0	302	495	1.6
Miscellaneous[2]	20,365	42,642	2.1	26,027	52,773	2.0

[1] Including "part owners" and "owners and tenants."
[2] Including sugar farms, florists' establishments, and nurseries.

CROPS.

The following table gives the statistics of the principal crops grown in 1899.

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	724,646	Bushels	16,610,730	$7,698,335
Wheat	447,928	Bushels	4,326,150	3,040,314
Oats	99,433	Bushels	1,833,840	637,176
Barley	253	Bushels	3,660	1,832
Rye	13,758	Bushels	111,031	58,784
Buckwheat	21,410	Bushels	267,257	134,893
Broom corn	82	Pouuds	32,570	2,029
Flaxseed	2	Bushels	7	7
Clover seed		Bushels	3,030	13,798
Grass seed		Bushels	1,354	2,311
Hay and forage	601,935	Tons	644,535	5,517,073
Tobacco	5,129	Pounds	3,087,140	228,620
Hops	1	Pounds	662	117
Peanuts	11	Bushels	199	228
Dry beans	5,221	Bushels	52,815	80,494
Dry pease	323	Bushels	3,613	3,731
Potatoes	30,123	Bushels	2,245,821	1,133,381
Sweet potatoes	3,393	Bushels	202,424	125,523
Onions	674	Bushels	136,423	107,547
Miscellaneous vegetables	28,616			1,589,481
Maple sugar		Pounds	141,550	12,273
Maple sirup		Gallons	14,874	12,998
Sorghum cane	6,870	Tons	[1] 3,392	9,795
Sorghum sirup		Gallons	450,777	180,140
Small fruits	1,994			149,391
Grapes	[2] 715	Centals	21,921	[3] 50,874
Orchard fruits	[2] 142,159			[4] 2,155,509
Nuts				4,488
Forest products				2,632,980
Flowers and plants	39			44,384
Seeds	7			760
Nursery products	548			61,700
Miscellaneous	15			5,233
Total	2,185,285			25,696,189

[1] Sold as cane.
[2] Estimated from number of vines or trees.
[3] Includiug value of raisins, wine, etc.
[4] Including value of cider, vinegar, etc.

Of the total value of crops, cereals contributed 45.0 per cent; hay and forage, 21.5 per cent; forest products, 10.2 per cent; orchard fruits, 8.4 per cent; miscellaneous vegetables, 6.2 per cent; potatoes, 4.4 per cent; and all other products, 4.3 per cent.

The average value per acre of the various crops is as follows: Flowers and plants, $1,138; nursery products, $113; miscellaneous vegetables, $56; potatoes, $38; orchard fruits, $15; hay and forage, $9; and cereals, $9. The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production required a relatively great amount of labor and large expenditures for fertilizers.

CEREALS.

The following table is a statement of the cereal production since 1869.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1869 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	253	21,410	724,646	99,433	13,758	447,928
1889	326	13,696	592,763	180,815	14,962	349,016
1879	424	30,334	565,785	126,931	17,279	393,068

[1] No statistics of acreage were secured prior to 1879.

PART 2.—BUSHELS PRODUCED.

1899	3,660	267,257	16,610,730	1,833,840	111,031	4,326,150
1889	5,387	120,469	13,730,506	2,946,653	117,113	3,634,197
1879	9,740	285,298	14,090,609	1,908,505	113,181	4,001,711
1869	50,363	82,916	8,197,865	2,413,749	277,746	2,483,543

The total area devoted to cereals in 1879, was 1,133,821 acres; in 1889, 1,151,578 acres; and in 1899, 1,307,428 acres. The total number of bushels produced in 1869 was 13,506,182, and in 1899, 23,152,668, showing an increase of 71.4 per cent in thirty years. The increases in area under cereals in the decade 1889 to 1899, were: Buckwheat, 56.3 per cent; wheat, 28.3 per cent; and corn, 22.2 per cent. The decreases were: Oats, 45.0 per cent; barley, 22.4 per cent; and rye, 8.0 per cent.

Of the total area under cereals in 1899, 55.4 per cent was devoted to corn; 34.3 per cent, to wheat; 7.6 per cent, to oats; 2.7 per cent, to rye, buckwheat, and barley.

Corn is raised in all the counties, particularly in the Kanawha Valley, Wayne, Kanawha, Jackson, and Mason counties reporting nearly one-sixth of the total area. Wheat is grown extensively in Jefferson, Berkeley, and Mason counties, these counties reporting nearly one-fifth of the total area. Hampshire, Hardy, and Morgan counties in the extreme northeast reported 61.6 per cent of the total acreage of rye. Preston county led in the production of oats and buckwheat, having reported over one-tenth of the area in oats, and almost one-third of the total acreage under buckwheat.

HAY AND FORAGE.

In 1900, 64,767 farmers, or 69.7 per cent of the total number, reported hay and forage crops. Exclusive of cornstalks and corn strippings, they obtained an average yield of 0.9 ton per acre. The total acreage in hay and forage for 1899 was 601,935, or 3.9 per cent greater than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 849 acres and 759 tons; millet and Hungarian grasses, 4,924 acres and 5,428 tons; alfalfa or lucern, 123 acres and 198 tons; clover, 25,170 acres and 23,521 tons; other tame and cultivated grasses, 555,787 acres and 494,467 tons; grains cut green for hay, 13,118 acres and 13,017 tons; crops grown for forage, 1,964 acres and 3,694 tons; and cornstalks and corn strippings, 137,424 acres and 103,451 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is included under "corn," as the forage secured was only an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 may be seen in the following table.

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900.	1890.	1899.	1889.
Apples	5,441,112	2,870,535	7,495,743	4,439,978
Apricots	1,870	1,248	145	587
Cherries	300,363	126,307	87,828	51,057
Peaches	1,695,642	450,440	18,100	376,662
Pears	110,194	23,055	19,475	15,406
Plums and prunes	187,695	35,053	19,123	3,774

The total number of fruit trees in the state in 1890 was 3,506,638, and in 1900 there were 7,748,152, showing an increase of 4,241,514, or 121.0 per cent. Increases were as follows: Cherry trees, 137.8 per cent; apple trees, 89.6 per cent; apricot trees, 49.8 per cent. Over three times as many peach trees; over four times as many pear trees; and more than five times as many plum and prune trees were reported in 1900 as in 1890.

Of all fruit trees in 1900, 70.2 per cent were apple trees; 21.9 per cent, peach trees; 3.9 per cent, cherry trees; 2.4 per cent, plum and prune trees; 1.6 per cent, pear, apricot, and unclassified fruit trees. The latter class, which is not included in the table, numbered 11,276, and yielded 1,779 bushels of fruit.

The value of orchard fruits, given in Table 18, includes the value of 28,693 barrels of cider, 9,039 barrels of vinegar, and 1,843,060 pounds of dried and evaporated fruits manufactured on the farms. Comparisons of yields, when made by decades only, have little significance, as the yield of any given year depends upon the nature of the season.

SMALL FRUITS.

Of the 1,994 acres devoted to small fruits, more than one-fourth were reported from Brooke, Harrison, Ohio, and Wood counties. Strawberries occupied 799 acres, or 40.1 per cent of the total area, and yielded 1,068,300 quarts. The acreage and production of other berries were as follows: Raspberries and Logan berries, 704 acres and 788,360 quarts; blackberries and dewberries, 367 acres and 396,850 quarts; gooseberries, 59 acres and 66,400 quarts; currants, 50 acres and 51,340 quarts; and other small fruits, 15 acres and 16,820 quarts. These small fruits were grown by 11,623 farmers, who derived therefrom an average of $12.85 per farm.

VEGETABLES.

The total value of vegetables grown in 1899, including potatoes, sweet potatoes, and onions, was $2,955,932, of which 38.3 per cent represents the value of potatoes; 4.3 per cent, that of sweet potatoes; 3.6 per cent, that of onions; and 53.8 per cent, that of miscellaneous vegetables.

In the growing of miscellaneous vegetables 28,616 acres were used. Of this area the products of 21,958 acres were not reported in detail. Of the remaining 6,658 acres, 2,109 acres were devoted to cabbages; 1,812 acres, to tomatoes; 1,416 acres, to sweet corn; 688 acres, to watermelons; 215 acres, to cucumbers; 190 acres, to muskmelons; and 228 acres, to other vegetables.

TOBACCO.

In 1899 tobacco was grown by 5,045 farmers on 5,129 acres, an average of a little over one acre for each farm reporting. From this area they produced 3,087,140 pounds, a gain in ten years of 10.4 per cent in acreage, and 18.6 per cent in production. Both the acreage and production of 1899 were the largest ever reported, the next largest being in 1889, when 4,647 acres produced 2,602,021 pounds.

The average yield per acre in 1889 was 560 pounds, while in 1899 it was 602 pounds. The total value of the crop in the latter year was $228,620, an average of $45.32 for each farm reporting, and of $44.57 per acre.

The crop was grown in 48 counties, Lincoln county leading with 1,255 acres, and Putnam and Cabell coming next in order. These three counties together reported 60.0 per cent of the total acreage, and 63.7 per cent of the total production.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was grown by 14,834 farmers on 6,870 acres, an average of 0.5 of an acre for each farm reporting. From this area they sold 3,392 tons of cane for $9,795, and from the remaining product manufactured 450,777 gallons of sirup, valued at $180,140. This was a decrease in acreage from 1889 of 11.0 per cent. The total value of sorghum-cane products in 1899 was $189,935, an average of $12.80 for each farm reporting, and of $27.65 per acre.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 39 acres, and the value of the products sold therefrom was $44,384. These flowers and plants were grown by 47 farmers and florists. Of this number, 20 made commercial floriculture their principal business. These 20 proprietors reported a glass surface of 124,710 square feet. They had invested in land, buildings, implements, and live stock, $124,060, of which $50,100 represents the value of buildings. Their sales of flowers and plants amounted to $38,650, and of other products to $2,350. The expenditure for labor was $3,845, and for fertilizers, $337. The average income for each farm reporting, including the value of products fed to live stock, was $2,050.

In addition to the 20 principal florists' establishments, 335 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 189,768 square feet, making, with the 93,532 square feet belonging to the florists' establishments, a total of 283,300 square feet.

NURSERIES.

The total value of nursery products sold in 1899 was $61,700, reported by the operators of 48 farms and nurseries. Of this number, 11 derived their principal income from the nursery business. They had invested in the aggregate $52,603, of which $38,080 represents the value of 1,563 acres of land. The value of their products in 1899 was $54,872, of which $52,462 represents the value of nursery products, and $2,410 that of other products. The expenditure for labor was $3,915, and for fertilizers, $105. The average value of all products for each farm reporting was $4,988.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $2,041,560, an average of $22 per farm. The average expenditure was $356 for nurseries, $192 for florists' establishments, $44 for dairy farms, $32 for vegetable farms, $27 for live-stock farms, $24 for hay and grain farms, $22 for fruit farms, $16 for tobacco farms, and $14 for sugar farms. "Managers" expended on an average, $74; "owners," $23; "cash tenants," $16; and "share tenants," $14. White farmers expended $22 per farm, and colored farmers, $10.

Fertilizers purchased in 1899 cost $405,270, an average of $4 per farm and an increase since 1890 of 92.3 per cent. The average expenditure was $17 for florists' establishments, $10 for nurseries, $6 for hay and grain farms, $6 for vegetable farms, $5 for fruit farms, $5 for live-stock farms, $4 for dairy farms, and $2 for tobacco farms.

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 212. WASHINGTON, D. C. June 25, 1902.

MANUFACTURES.

PENS AND PENCILS.

Hon. WILLIAM R. MERRIAM,

Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on the manufacture of pens and pencils during the census year ending May 31, 1900, prepared under my direction by Mr. Charles M. Karch, of the Census Office.

The statistics included in this report were collected, as in previous censuses, upon the schedule used for the general statistics of manufactures. But in order to present properly the important features of the several industries, it was decided to give them more detailed treatment than is given to manufacturing industries in general, or than these industries have received heretofore, and, for this purpose, to supplement by correspondence the canvass made by the enumerators and local special agents.

This report is divided into four parts, which relate respectively to the manufacture of fountain and stylographic pens, gold pens, steel pens, and lead pencils. A brief historical sketch for each industry is included in the report.

The statistics are presented in 30 tables. Tables 1 and 2 relate to the combined industry, as follows: Table 1, a summary of the four industries; Table 2, quantities and values of pens—fountain, stylographic, gold, and steel—and lead pencils, manufactured during the census year, irrespective of the classification of the establishments by industries.

Tables 3 to 9, inclusive, relate to the manufacture of fountain and stylographic pens, as follows: Table 3, a comparative summary, 1890 and 1900; Table 4, number of establishments, by states arranged geographically, 1890 and 1900; Table 5, a comparative summary of the statistics of capital for 1890 and 1900; Table 6, cost of materials used for 1900; Table 7, quantity and value of all products of fountain and stylographic pen establishments, 1900; Table 8, quantity and value of fountain and stylographic pens manufactured during the census year, as reported by establishments of any character; Table 9, the detailed statistics for the industry in 1900, by states.

Tables 10 to 16, inclusive, relate to the manufacture of gold pens as follows: Table 10, a comparative summary, 1880 to 1900; Table 11, the number of establishments in operation in 1890 and 1900, by states; Table 12, the statistics of capital for 1890 and 1900; Table 13, cost of materials used for 1900; Table 14, the quantity and value of all products of gold pen establishments for 1900; Table 15, the quantity and value of gold pens manufactured during the census year as reported by establishments of any character; Table 16, the detailed statistics for the industry in 1900, by states.

Tables 17 to 23, inclusive, relate to the manufacture of steel pens, as follows: Table 17, a comparative summary, 1870 to 1900; Table 18, the number of establishments in operation in 1890 and 1900, by states; Table 19, the statistics of capital for 1890 and 1900; Table 20, the cost of materials used for 1900; Table 21, the quantity and value of products of steel pen establishments for 1900; Table 22, the quantity and value of steel pens manufactured during the census year as reported by establishments of any character; Table 23, the detailed statistics for the industry in 1900, by states.

Tables 24 to 30, inclusive, relate to the manufacture of lead pencils, as follows: Table 24, a comparative summary, 1860 to 1900; Table 25, the number of establishments in operation in 1890 and 1900, by states; Table 26, the statistics of capital for 1890 and 1900; Table 27, the cost of materials used for 1900; Table 28, the quantity and value of all products of lead pencil establishments for 1900; Table 29, the quantity and value of lead pencils manufactured during the census year, as reported by establishments of any character; Table 30, the detailed statistics for the industry in 1900, by states.

Owing to changes in the method of taking the census, comparisons between the earlier and later decades, represented in Tables 10, 17, and 24, should be drawn only in the most general way. Nevertheless, the growth of the industries may be approximately measured from the figures given.

In drafting the schedules of inquiry for the census of 1900, care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

In some instances the number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations or cooperative establishments.

The reports show a capital of $3,671,741 invested in the manufacture of pens and pencils in the 55 establishments reporting for the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations engaged in these industries. The value of the products is returned at $4,222,148, to produce which involved an outlay of $281,636 for salaries of officials, clerks, etc.; $1,192,405 for wages; $471,655 for miscellaneous expenses, including rent, taxes, etc.; and $1,747,852 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of pens and pencils during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the shop or factory. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures.

PENS AND PENCILS.

By Charles M. Karch.

The statistics of the manufacture of pens and pencils in the United States at the census of 1900 are presented in this report under the following groups: Pens, fountain and stylographic; pens, gold; pens, steel; and lead pencils. Statistics for each of these groups are shown separately in this report.

A summary for the combined industry, as reported for 1900, is presented in Table 1.

Table 1.—PENS, FOUNTAIN, GOLD, AND STEEL, AND PENCILS, LEAD: SUMMARY FOR THE UNITED STATES, 1900.

	Total.	Pens, fountain and stylographic.	Pens, gold.	Pens, steel.	Pencils, lead.
Number of establishments	55	23	22	3	7
Capital	$3,671,741	$590,629	$496,246	$357,460	$2,227,406
Land	$212,950	$8,150	$33,000	$20,000	$151,800
Buildings	$317,132	$13,632	$7,000	$43,000	$253,500
Machinery, tools, and implements	$535,574	$79,074	$129,775	$82,000	$244,725
Cash and sundries	$2,606,085	$489,773	$326,471	$212,460	$1,577,381
Salaried officials, clerks, etc., number	240	84	62	13	81
Salaries	$281,636	$80,808	$67,522	$21,416	$111,890
Wage-earners, average number	3,331	318	378	473	2,162
Total wages	$1,192,405	$141,012	$229,679	$138,433	$683,281
Miscellaneous expenses	$471,655	$113,334	$42,740	$37,405	$278,176
Cost of materials used	$1,747,852	$351,932	$312,537	$52,466	$1,030,917
Value of products	$4,222,148	$906,454	$799,078	$294,340	$2,222,276

It appears from Table 1 that pens, fountain and stylographic, led in the number of establishments reporting in 1900, closely followed by the gold pen industry, which reported but 1 establishment less. Of the total amount of capital invested in the four industries, lead pencils, with 7 establishments, contributed 60.7 per cent; steel pens, with 3 establishments, 9.7 per cent; gold pens, with 22 establishments, 13.5 per cent; fountain and stylographic pens, with 23 establishments, 16.1 per cent. Of the total value of products for the four industries, that reported for lead pencils formed 52.6 per cent; for fountain and stylographic pens 21.5 per cent; for gold pens, 18.9 per cent; and for steel pens, 7.0 per cent.

It should be noticed, however, that the four industries are very closely allied, and in many instances overlap. Many establishments principally engaged in manufacturing fountain and stylographic pens produced gold pens and lead pencils; and establishments principally engaged in the manufacture of gold pens reported fountain and stylographic pens and lead pencils as subsidiary products; while establishments reporting lead pencils as the principal product manufactured pens as a secondary product. In the tabulation of the reports the rule was adopted of classifying establishments in accordance with the predominating product. In following out this plan, in many instances a product that appears as the principal product of one of the industries included in this report may appear again as a subsidiary product of one or more of the other industries.

Table 2 shows the production of pens, fountain, stylographic, gold and steel, and of lead pencils, manufactured during the census year, irrespective of the classification of the establishments in which they were produced, and it seems as convenient to present this information here as at any place in the report.

Table 2.—SUMMARY: KINDS, QUANTITIES, AND VALUE OF PRODUCTS, BY STATES, 1900.

PRODUCTS.	United States.	New York.	All others.
Aggregate value	$4,119,809	$2,337,788	$1,782,021
Pens: Total value	$1,855,658	$1,004,401	$851,257
Fountain—Gross	8,028	3,760	4,268
Value	$902,734	$567,667	$335,067
Stylographic—Gross	1,803	1,613	196
Value	$82,676	$71,684	$10,992
Gold—Gross	6,735	5,210	1,525
Value	$458,376	$365,050	$93,326
Steel—Gross	1,764,079	....	1,764,079
Value	$411,872	....	$411,872
Pencils, lead: Total value	$2,264,151	$1,333,387	$930,764
Wood—Gross	1,653,973	909,170	744,803
Value	$2,053,484	$1,151,495	$901,989
Gold—Gross	31	26	5
Value	$32,526	$32,326	$200
Silver—Gross	2,281	2,055	226
Value	$111,518	$102,718	$8,800
Plated—Gross	3,988	3,204	784
Value	$64,523	$46,848	$17,675
Other varieties—Gross	581	....	581
Value	$2,100	....	$2,100

The aggregate value of the pens and pencils produced in the United States during the census year was $4,119,809, of which 45 per cent represented the value of pens and 55 per cent that of pencils. New York state produced 56.7 per cent of the aggregate product; and "all others," comprising those states which reported less than 3 establishments, and which are shown collectively in order to avoid disclosing the operations of individual establishments, manufactured 43.3 per cent of the entire output of pens and pencils. Of the total production of pens, 54.1 per cent were manufactured in New York state. Fountain and stylographic pens represented 53.1 per cent of the total value of pens produced, gold pens 24.7 per cent, and steel pens 22.2 per cent. New York led also in the manufacture of pencils during the census year, having produced 58.9 per cent of the total output. Lead pencils inclosed in wooden cases contributed 90.7 per cent of the total value of pencils.

The lack of uniformity in the value of the products manufactured by the establishments located in the various states is due to the variation in the quality of materials used and the design and workmanship of the articles produced. This difference in the value of the various designs is particularly noticeable in the statistics presented in the accompanying tables for establishments engaged in the manufacture of fountain, stylographic, and gold pens, and lead pencils incased in silver and gold.

Attention should be here directed to the fact that the figures reported in Table 2 possibly do not represent the total quantity and value of pens and pencils manufactured in the United States during the census year. Establishments engaged primarily in other industries may have manufactured one or more of these articles as a subsidiary product and made no direct mention of that fact in their returns. Notwithstanding these facts the figures reported may be accepted as fairly representing the quantities and values of pens and pencils manufactured during this period.

FOUNTAIN AND STYLOGRAPHIC PENS.

Although fountain and stylographic pens were manufactured in the United States prior to 1890, the census of that year was the first to publish separate statistics for the industry. The manufacture was successfully established as early as 1880, but it was included under some other classification in that year. At the close of the first ten years of its existence the industry was established in 6 states and had in operation 15 plants, well capitalized and reporting a considerable product.

Table 3 is a comparative summary of the statistics for the manufacture of fountain and stylographic pens as returned at the censuses of 1890 and 1900, with the percentages of increase for the decade.

Table 3.—PENS, FOUNTAIN AND STYLOGRAPHIC: COMPARATIVE SUMMARY, 1890 AND 1900, WITH PER CENT OF INCREASE FOR THE DECADE.

	DATE OF CENSUS.		PER CENT OF INCREASE.
	1900	1890	1890 to 1900
Number of establishments	23	15	53.3
Capital	$590,629	$142,265	315.2
Salaried officials, clerks, etc., number	84	[1]24	250.0
Salaries	$80,808	[1]$28,902	179.6
Wage-earners, average number	318	152	109.2
Wages	$141,012	$73,897	90.8
Men, 16 years and over	241	128	88.3
Wages	$122,777	$67,822	81.0
Women, 16 years and over	66	24	175.0
Wages	$16,008	$6,075	163.5
Children, under 16 years	11		
Wages	$2,227		
Miscellaneous expenses	$113,334	$12,380	815.5
Cost of materials used	$351,932	$123,214	185.6
Value of products	$906,454	$351,775	157.7

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 9.)

The table shows that during the decade the industry made rapid advancement, not only in number of establishments, but also in the amount of capital invested and the value of products. The percentage of increase in the number of women and children employed, as compared with the percentage of increase in the number of men employed, would indicate that some branches of the work performed by men in 1890 were done by women and children in 1900. Each item in Table 3 shows a good percentage of increase for the decade, and indicates that although the industry is yet in its infancy, it is firmly established and in a healthy and prosperous condition.

Table 4 presents, by states arranged geographically, the number of establishments actively engaged in the manufacture of fountain pens in 1890 and in 1900, and the increase for the decade.

Table 4.—PENS, FOUNTAIN AND STYLOGRAPHIC: COMPARATIVE SUMMARY; NUMBER OF ESTABLISHMENTS 1890 AND 1900, AND INCREASE DURING THE DECADE, BY STATES ARRANGED GEOGRAPHICALLY.

STATES.	1900	1890	Increase.
United States	23	15	8
New England states	5	5	
Connecticut	2	1	1
Massachusetts	2	3	[1]1
Rhode Island	1	1	
Middle states	11	9	2
New York	9	8	1
Pennsylvania	2	1	1
Central states	7	1	6
Illinois		1	[1]1
Indiana	1		1
Iowa	1		1
Ohio	4		4
Wisconsin	1		1

[1] Decrease.

It appears from Table 4 that there were 8 more establishments engaged in this industry in 1900 than in 1890, showing an increase of 53.3 per cent for the decade. The largest addition to the number of establishments was made by Ohio, which reported 4 establishments in 1900, having none in 1890. Massachusetts and Illinois reported decreases of 1 establishment each.

Table 5 is a comparative summary of capital as returned at the censuses of 1890 and 1900, with the per cent each item is of the total and the per cent of increase for the decade.

TABLE 5.—PENS, FOUNTAIN AND STYLOGRAPHIC: CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$590,629	100.0	$142,265	100.0	315.2
Land	8,150	1.4	3,100	2.2	162.9
Buildings	13,632	2.3	3,600	2.5	278.7
Machinery, tools, and implements	79,074	13.4	36,625	25.7	115.9
Cash and sundries	489,773	82.9	98,940	69.6	395.0

The most important item reported under the head of capital, both in 1890 and in 1900, was that of cash and sundries, including cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries. In 1890 this item represented 69.6 per cent of the total, and in 1900, 82.9 per cent, the increase for the decade being $390,833, or 395 per cent. The items of land, buildings, and machinery, tools, and implements, each show a large percentage of increase for the decade, but represent a smaller per cent of the total in 1900 than in 1890. The smallest increase and the most considerable reduction of percentage of the total is shown by machinery, tools, and implements, indicating that there has been but little progress made during the ten years in the way of application of new and improved machinery in this industry. The amounts reported for land, buildings, and machinery represent only such as are owned by the establishments engaged in the industry, and do not include the value of leased property.

Table 6 shows the cost of materials for 1900, and the proportion of each item to the whole amount.

TABLE 6.—PENS, FOUNTAIN AND STYLOGRAPHIC: COST OF MATERIALS USED, 1900.

	Amount.	Per cent of total.
Total	$351,932	100.0
Principal materials	347,201	98.7
Purchased in raw state	10,000	2.9
Purchased in partially manufactured form[1]	337,201	95.8
Fuel	864	0.2
Rent of power and heat	3,224	0.9
Freight	643	0.2

[1] Includes mill supplies and all other materials, which are shown separately in Table 9.

Materials purchased in partially manufactured form represented 95.8 per cent of the total cost of materials. This item includes those reported under Table 9, as "mill supplies" and "all other materials." "Mill supplies" consisted of materials, such as oil, waste, belting, and other articles which did not enter into the product, but were necessary to the process of manufacture. "All other materials" comprised those not otherwise specified in the schedule of inquiry and included such articles as boxes, bags, and packages. Materials purchased in raw state are those upon which no manufacturing force has been expended. The amount paid for fuel included that used both for motive power and for heating purposes, and is correlative with the amount paid for rent of power and heat leased from other establishments. Some establishments found it impossible, in making returns, to separate from the cost of materials the amount paid for freight, and reported the two together. For that reason, the amount of freight paid, as shown in Table 6, does not represent the entire cost of freight and should be considered only in connection with the cost of materials.

Table 7 shows in detail, by states, the quantity and value of fountain and stylographic pens manufactured during the census year, and the subsidiary products reported by the establishments engaged in this industry.

TABLE 7.—PENS, FOUNTAIN AND STYLOGRAPHIC: QUANTITY AND VALUE OF PRODUCTS, BY STATES: 1900.

STATES.	AGGREGATE VALUE.	PRODUCTS.											
		Total gross.	Total value.	Pens.									
				Total gross.	Total value.	Fountain (complete).		Gold.		Stylographic.		Other varieties.	
						Gross.	Value.	Gross.	Value.	Gross.	Value.	Gross.	Value.
Total	$906,454	8,695	$842,248	8,113	$832,748	5,836	$707,023	584	$47,945	1,686	$77,280	7	$500
New York	524,079	3,396	502,363	3,396	502,363	1,806	417,123	80	18,000	1,510	67,240		
Ohio	52,000	650	38,985	650	38,985	165	12,000	365	21,945	120	5,040		
All other states[1]	330,375	4,649	300,900	4,067	291,400	3,865	277,900	139	8,000	56	5,000	7	500

[1] Includes establishments distributed as follows: Connecticut, 2. Indiana, 1; Iowa, 1; Massachusetts, 1; Pennsylvania, 2; Rhode Island, 1; Wisconsin, 1.

TABLE 7.—PENS, FOUNTAIN AND STYLOGRAPHIC: QUANTITY AND VALUE OF PRODUCTS, BY STATES: 1900—Continued.

STATES.	PRODUCTS—continued. Pencils. Total gross.	Total value.	Gold. Gross.	Gold. Value.	Plate. Gross.	Plate. Value.	Other varieties. Gross.	Other varieties. Value.	ALL OTHER PRODUCTS. Value.
Total	582	$9,500	5	$200	521	$8,000	56	$1,300	$64,206
New York									21,716
Ohio									13,015
All other states[1]	582	9,500	5	200	521	8,000	56	1,300	29,475

[1] Includes establishments distributed as follows: Connecticut, 2; Indiana, 1; Iowa, 1; Massachusetts, 1; Pennsylvania, 2; Rhode Island, 1; Wisconsin, 1.

Of the total value of the products of the establishments engaged in this industry, New York produced 59.6 per cent. The overlapping of the industries is very strikingly exemplified in the above table, especially in the production of gold pens.

The tables which have thus far been shown for this industry give an incomplete statement of the quantity and value of fountain and stylographic pens manufactured during the census year because of the rule adopted, as explained above, of classifying establishments according to the predominating product.

Table 8 makes up for this deficiency by showing the total quantity and value of fountain and stylographic pens produced during the census year, as reported by establishments of any character.

TABLE 8.—PENS, FOUNTAIN AND STYLOGRAPHIC: QUANTITY AND VALUE OF PRODUCTS, BY STATES, 1900.

STATES.	Total.	FOUNTAIN. Gross.	FOUNTAIN. Value.	STYLOGRAPHIC. Gross.	STYLOGRAPHIC. Value.
United States	$985,410	8,028	$902,734	1,803	$82,676
New York	639,351	3,760	567,667	1,613	71,684
Ohio	47,740	346	42,000	130	5,740
All other states[1]	298,319	3,922	293,067	60	5,252

[1] Includes establishments distributed as follows: Connecticut, 2; Illinois, 2; Indiana, 1; Iowa, 1; Massachusetts, 1; Pennsylvania, 2; Rhode Island, 2; Wisconsin, 1.

Table 8 includes the quantity and value both of the fountain and stylographic pens produced in establishments engaged principally in their manufacture, and of those reported as a subsidiary product in establishments engaged primarily in the manufacture of gold pens and lead pencils. The values reported do not include the amounts reported as the value of "all other products," in the tables showing products by establishments, therefore the totals given in Table 8 do not agree with the totals elsewhere given in this report, or with those dealing with this industry in the general report on Manufactures, Parts I and II.

HISTORICAL AND DESCRIPTIVE.

Fountain pens are the most modern variety of pens made and represent the highest type of the pen-maker's art. The first successful manufacture of these pens in the United States dates back but twenty-one years before the taking of the Twelfth Census, although attempts were made to manufacture them before that time. They were manufactured in England as early as 1835, but they were not satisfactory enough to warrant their use to any extent.[1] At that time there were two fountain pens invented, known as the Schaeffer pen and the Parker hydraulic pen. Schaeffer's pen had a reservoir for ink in the holder and the ink was admitted to the pen by the pressure of the thumb on a projecting stud. Parker's pen also had a reservoir in the holder, which contained a piston operated by a screw stem and a nut on the end of the holder. The lower end of the reservoir being dipped in ink, the piston was drawn up by rotating the nut, thus filling the reservoir. The ink was ejected as required by a reverse motion of the thumb nut. The early attempts to construct fountain pens were generally confined to the invention of contrivances such as internal tubes, ducts, valves, or springs, which were operated upon by the action of the nibs, and which forced the ink from a feeding pipe upon the pen, assisted by air admitted at the top of the holder

[1] Universal Cyclopædia, vol. 9, page 198.

to take the place of the exhausted ink. Pens dependent upon such mechanism were very erratic in their work, as the ink flowed either too slow or too fast. After many experiments to secure a continuous and properly regulated flow of ink into the pen, it was found that the best results were obtained by the use of a tubular holder tightly closed at its upper end, and at the lower end fitted with an ordinary nib pen made of gold, with an ink feeder lying adjacent to the pen to attract the ink from the reservoir. As the ink in the process of writing is withdrawn, air enters at the lower end of the holder and ascends in globules through the column of ink to fill the space left vacant. There are many varieties of fountain pens made in the United States, but the basic principles underlying all are practically the same, the retention of the ink by atmospheric pressure and the furnishing of a supply ready for use throughout many hours of continuous writing.

The stylographic pen is a variety of fountain pen in which a blunt needle incased in a sheath at the end of the holder serves as a valve to release the ink when the point is pressed on the paper.

Table 9 presents a detailed statement of the statistics for the fountain and stylographic pen industry, by states, 1900.

TABLE 9.—PENS, FOUNTAIN AND STYLOGRAPHIC: BY STATES, 1900.

	United States.	New York.	Ohio.	All other states.[1]
Number of establishments	23	9	4	10
Character of organization:				
Individual	11	5	2	4
Firm and limited partnership	7	2	2	3
Incorporated company	5	2	....	3
Capital:				
Total	$590,629	$261,670	$25,540	$303,419
Land	$8,150	....	$350	$7,800
Buildings	$13,632	....	$600	$13,032
Machinery, tools, and implements	$79,074	$25,175	$9,350	$44,549
Cash and sundries	$489,773	$236,495	$15,240	$238,038
Proprietors and firm members	25	8	6	11
Salaried officials, clerks, etc.:				
Total number	84	49	3	32
Total salaries	$80,808	$56,834	$1,669	$22,305
Officers of corporations—				
Number	9	4	....	5
Salaries	$19,650	$13,250	....	$6,400
General superintendents, managers, clerks, etc.—				
Total number	75	45	3	27
Total salaries	$61,158	$43,584	$1,669	$15,905
Men—				
Number	42	25	3	14
Salaries	$47,491	$33,697	$1,669	$12,125
Women—				
Number	33	20	....	13
Salaries	$13,667	$9,887	....	$3,780
Wage-earners, including pieceworkers, and total wages:				
Greatest number employed at any one time during the year	339	114	48	177
Least number employed at any one time during the year	299	112	39	148
Average number	318	105	43	170
Wages	$141,012	$48,395	$16,515	$76,102
Men, 16 years and over—				
Average number	241	94	27	120
Wages	$122,777	$44,620	$12,495	$65,662
Women, 16 years and over—				
Average number	66	10	15	41
Wages	$16,008	$3,550	$3,700	$8,758
Children, under 16 years—				
Average number	11	1	1	9
Wages	$2,227	$225	$320	$1,682
Average number of wage-earners, including pieceworkers, employed during each month:				
Men, 16 years and over—				
January	244	94	30	120
February	243	94	30	119
March	242	94	30	118
April	233	93	24	116
May	234	94	24	116
June	233	94	24	115
July	243	95	28	120
August	242	94	25	123
September	246	93	28	125
October	243	93	24	126
November	246	94	29	123
December	243	96	30	117
Women, 16 years and over—				
January	64	9	14	41
February	66	9	16	41
March	65	9	16	40
April	64	9	14	41
May	72	18	14	40
June	63	9	14	40
July	67	9	16	42
August	64	9	14	41
September	64	9	14	41
October	64	9	14	41
November	64	9	14	41
December	75	12	20	43
Children, under 16 years—				
January	12	1	2	9
February	12	1	2	9
March	12	1	2	9
April	11	1	1	9
May	12	1	1	10
June	11	[illegible]	1	9

[1] Includes establishments distributed as follows: Connecticut, 2; Indiana, 1; Iowa, 1; Massachusetts, 2; Pennsylvania, 2; Rhode Island, 1; Wisconsin, 1.

TABLE 9.—PENS, FOUNTAIN AND STYLOGRAPHIC: BY STATES: 1900—Continued.

	United States.	New York.	Ohio.	All other states.[1]
Average number of wage earners, including pieceworkers, employed during each month—Continued.				
Children, under 16 years—Continued.				
July	11	1	1	9
August	12	1	2	9
September	11	1	1	9
October	11	1	1	9
November	11	1	1	9
December	6	1	1	4
Miscellaneous expenses:				
Total	$113,334	$72,371	$2,964	$37,999
Rent of works	$15,880	$11,620	$1,400	$2,860
Taxes, not including internal revenue	$936	$142	$37	$757
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$94,518	$58,609	$1,527	$34,382
Amount paid for contract work	$2,000	$2,000	....	....
Materials used:				
Total cost	$351,932	$235,550	$22,189	$94,193
Principal materials—				
Total cost	$314,153	$206,543	$20,109	$87,501
Purchased in raw state	$10,000	....	....	$10,000
Purchased in partially manufactured form	$304,153	$206,543	$20,109	$77,501
Fuel	$864	$146	$95	$623
Rent of power and heat	$3,224	$1,690	$320	$1,214
Mill supplies	$821	$76	$20	$725
All other materials	$32,227	$26,995	$1,357	$3,875
Freight	$643	$100	$288	$255
Products:				
Total value	$906,454	$524,079	$52,000	$330,375
Pens and pencils—				
Total value	$842,248	$502,363	$38,985	$300,900
Pens—				
Total gross	8,113	3,396	650	4,067
Total value	$832,748	$502,363	$38,985	$291,400
Fountain (complete)—				
Number of gross	5,836	1,806	165	3,865
Value	$707,023	$417,123	$12,000	$277,900
Gold—				
Number of gross	584	80	365	139
Value	$47,945	$18,000	$21,945	$8,000
Stylographic—				
Number of gross	1,686	1,510	120	56
Value	$77,280	$67,240	$5,040	$5,000
Other varieties—				
Number of gross	7	....	....	7
Value	$500	....	....	$500
Pencils—				
Total gross	582	....	....	582
Total value	$9,500	....	....	$9,500
Gold—				
Number of gross	5	....	....	5
Value	$200	....	....	$200
Plated—				
Number of gross	521	....	....	521
Value	$8,000	....	....	$8,000
Other varieties—				
Number of gross	56	....	....	56
Value	$1,300	....	....	$1,300
All other products	$64,206	$21,716	$13,015	$29,475
Comparison of products:				
Number of establishments reporting for both years	20	8	3	9
Value for census year	$893,154	$523,579	$51,200	$318,375
Value for preceding business year	$756,369	$435,619	$49,750	$271,000
Power:				
Number of establishments reporting	15	6	2	7
Total horsepower	406	20	7	379
Owned—				
Engines—				
Steam—				
Number	3	....	....	3
Horsepower	270	....	....	270
Rented—				
Electric, horsepower	31	20	2	9
Other kind, horsepower	105	....	5	100
Horsepower furnished to other establishments	1	....	....	1
Establishments classified by number of persons employed, not including proprietors and firm members:				
Total number of establishments	23	9	4	10
No employees	3	....	2	1
Under 5	4	2	....	2
5 to 20	8	4	1	3
21 to 50	6	2	1	3
51 to 100	2	1	....	1
101 to 250	....	....	....	....
251 to 500	....	....	....	....
501 to 1,000	....	....	....	....
Over 1,000	....	....	....	....

[1] Includes establishments distributed as follows: Connecticut, 2; Indiana, 1; Iowa, 1; Massachusetts, 2; Pennsylvania, 2; Rhode Island, 1; Wisconsin, 1.

GOLD PENS.

Although the manufacture of gold pens was carried on successfully as early as 1850, the census reports on this industry prior to 1880 were not sufficiently accurate to justify their use in comparisons with later censuses to show the growth of the industry. The census of 1850 reported the manufacture of pens under the general classification of pens and pencils, and, as there was but a small amount of pencils, and a very limited amount, if any, of steel, fountain, and stylographic pens produced in the United States at that time, a very large proportion of the value of the products reported for that year was obviously that of gold pens. In the census of 1860 the manufacture of gold pens was reported as a subdivision of jewelry, and the reports show that there were then 9 establishments engaged in the industry, with a capital of $32,500, employing 89 people at a cost of $32,228, and manufacturing products to the value of $113,600. The census of 1870 reported the industry in connection with the manufacture of gold pencils. The statistics for these combined industries in 1870 showed that there were 21 establishments engaged in the manufacture of gold pens and pencils, and that they had a capital of $268,250, and a product of $467,380. The growth of the gold pen industry since 1880 has been gradual but satisfactory, as is shown by the statistics presented in the following tables.

Table 10 is a comparative summary of the statistics of the manufacture of gold pens as returned at the censuses of 1880 to 1900, inclusive, with the percentage of increase for each decade.

TABLE 10.—PENS, GOLD: COMPARATIVE SUMMARY, 1880 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.			PER CENT OF INCREASE.	
	1900	1890	1880	1890 to 1900	1880 to 1890
Number of establishments	22	18	16	22.2	12.5
Capital	$496,246	$473,964	$370,150	4.7	28.0
Salaried officials, clerks, etc., number	62	[1]62	(2)	......	......
Salaries	$67,522	[1]$75,124	(2)	[4]10.1	......
Wage-earners, average number	378	301	264	25.6	14.0
Total wages	$229,679	$185,545	$172,207	23.8	7.7
Men, 16 years and over	337	277	226	21.7	22.6
Wages	$216,838	$178,489	(2)	21.5	......
Women, 16 years and over	38	23	19	65.2	21.1
Wages	$12,541	$6,952	(2)	80.4	......
Children, under 16 years	3	1	19	200.0	[4]94.7
Wages	$300	$104	(2)	188.5	......
Miscellaneous expenses	$42,740	$82,753	(3)	[4]48.4	......
Cost of materials used	$312,537	$235,628	$190,906	32.6	23.4
Value of products, including custom work and repairing	$799,078	$718,070	$533,061	11.3	34.7

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 16.)
[2] Not reported separately.
[3] Not reported.
[4] Decrease.

It appears from Table 10 that for the decade oetween 1880 and 1890 the increase in capital and value of products was comparatively large, and in number of establishments, comparatively small; while for the decade between 1890 and 1900 the increase in number of establishments was greater than in the preceding decade, yet the capital increased hardly at all, and the value of products little.

Table 11 presents, by states, the number of establishments actively engaged in the manufacture of gold pens in 1890 and 1900, with the increase for the decade.

TABLE 11.—PENS, GOLD: NUMBER OF ESTABLISHMENTS, BY STATES, 1890 AND 1900.

STATES.	1900	1890	Increase.
United States	22	18	4
California	1	1	....
Illinois	2	....	2
Maryland	1	....	1
Massachusetts	1	1	....
Michigan	1	1	....
Nebraska	....	1	[1]1
New York	14	12	2
Ohio	1	1	....
Rhode Island	1	1	....

[1] Decrease.

Two-thirds of the establishments, both in 1890 and 1900, were located in New York. During the decade there was a net increase of 4 establishments in the United States; Illinois and New York contributing 2 each, and Maryland 1. The only state showing a decrease was Nebraska, which reported 1 establishment in 1890 and none in 1900.

A comparative summary of capital in its several subdivisions for 1890 and 1900, giving percentages of increase between the two census years, and the proportion of each item to the total for those years, is presented in Table 12.

TABLE 12.—PENS, GOLD: CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$496,246	100.0	$473,964	100.0	4.7
Land	33,000	6.6	12,000	2.5	175.0
Buildings	7,000	1.4	8,000	1.7	[1]12.5
Machinery, tools, and implements	129,775	26.2	129,120	27.3	0.5
Cash on hand, and sundries	326,471	65.8	324,844	68.5	0.5

[1] Decrease.

In this industry, as in the other industries reported in this bulletin, cash and sundries, including bills receivable, unsettled ledger accounts, etc., was the largest item reported in the table, but this item was only a little larger in 1900 than in 1890. The item for machinery, tools, and implements formed a considerable proportion of the total amount of capital for the years 1890 and 1900, indicating that machinery is extensively used in the industry, but from the very insignificant percentage of increase in this item during the decade, it is evident that very little new machinery has been added. The items of land and buildings each form but a small percentage of the total capital; the value of the land, however, increased during the decade $21,000, while the value of the buildings decreased $1,000.

The cost of materials used in the manufacture of gold pens in 1900, and the cost of each item, with its percentage of the whole amount, are presented in Table 13.

TABLE 13.—PENS, GOLD: COST OF MATERIALS USED, 1900.

	Amount.	Per cent of total.
Total	$312,537	100.0
Principal materials[1]	308,545	98.7
Fuel	982	0.3
Rent of power and heat	3,010	1.0

[1] Includes items for mill supplies and all other materials, which are shown separately in Table 16.

By far the largest item shown in Table 13, covering almost the entire cost, is that reported for principal materials, which includes not only the materials purchased in partially manufactured form, but all materials that are used in the manufacture of gold pens. The largest part of this item consists of materials purchased in partially manufactured form. This item alone was $283,089, or 90.6 per cent of the total cost of materials. The materials used were principally gold bullion and iridium, but other metals were used to some extent.

Table 14 is a detailed statement, by states, of the quantity and value of gold pens manufactured during the census year by the establishments principally engaged in this industry, and the subsidiary products reported by them.

TABLE 14.—GOLD PENS: QUANTITY AND VALUE OF PRODUCTS, BY STATES, 1900.

STATES.	AGGREGATE VALUE.	PRODUCTS.									
		Total gross.	Total value.	Pens.							
				Total gross.	Total value.	Gold.		Fountain (complete).		Stylographic.	
						Gross.	Value.	Gross.	Value.	Gross.	Value.
Total	$799,078	11,737	$705,832	7,931	$567,755	6,120	$408,229	1,745	$156,586	66	$2,940
New York	657,693	9,975	577,857	6,658	458,255	5,099	344,848	1,507	111,419	52	1,988
All other states[1]	141,385	1,762	127,975	1,273	109,500	1,021	63,381	238	45,167	14	952

STATES.	PRODUCTS—continued.								
	Pencils.								All other.
	Total gross.	Total value.	Gold.		Silver.		Plate.		
			Gross.	Value.	Gross.	Value.	Gross.	Value.	Value.
Total	3,806	$138,077	26	$32,326	795	$68,022	2,985	$37,729	$93,246
New York	3,317	119,602	26	32,326	569	59,222	2,722	28,054	79,836
All other states[1]	489	18,475	....	....	226	8,800	263	9,675	13,410

[1] Includes establishments distributed as follows: Illinois, 1; Maryland, 1; Massachusetts, 1; Michigan, 1; Ohio, 1; Rhode Island, 1.

In this industry, as in the manufacture of fountain and stylographic pens, New York led, producing almost five times as much as all other states combined. The overlapping of the industries is more strikingly exemplified in this industry than in the manufacture of fountain and stylographic pens, the principal product of gold pen establishments making up only 52.1 per cent of the total number of gross produced, while in fountain and stylographic pen establishments the principal product furnished 86.5 per cent of the total.

The tables which have thus far been shown for this industry do not give complete statistics of the quantity and value of gold pens produced during the census year, because of the rule adopted of classifying establishments according to the predominating product. Table 15 shows the total quantity and value of gold pens produced during the census year as reported by establishments of any character.

TABLE 15.—PENS, GOLD: QUANTITY AND VALUE OF PRODUCTS, BY STATES, 1900.

STATES.	Gross.	Value.
United States	6,735	$458,376
New York	5,210	365,050
All other states[1]	1,525	93,326

[1] Includes establishments distributed as follows: Illinois, 2; Maryland, 1; Massachusetts, 2; Michigan, 1; Ohio, 2; Rhode Island, 1.

Table 15 includes the quantity and value of gold pens produced in establishments engaged primarily in this industry, and also the quantity and value reported as a subsidiary product of establishments engaged in the manufacture of fountain and stylographic pens and lead pencils. The values reported in Table 15 do not include the amounts reported as the value of any other products, therefore the totals given in this table do not agree with the totals elsewhere given with those of the general report on Manufactures, Parts I and II.

HISTORICAL AND DESCRIPTIVE.

The manufacture of gold pens was commenced in the United States in 1835 by a watchmaker of Detroit, Mich. Attempts had been made in England to make gold pens prior to that time, but they met with little success. Alloyed gold is too soft to make a durable point, and this circumstance made it necessary to protect the pen points with diamonds or rubies until John Isaac Hawkins, a citizen of the United States, but residing in England while the experiments in the manufacture of the gold pen were in progress there, accidentally discovered that the native alloy of iridium and osmium, one of the hardest and most refractory of all metallic alloys, could be used for protecting the points to much better advantage and more cheaply. Hawkins' rights were purchased by a clergyman of Detroit, Mich., who induced the watchmaker above mentioned to manufacture gold pens. The first pens made by him were very poor substitutes for the quill then in use. In 1840 his plant was taken to New York, where the business was enlarged. Quite an improvement was added to the plant by the machines, for the making and tempering of the pens, invented by John Rendell, one of the employees of the establishment. This establishment soon produced a gold pen so perfect that it combined the elasticity of the quill with the permanency of the metal. About 1850 it was discovered that by embedding the iridium points in the gold instead of soldering them on, the corrosive influence of the ink on the two metals, the solder and the gold, was avoided, and a firmer hold in the pen was given to the points.[1]

The gold pen has been brought to its present degree of perfection by the American manufacturer, and the industry from its inception has been characterized by the use of American methods. For the production of the gold pen a high degree of skill is necessary, and only experts are employed in the different plants.

The gold used in the making of the pens is obtained from the United States Assay Office. It is then melted and alloyed to about 16 carats fine, and rolled into a long narrow ribbon from which pen blanks or flat plates in the shape of a pen, but considerably thicker than the finished pen, are cut by means of a lever press or die and punch. The blunt nib of the blank is notched or recessed at the end to receive the iridium that forms the exceedingly hard point which all good gold pens possess. The iridium is coated with a cream of borax ground in water, and laid in the notch formed in the end of the blank. It is then secured by a process of sweating, which is nothing more nor less than melting the gold of which the pen is formed so that it unites solidly with the iridium. The blank is then passed between rollers of peculiar form to give a gradually diminishing thickness from the point backward. The rolls have a small cavity in which the extreme end of the iridium-pointed nib is placed, to prevent injury to the iridium. After rolling, the nib of every pen is stiffened and rendered spongy by hammering. This is the most important process in the manufacture of the pen, as the elasticity of the nib depends entirely upon this operation. The pen is then trimmed by a press similar to that which is used for cutting out the blanks, or by automatic machinery. When the blank has been trimmed, the name of the manufacturer and the number of the pen are stamped on it by means of a screw press. The pen is given its convex surface also by means of a screw press, the blank being pressed between a concave die beneath and a convex one above. Quite a little force is necessary to bring the pen to the required convexity, and when this operation is completed, two jaws approach the blank and press it up on the opposite edges, thus giving the pen its final shape. The next step is to cut the iridium into two points by holding it on the edge of a very thin copper disk, which is charged with fine emery and oil and revolves at a high speed. The nib is then slit by a machine and the slit cleared by means of a fine circular saw. After slitting, the nibs are brought together by hammering, and the pen burnished on the inside in a concave form and on the outside in a convex form. This is necessary in order to give the pen a uniform surface and greater elasticity. These nibs are then set by the fingers alone, after which operation the pen is ground by a lathe with a thin steel disk and a copper cylinder, both charged with fine emery and oil. The slit is then ground by a thin disk and the sides of the nibs and the points are ground upon the copper cylinder. After the grinding is done the pen is polished upon buff wheels, which completes the process of manufacture. Before the pen is placed upon the market, however, it is given a thorough inspection to see that it possesses the proper elasticity, fineness and weight, then passed to an inspector who tests it and weighs it.

Table 16 is a detailed statement of the statistics for the manufacture of gold pens, by states, 1900.

TABLE 16.—PENS, GOLD: BY STATES, 1900.

	United States.	New York.	All other states.[1]
Number of establishments	22	14	8
Character of organization:			
Individual	11	5	6
Firm and limited partnership	5	5	....
Incorporated company	6	4	2
Capital:			
Total	$496,246	$307,734	$188,512
Land	$33,000	....	$33,000
Buildings	$7,000	....	$7,000
Machinery, tools, and implements	$129,775	$88,856	$40,919
Cash and sundries	$326,471	$218,878	$107,593
Proprietors and firm members	23	17	6
Salaried officials, clerks, etc.:			
Total number	62	39	23
Total salaries	$67,522	$45,672	$21,850
Officers of corporations—			
Number	8	6	2
Salaries	$15,860	$9,660	$6,200

[1] Includes establishments distributed as follows: California, 1; Illinois, 2; Maryland, 1; Massachusetts, 1; Michigan, 1; Ohio, 1; Rhode Island, 1.

[1] Universal Cyclopædia, vol. 9, page 198.

TABLE 16.—PENS, GOLD: BY STATES, 1900—Continued.

	United States.	New York.	All other states.[1]
Salaried officials, clerks, etc.—Continued.			
General superintendents, managers, clerks, etc.—			
Total number	54	33	21
Total salaries	$51,662	$36,012	$15,650
Men—			
Number	43	27	16
Salaries	$47,252	$33,212	$14,040
Women—			
Number	11	6	5
Salaries	$4,410	$2,800	$1,610
Wage-earners, including pieceworkers, and total wages:			
Greatest number employed at any one time during the year	431	340	91
Least number employed at any one time during the year	370	296	74
Average number	378	302	76
Wages	$229,679	$191,623	$38,056
Men, 16 years and over—			
Average number	337	274	63
Wages	$216,838	$181,517	$35,321
Women, 16 years and over—			
Average number	38	28	10
Wages	$12,541	$10,106	$2,435
Children, under 16 years—			
Average number	3	...	3
Wages	$300	...	$300
Average number of wage-earners, including pieceworkers, employed during each month:			
Men, 16 years and over—			
January	348	286	62
February	345	280	65
March	350	284	66
April	344	277	67
May	354	289	65
June	342	280	62
July	290	249	41
August	291	250	41
September	334	264	70
October	346	276	70
November	356	283	73
December	344	271	73
Women, 16 years and over—			
January	37	28	9
February	38	28	10
March	38	28	10
April	38	28	10
May	41	31	10
June	37	28	9
July	34	29	5
August	35	30	5
September	39	27	12
October	41	28	13
November	41	28	13
December	37	24	13
Children under 16 years—			
January	3	...	3
February	3	...	3
March	3	...	3
April	3	...	3
May	3	...	3
June	3	...	3
July	...	...	...
August	...	...	...
September	5	...	5
October	5	...	5
November	3	...	3
December	5	...	5
Miscellaneous expenses:			
Total	$42,740	$27,845	$14,895
Rent of works	$15,564	$12,574	$2,990
Taxes, not including internal revenue	$455	$271	$184
Miscellaneous expenses—Continued.			
Rent of offices, insurance, interest, and all sundry expenses, not hitherto included	$23,321	$11,600	$11,721
Amount paid for contract work	$3,400	$3,400	...
Materials used:			
Total cost	$312,537	$264,138	$48,399
Principal materials—			
Total cost	$283,089	$248,838	$34,251
Purchased in raw state	...	...	...
Purchased in partially manufactured form	$283,089	$248,838	$34,251
Fuel	$982	$473	$509
Rent of power and heat	$3,010	$2,540	$470
Mill supplies	$775	$625	$150
All other materials	$24,681	$11,662	$13,019
Freight	...	...	...
Products:			
Total value	$799,078	$657,693	$141,385
Pens and pencils—			
Total value	$705,832	$577,857	$127,975
Pens—			
Total gross	7,933	6,658	1,273
Total value	$567,755	$458,255	$109,500
Gold—			
Gross	6,120	5,099	1,021
Value	$408,229	$344,848	$63,381
Fountain (complete)—			
Gross	1,745	1,507	238
Value	$156,586	$111,419	$45,167
Stylographic—			
Gross	66	52	14
Value	$2,940	$1,988	$952
Pencils—			
Total gross	3,806	3,317	489
Total value	$138,077	$119,602	$18,475
Gold—			
Gross	26	26	...
Value	$32,326	$32,326	...
Silver—			
Gross	795	569	226
Value	$68,022	$59,222	$8,800
Plated—			
Gross	2,985	2,722	263
Value	$37,729	$28,054	$9,675
All other products	$93,246	$79,836	$13,410
Comparison of products:			
Number of establishments reporting for both years	20	12	8
Value for census year	$761,553	$620,168	$141,385
Value for preceding business year	$719,000	$560,362	$158,638
Power:			
Number of establishments reporting	16	13	3
Total horsepower	121	66	55
Owned—			
Engines—			
Steam—			
Number	3	2	1
Horsepower	67	17	50
Rented—			
Electric, horsepower	28	23	5
Other kind, horsepower	26	26	...
Establishments classified by number of employees, not including proprietors and firm members:			
Total number of establishments	22	14	8
No employees	4	...	4
Under 5	...	...	...
5 to 20	9	7	2
21 to 50	6	5	1
51 to 100	3	2	1
101 to 250	...	...	...
251 to 500	...	...	...
501 to 1,000	...	...	...
Over 1,000	...	...	...

[1] Includes establishments distributed as follows: California, 1; Illinois, 2; Maryland, 1; Massachusetts, 1; Michigan, 1; Ohio, 1; Rhode Island, 1.

STEEL PENS.

The steel pen manufacture was successfully established in the United States by 1860, but the statistics of the industry were not separately reported until the census of 1870. Its growth since that time, though slow, has been satisfactory, until to-day the home manufacturer not only supplies three-fourths of the home trade, but exports a considerable quantity.

The statistics for the manufacture of steel pens, as returned at the censuses of 1870 to 1900, inclusive, with the percentages of increase for each decade, are presented in Table 17.

TABLE 17.—PENS, STEEL: COMPARATIVE SUMMARY, 1870 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.				PER CENT OF INCREASE.		
	1900	1890	1880	1870	1890 to 1900	1880 to 1890	1870 to 1880
Number of establishments	3	3	3	3	....	....	....
Capital	$357,460	$399,182	$182,500	$175,000	[1]10.5	118.7	4.3
Salaried officials, clerks, etc., number	13	[2]15	(3)	(3)	[1]13.3	....	....
Salaries	$21,416	[2]$20,143	(3)	(3)	6.3	....	....
Wage-earners, average number	473	496	280	257	[1]4.6	77.1	8.9
Total wages	$138,433	$132,032	$88,500	$60,000	4.8	49.2	47.5
Men, 16 years and over	65	141	34	47	[1]53.9	314.7	[1]27.7
Wages	$26,684	$59,907	(3)	(3)	[1]55.5	....	....
Women, 16 years and over	371	322	230	195	15.2	40.0	17.9
Wages	$101,622	$66,876	(3)	(3)	52.0	....	....
Children, under 16 years	37	33	16	15	12.1	106.3	6.7
Wages	$10,127	$5,249	(3)	(3)	92.9	....	....
Miscellaneous expenses	$37,405	$6,295	(4)	(4)	494.2	....	....
Cost of materials used	$52,466	$56,630	$38,950	$49,943	[1]7.4	45.4	[1]22.0
Value of products, including custom work and repairing	$294,340	$268,259	$164,000	$180,000	9.7	63.6	[1]8.9

[1] Decrease.
[2] Includes proprietors and firm members with their salaries; number only reported in 1900, but not included in this table. (See Table 23.)
[3] Not reported separately.
[4] Not reported.

It appears from Table 17 that the period of the industry's greatest growth was from 1880 to 1890. By a singular coincidence the number of establishments engaged in the industry has been the same at the several censuses. This does not necessarily mean that the establishments reporting in 1900 are individually the same establishments that reported in 1870, 1880, and 1890, although it is more than probable that one or more of the establishments reported in 1900 was actively engaged in the business in previous census years. During the whole period between 1870 and 1900, the capital invested in the industry increased $182,460, and the products $114,340. Between 1890 and 1900 the value of the products increased very slightly, and the amount of capital showed a decrease of 10.5 per cent. The large number of women employed in the manufacture as compared with the number of men is to be expected in an industry using machinery that requires but little skill and strength to operate.

Table 18 presents, by states, the number of establishments actively engaged in the manufacture of steel pens in 1890 and 1900, with the increases and decreases for the decade.

TABLE 18.—PENS, STEEL: NUMBER OF ESTABLISHMENTS, BY STATES, 1890 AND 1900.

STATES.	1900	1890	Increase.
United States	3	3	....
Connecticut	....	1	[1]1
New Jersey	1	1	....
Ohio	1	....	1
Pennsylvania	1	1	....

[1] Decrease.

During the decade 1 plant was established in Ohio, which in 1890 had none. Owing to the plan adopted by this census of classifying establishments in accordance with the predominating product, it is probable that the establishment engaged in this industry in Connecticut in 1890 was reported under some other classification in 1900. An examination of the returns for that state shows that steel pens were manufactured there during the census year, 1900, and the quantity and value of such product is included in Table 22.

In Table 19 is presented a comparative summary, for 1890 and 1900, of the capital in its several subdivisions, with the percentage that each item is of the total in the two census years, and percentages of increase for the decade.

TABLE 19.—PENS, STEEL: CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$357,460	100.0	$399,182	100.0	[1]10.5
Land	20,000	5.6	36,000	9.0	[1]44.4
Buildings	43,000	12.0	52,672	13.2	[1]18.4
Machinery, tools, and implements	82,000	22.9	87,443	23.0	[1]6.2
Cash and sundries	212,460	59.5	223,067	59.4	[1]4.8

[1] Decrease.

The table shows a decrease of 10.5 per cent in the total capital for the industry during the decade, and decreases in each item making up the total. The most marked decreases are shown in the items of land and buildings; machinery, tools, and implements, and cash on hand, bills receivable, etc., formed a greater proportion of the total capital in 1900 than in 1890, yet each of these items showed a decrease for the decade. This industry reported a considerable amount for machinery, tools, and implements, thus indicating that machinery is extensively used in the manufacture of the steel pen.

The cost of materials used in the manufacture of steel pens in 1900, and the cost of each item, with its proportion to the whole amount, are presented in Table 20.

TABLE 20.—PENS, STEEL: COST OF MATERIALS, 1900.

	Amount.	Per cent of total.
Total	$52,466	100.0
Principal materials[1]	50,237	95.8
Fuel	2,090	4.0
Rent of power and heat	139	0.2

[1] Includes items mill supplies and all other materials which are shown separately in Table 23.

Of the item "principal materials," $39,168 was for materials purchased in partially manufactured form, while $10,491 was for all other materials used in the manufacture. Steel and aluminum, and one or two other metals constituted all that was purchased in partially manufactured form.

Table 21 is a statement of the quantity and value of steel pens manufactured during the census year as reported by establishments engaged primarily in the manufacture of steel pens.

TABLE 21.—PENS, STEEL: QUANTITY AND VALUE OF PRODUCTS, 1900.

	Aggregate value.	PRODUCTS—PENS.				All other products, value.
		Total gross.	Total value.	Steel.		
				Gross.	Value.	
All establishments[1]	$294,340	1,075,780	$289,340	1,075,780	$289,340	$5,000

[1] Distributed as follows: New Jersey, 1; Ohio, 1; Pennsylvania, 1.

This table does not give statistics of the industry by states, separately, as the number of establishments in each is too small to permit such presentation without disclosing the operations of individual concerns. The establishments reporting for this industry for 1900 were then engaged exclusively in the manufacture of steel pens and did not report any subsidiary product of other pens or of pencils. The above table, however, does not show the total quantity and value of steel pens manufactured in this country during the census year, as some of the establishments, engaged primarily in manufacturing other articles, reported steel pens as a subsidiary product.

Table 22 shows the total quantity and value of steel pens produced during the census year as reported by establishments of any character.

TABLE 22.—PENS, STEEL: QUANTITY AND VALUE, 1900.

	Gross.	Value.
All establishments[1]	1,764,079	$411,872

[1] Distributed as follows: Connecticut, 1; New Jersey, 1; New York, 1; Ohio, 1; Pennsylvania, 1.

The totals shown in Table 22 do not agree with the totals elsewhere shown in this report or with those of the general report on this industry as presented in Manufactures, Parts I and II, for reasons previously mentioned.

HISTORICAL AND DESCRIPTIVE.

The real inventor of the steel pen is unknown. France, England, and the United States each have claimants for the honor, and it is difficult to decide to whom it belongs. Arnoux, a French mechanic, made metallic pens with side slits in 1750. Samuel Harrison, an Englishman, made a steel pen for Dr. Priestly in 1780. Peregrine Williamson, a native of New York, while engaged as a jeweler in Baltimore, made steel pens in that city in 1800. He met with signal success and produced a very good article.[1]

The first manufacture of steel pens by mechanical appliances was in England during the third decade of the Nineteenth century, and the names associated with it were John Mitchell, Joseph Gillott, and Josiah Mason, each doing something toward perfecting the processes of manufacture by mechanical means. At the period when these men commenced operations the pens in use were very crude specimens, made from a piece of steel formed into a tube, and filed into the shape of a pen, by hand, the joint of the two edges forming the slit. By degrees a press was contrived to do the cutting, bending, and marking; and machinery was devised for cleaning and polishing. Experiments were made with the object of securing the best possible quality of steel, and by the year 1860, when the manufacture of steel pens was first begun in this country, the article had been brought to a considerable degree of perfection.

The pens in use half a century ago were mostly fine pointed, and while they gave satisfaction in certain lines of penmanship, some objections were made to them for business and rapid writing. Since that time there has been a gradual improvement in the material used and the process of manufacture, and the fine-pointed pens have given away to some extent to the stub and other blunt-pointed pens.

The first steel pens made in the United States by mechanical appliances were made at New York in 1858 by Harrison & Bradford. Two years later a factory was started at Camden, New Jersey, by Richard Esterbrook, sr., Richard Esterbrook, jr., and James Bromgrove. This firm met with success, and in 1866 the establishment was incorporated as the Esterbrook Steel Pen Company. Their enterprise was successful, and the growth of the plant has continued up to the present time.[2]

The many prefixes, such as Peruvian, Damascus, Amalgam, and Silver, used to describe the pen, are but fancy names and do not indicate the quality of the article. The material used for all kinds is cast steel of the best quality, imported from England or Sweden.

[1] Scientific American, Nov. 28, 1878.

[2] One Hundred Years of American Commerce, Vol. II, page 660.

The best variety is that made from Swedish iron, which has in its granular structure a peculiar density and compactness. Steel for the manufacture of the pen has not yet been successfully produced in the United States.

The steel used in the industry is received in sheets varying in length, width, and thickness. These sheets are cut by the manufacturer into strips of convenient width, and are packed in an oblong iron box, which is placed with the open top downward in another box of the same material, the interstices being then filled up with a composition in order to exclude the air. The boxes are placed in a furnace, gradually heated until they are dull red in appearance, and then gradually cooled. In this process the strips become covered with bits of small scale. To remove this roughness they are immersed in a bath of diluted sulphuric acid, which loosens the scales, and they are then placed in wooden barrels containing water and broken pebbles. These barrels are revolved until the whole of the scaly substance is removed and the strips are of a silver-gray appearance. The strips are then taken to the rolling mill, where they are passed between successive rolls until reduced to the required gauge, the more common thickness being the one-hundred and sixtieth part of an inch. This operation requires considerable care and skill, as the variation of one-thousandth part of an inch in the thickness of the strip would seriously affect the flexibility of the pens. The strips are now three times their original length and have a bright surface.

In these preliminary processes the labor is performed by men and boys, but the processes of forming and shaping the pen, that begin at this point, are carried on by women and girls, who are more adapted to the work. The cutting of the blanks is accomplished by a die and a punch. This die is set in a bolster and is perforated by a hole the exact shape of the blank; and a punch, also of the exact shape of the blank, is attached to the bottom of the screw bolt of a press. The operator with her left hand introduces one of the strips of steel at the back of the press and pulls the handle toward her with the right hand. This causes the screw to descend, driving the punch into the bed, thus perforating the strip of steel with a scissor-like cut, and making a blank which falls through the opening in the die into a drawer below. The operator then pulls the strip of steel toward her until it is stopped by a little projection called a guide, and the operation just described is repeated, and again repeated, until the whole of one side of the strip is perforated, when the strip is reversed and the other side treated in a similar way. In the operation of cutting, a small V-shaped indentation is formed in the blanks upon the upper edge of that part inserted in the holder, which may be found upon a careful examination, and which plays an important part in the succeeding processes, as it enables the operator to distinguish between the smooth and rough sides of the blank.

The next process, called marking, is done by a stamp. The precise mark required is cut upon a piece of steel, which is placed in the hammer of the stamp. The stamp is operated by foot power. The operator takes a handful of blanks with her left hand, and by a dexterous motion makes a little train of them between the thumb and finger, presenting the first in the most ready position to be passed to the other hand. By the right hand the blank is placed, with the point toward the worker, in a guide upon the bed of the stamp, where the hammer falls upon it and makes the impression of the name cut upon the punch. So skillful do operators become in this process that they can stamp 200 to 250 gross of pens a day. Should the impression to be made be unusually large, the marking process is deferred until later in the course of construction.

The next process in the manufacture is "piercing," which produces the elasticity desired and causes the ink to attach itself to the pen. The tools used in this operation are very delicate and must be made with great precision. A piercing punch and bed are fixed in a screw press, and an ingenious arrangement of guides is fastened thereto. The operator then places the blank in its proper position and so manipulates the machinery as to cause the screw to descend, driving the punch into the bed. In order to soften the blanks, so that they can be properly shaped, they are put through a process called annealing. In this process the blanks are freed from the dust and grease that has become attached to them, and are then carefully placed in round iron pots, which are again inclosed in larger ones, covered over with charcoal dust to prevent the entrance of gases and put into the furnace, where they are heated to a dull red, and then gradually cooled.

After this process is finished the blanks are soft and pliable and readily assume the various shapes into which they are made by the next process, called "raising." In this operation a punch and die are again brought into use. The punch is fitted into a contrivance fixed in the bottom of the screw of the press; the die, or bed, is placed in a bolster, a cylindrical piece of steel attached to the bottom of the press, with a groove cut for the reception of the die. Four pieces of steel, called guides, are fixed to the bolster in such a position that the operator is enabled to slide the blank into the bed, where it is held by the guides until the punch descends, forcing the blank into the bed, and giving the pen its shape. The blanks are then placed in thin layers in round pans with lids and go through the process called "hardening." In this operation the pans mentioned are placed in the furnace for a period varying from twenty to thirty minutes, at the end of which time they have come to a bright red heat. The pans are then taken from the furnace and their contents thrown into a large bucket immersed in a tank of oil. This bucket is perforated, and when lifted from the tank the oil drains off. The pens are then placed in a perforated cylinder, which is set in motion and drains off the remainder of the oil. At this stage of the manufacture the pens are very greasy and as brittle as glass. To remove the grease adhering to them they are again placed in perforated buckets and immersed in a tank of boiling soda water.

The pens are then put into an iron cylinder, which is kept revolving over a charcoal fire until they are softened or tempered down to the degree required. This process is regulated according to the color shown by the pens, which indicates the varying temperature of the metal. After this operation the pens are black and rough at the point. To remedy these defects, the pens are subjected to the process known as "scouring," which consists in dipping the pens in a bath of diluted sulphuric acid, which removes all extraneous substances acquired in the hardening and tempering processes. Great care is exercised in this operation, as the acid is very likely to injure the steel. The pens are then placed in iron barrels with a quantity of water and a material composed of annealing pots broken and ground fine enough to pass through a fine riddle. The barrels are then set in motion, which is continued for a period varying from five to eight hours. At the end of this time they are placed in barrels with dry pot for about the same period, after which they are put into other barrels, together with a quantity of dry sawdust. They are then ground between the center pierce and the point. This is done by girls with the aid of a "bob," or "glazer," a circular piece of alder wood about 10½ inches in diameter and one-half an inch in width. Around this a piece of leather is stretched and dressed with emery. A spindle is driven through the center and the two ends placed in sockets. The mechanism thus arranged is set in motion by means of a leather band, and the operator, holding a pen firmly, grinds off, with a light touch, a portion of the surface.

The last and most important mechanical operation performed upon the pen is slitting. The tools used for this purpose are two oblong pieces of steel known as cutters, which are about 1½ inches long, three-eighths of an inch thick, and 1¼ inches wide. The edges of these cutters are equal in delicacy to the cutting edge of a razor. One of the cutters is fixed in a press with a pair of guides screwed on either side, and the other cutter is held by a bolster, having attached to it a small tool called a rest, or table. The operator places the pen upon the table, pushes the point up toward the guide, and, by operating the machine, makes the upper cutter descend and meet the lower one, thus slitting the pen.

At this stage in the process of manufacture the outer edge of each point is smooth, but the inside edges are sharp and rough. To remedy these defects the pens are again put in the iron barrels with pounded pot, and kept revolving for five or six hours, when they are removed and polished in sawdust. The pens are then colored by being placed in a copper or iron cylinder which revolves over a coke fire until the requisite tint is obtained. If the pens are to be lacquered they are placed in a solution of shellac dissolved in alcohol. This solution is afterwards drained off and the pens are placed in iron cylinders that are kept revolving until the pens are dry. The pens are then scattered upon iron trays and heated in an oven until the lacquer is diffused equally over the whole surface of the pens. The lacquer gives the pens a glossy appearance and prevents rust; and when the pens have cooled they are complete as far as manufacturing processes are concerned. Before they are offered to the public, however, they are given a very careful inspection, to see that no inferior ones are put on the market.

Table 23 presents a detailed statement of the statistics for the manufacture of steel pens, by states, 1900.

TABLE 23.—STATISTICS OF STEEL PENS, 1900.

	United States.[1]
Number of establishments	3
Character of organization:	
Individual	....
Firm, and limited partnership	1
Incorporated companies	2
Capital:	
Total	$357,460
Land	$20,000
Buildings	$43,000
Machinery, tools, and implements	$82,000
Cash and sundries	$212,460
Proprietors and firm members	3
Salaried officials, clerks, etc.:	
Total number	13
Total salaries	$21,416
Officers of corporations—	
Number	3
Salaries	$10,000
General superintendents, managers, clerks, etc.—	
Total number	10
Total salaries	$11,416
Men—	
Number	10
Salaries	$11,416
Women—	
Number	....
Salaries	....
Wage-earners, including pieceworkers, and total wages:	
Greatest number employed at any one time during the year	473
Least number employed at any one time during the year	471
Average number	473
Wages	$138,433
Men, 16 years and over—	
Average number	65
Wages	$26,684
Women, 16 years and over—	
Average number	371
Wages	$101,622
Children, under 16 years—	
Average number	37
Wages	$10,127
Average number of wage-earners, including pieceworkers, employed during each month:	
Men, 16 years and over—	
January	65
February	65
March	65
April	65
May	65
June	65
July	65
August	65
September	65
October	65
November	66
December	64
Women, 16 years and over—	
January	371
February	371
March	371
April	371
May	371
June	371
July	371
August	371
September	371
October	371
November	371
December	371

[1] Includes establishments distributed as follows: New Jersey, 1; Ohio, 1; Pennsylvania, 1.

TABLE 23.—STATISTICS OF STEEL PENS, 1900—Continued.

	United States.[1]
Average number of wage-earners, including pieceworkers, employed during each month—Continued.	
Children, under 16 years—	
January	37
February	37
March	37
April	37
May	37
June	37
July	36
August	36
September	36
October	36
November	42
December	36
Miscellaneous expenses:	
Total	$37,405
Rent of works	$945
Taxes, not including internal revenue	$1,578
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$34,882
Amount paid for contract work	....
Materials used:	
Total cost	$52,466
Principal materials—	
Total cost	$39,168
Purchased in raw state	....
Purchased in partially manufactured form	$39,168
Fuel	$2,090
Rent of power and heat	$139
Mill supplies	$578
All other materials	$10,491
Freight	....

	United States.[1]
Products:	
Total value	$294,340
Pens, steel—	
Gross	1,075,780
Value	$289,340
All other products	$5,000
Comparison of products:	
Number of establishments reporting for both years	3
Value for census year	$294,340
Value for preceding business year	$267,127
Power:	
Number of establishments reporting	3
Total horsepower	138
Owned—	
Engines—	
Steam—	
Number	1
Horsepower	125
Gas or gasoline—	
Number	1
Horsepower	10
Rented—	
Total horsepower	3
Establishments classified by number of persons employed, not including proprietors and firm members:	
Total number of establishments	3
No employees	....
Under 5	....
5 to 20	1
21 to 50	....
51 to 100	1
101 to 250	....
251 to 500	1
501 to 1,000	....
Over 1,000	....

[1] Includes establishments distributed as follows: New Jersey, 1; Ohio, 1; Pennsylvania, 1.

LEAD PENCILS.

The lead pencil industry was first reported separately at the census of 1860, as a subdivision of the general class of stationery. At the census of 1850 it was reported under the general classification of pens and pencils, when it was shown that there were four establishments engaged in the manufacture of pens and pencils, with a capital of $43,000 invested, employing 58 people at a cost of $14,028, and producing a product of $85,300. It is probable that the value of the products of the lead pencil industry was very small at that time, as it was only $20,400 in 1860. The growth of the lead pencil industry since 1860 has been constant, and in some periods remarkably great, as is shown by the statistics presented in the following tables.

Table 24 is a comparative summary of the statistics of the manufacture of lead pencils at the censuses of 1860 to 1900, inclusive, with the percentages of increase for each decade.

TABLE 24.—PENCILS, LEAD: COMPARATIVE SUMMARY, 1860 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.					PER CENT OF INCREASE.			
	1900	1890	1880	1870	1860	1890 to 1900	1880 to 1890	1870 to 1880	1860 to 1870
Number of establishments	7	5	4	8	6	40.0	25.0	[1]50.0	33.3
Capital	$2,227,406	$3,100,836	$341,597	$261,150	$6,600	[1]28.2	807.7	30.8	3,856.8
Salaried officials, clerks, etc., number	81	[2]64	(3)	(3)	(3)	26.6	......	......	......
Salaries	$111,890	[2]$130,300	(3)	(3)	(3)	[1]14.1	......	......	......
Wage-earners, average number	2,162	1,388	399	160	24	55.8	247.9	149.4	566.7
Total wages	$683,281	$450,450	$102,233	$51,150	$7,920	51.7	340.6	99.9	545.8
Men, 16 years and over	758	483	116	65	18	56.9	316.4	78.5	261.1
Wages	$352,563	$264,481	(3)	(3)	(3)	33.3	......	......	......
Women, 16 years and over	1,087	632	144	95	6	72.0	338.9	51.6	1,483.3
Wages	$263,118	$144,409	(3)	(3)	(3)	82.2	......	......	......
Children, under 16 years	317	273	139	(3)	(3)	16.1	96.4	......	......
Wages	$67,600	$41,560	(3)	(3)	(3)	62.7	......	......	......
Miscellaneous expenses	$278,176	$154,528	(4)	(4)	(4)	80.0	......	......	......
Cost of materials used	$1,030,917	$796,378	$97,344	$57,510	$3,335	29.5	718.1	69.3	1,624.4
Value of products, including custom work and repairing	$2,222,276	$1,687,560	$279,427	$180,000	$20,400	31.7	503.9	55.2	782.4

[1] Decrease.
[2] Includes proprietors and firm members with their salaries; number only reported in 1900, but not included in this table. (See Table 30.)
[3] Not reported separately.
[4] Not reported.

In 1860 the 6 establishments engaged in this industry reported a capital of $6,600 and products valued at $20,400. From 1860 to 1870 the growth of the industry was nothing less than remarkable. Although the number of establishments was increased by 2 only, the increase in capital was $254,550, and in products, $159,600. This rapid growth was probably due to the establishment in New York of branches of the leading factories in Germany, where the process of manufacture had attained a high degree of perfection.

During the next decade the number of establishments decreased one-half, while the capital invested and the value of the products showed gratifying gains, indicating that the larger plants remaining were successful in the manufacture of the article. Although the number of establishments increased but one from 1880 to 1890, the increase in the amount of capital invested exceeded that for any decade, and the increase in the value of the products was correspondingly large. In comparing the capital as reported at different censuses, however, it should be borne in mind that until the census of 1890, no definite attempt was made to include live capital in the returns. During the past decade there has been a marked decrease in the amount of capital invested, but an increase in number of establishments and in value of products. Women wage-earners predominate in this industry, and for each decade except 1870 to 1880 their number increased in greater proportion than that of the men wage-earners.

The number of establishments actively engaged in the manufacture of lead pencils in 1890 and in 1900, with the increase or decrease, by states, is presented in Table 25.

TABLE 25.—PENCILS, LEAD: NUMBER OF ESTABLISHMENTS, 1890 AND 1900.

STATES.	1900	1890	Increase.
United States	7	5	2
Illinois	1	....	1
Massachusetts	1	....	1
New Jersey	2	1	1
New York	3	3	....
Rhode Island	....	1	[1]1

[1] Decrease.

It appears from Table 25 that the number of establishments increased 2, or 40 per cent, during the decade. Illinois, Massachusetts, and New Jersey each show a gain of 1 establishment, while Rhode Island reported 1 establishment in 1890 and none in 1900. The center of the industry in 1900 was in New York and New Jersey, and but 2 establishments are reported outside of those states.

Table 26 is a comparative summary of the capital for 1890 and 1900, in its several subdivisions, with percentages of increase for the decade and the per cent each item is of the total.

TABLE 26.—PENCILS, LEAD: CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$2,227,406	100.0	$3,100,836	100.0	[1]28.2
Land	151,800	6.8	270,000	8.7	[1]43.8
Buildings	253,500	11.4	373,000	12.0	[1]32.0
Machinery, tools, and implements	244,725	11.0	293,000	9.5	[1]16.5
Cash and sundries	1,577,381	70.8	2,164,836	69.8	[1]27.1

[1] Decrease.

The total amount of capital invested showed a large decrease for the decade. The different items making up the total also showed decreases of varying proportions. The most marked decrease in the items is shown in the value of lands owned by the establishments. The item of machinery represented a greater percentage of the total capital in 1900 than in 1890, and showed the smallest percentage of decrease of any item reported in Table 26. The items of buildings owned and cash on hand, bills receivable, etc., represented very nearly the same percentage of the total for the year 1890 as in 1900.

The cost of materials used in the manufacture of lead pencils and the proportion of each item to the total for 1900 is shown in Table 27.

TABLE 27.—PENCILS, LEAD: COST OF MATERIALS, 1900.

	Amount.	Per cent of total.
Total	$1,030,917	100.0
Principal materials	1,002,710	97.3
Purchased in raw state	79,233	7.7
Purchased in partially manufactured form[1]	923,477	89.6
Fuel	13,757	1.3
Rent of power and heat	....	....
Freight	14,450	1.4

[1] Includes mill supplies and all other materials, which are shown separately in Table 30.

The largest item shown in Table 27 is that reported for principal materials, which is divided into those purchased in raw state, that is, materials upon which no manufacturing force has been expended, and those purchased in a partially manufactured form. Of the amount shown for materials purchased in a raw state, the cost of cedar logs made up the greatest proportion. In the amount reported for materials purchased in a partially manufactured form are included cost of "mill supplies" and "all other materials," the former being $32,566 and the latter $255,587. Some establishments were unable to separate the amount paid for freight from the cost of materials, and reported the two together. For this reason the $14,450 does not represent the entire cost of freight, and should be considered only in connection with the cost of material. Nothing was reported under the item "rent of power and heat."

A detailed statement, by states, of the number of gross and the value of the different varieties of lead pencils, and the subsidiary products, of plants engaged primarily in this industry, is presented in Table 28.

TABLE 28.—PENCILS, LEAD: QUANTITY AND VALUE OF PRODUCTS, 1900.

STATES.	Aggregate value.	PRODUCTS.									
		Pencil cases.									
		Total gross.	Total value.	Wood.		Silver.		Plate.		Other material.	
				Gross.	Value.	Gross.	Value.	Gross.	Value.	Gross	Value.
Total	$2,222,276	1,383,822	$1,705,065	1,381,329	$1,641,975	1,486	$43,496	482	$18,794	525	$800
New York	1,581,351	911,138	1,213,785	909,170	1,151,495	1,486	43,496	482	18,794		
All other states[1]	640,925	472,684	491,280	472,159	490,480					525	800

STATES.	PRODUCTS—continued.										ALL OTHER PRODUCTS.
	Pens.										
	Total gross.	Total value.	Fountain (complete).		Gold.		Steel.		Stylographic.		
			Gross.	Value.	Gross.	Value.	Gross.	Value.	Gross.	Value.	Value.
Total	432,759	$115,101	447	$39,125	31	$2,202	432,230	$71,318	51	$2,456	$402,110
New York	432,759	115,101	447	39,125	31	2,202	432,230	71,318	51	2,456	252,465
All other states[1]											149,645

[1] Includes establishments distributed as follows: Illinois, 1; Massachusetts, 1; New Jersey, 2.

It appears from Table 28 that New York led in the output of lead pencils in the census year, producing almost twice as many gross as all other states combined. To show to a better advantage the different varieties of lead pencils manufactured during the census year, it was decided to subdivide the product according to the case in which the lead was inclosed. In doing this 5 divisions (wood, gold, silver, plated, and other varieties) were made. Practically, all lead pencils manufactured are inclosed in wooden cases, as will be seen from Table 28. A considerable overlapping of the pen and pencil industries is shown in this table. Table 28 gives only an incomplete enumeration of the quantity of lead pencils produced during the census year, for the reason that many lead pencils were reported as a subsidiary product of the industries engaged primarily in the manufacture of pens and other articles. The total quantity and value of lead pencils produced by establishments of any character is shown in Table 29.

Of the total quantity of lead pencils manufactured during the census year, those incased in wood were 1,653,973 gross, valued at $2,053,484, and all other varieties were but 6,881 gross, valued at $210,677. There were produced in all during the census year 1,660,854 gross, or 239,162,976 lead pencils—more than three for each man, woman, and child then living in the United States. The totals shown in Table 29 do not agree with the totals elsewhere given in this report, or with those in the general report on this industry as presented in Manufactures, Parts I and II.

TABLE 29.—PENCILS, LEAD: QUANTITY AND VALUE OF PRODUCTS, 1900.

STATES.	Total value.	CASES.									
		Wood.		Gold.		Silver.		Plated.		Other materials.	
		Gross.	Value.	Gross.	Value.	Gross.	Value.	Gross.	Value.	Gross.	Value.
United States	$2,264,151	1,653,973	$2,053,484	31	$32,526	2,281	$111,518	3,988	$64,523	581	$2,100
New York	1,333,387	909,170	1,151,495	26	32,326	2,055	102,718	3,204	46,848		
All other states[1]	930,764	744,803	901,989	5	200	226	8,800	784	17,675	581	2,100

[1] Includes establishments distributed as follows: Illinois, 1; Massachusetts, 1; New Jersey, 3, including 1 establishment which reported pencils as a by-product; Ohio, 1; Rhode Island, 2.

As the importations of pencils, "paper or wood filled with lead or other material, and pencils of lead," were but 85,119 gross, valued at $228,144, for the fiscal year ending June 30, 1900,[1] and as this was greatly in excess of the reports for the previous years, it will be seen that the American manufacturer practically supplies the home trade. It is to be regretted that no statistics are available as to the amount of lead pencils exported.

[1] Annual Report, United States Treasury Department, on Commerce and Navigation of the United States for 1900.

HISTORICAL AND DESCRIPTIVE.

The manufacture of lead pencils is a comparatively modern industry in the United States, dating from 1861, when the Fabers, pencil manufacturers in Germany, established a branch factory in New York. The use, however, of metallic lead for marking is very old. Pliny refers to lead as used for marking lines on papyrus; La Moine cites a document of 1387 ruled with it; Cortez found the Aztecs, in 1520, using crayons made of it.[1] The manufacture of lead into pencils, however, was not very general until after the discovery of the famous Barrowdale graphite mine in Cumberland, England, in 1564. The material from this mine was so highly desired and was so closely maintained as a monopoly that, in pursuance of an act of Parliament, the mouth of the mine was guarded by an armed force. To keep up the monopoly, the mine was worked only six weeks in a year, and its mouth was closed by flooding with water after the workmen left. The process of preparing the graphite mined here was the simple one of dividing it into slips. The most general method used to accomplish this purpose was that of compressing pulverized graphite with hydraulic presses into solid blocks, and then sawing it into bars. About 1850 the Barrowdale mines became exhausted, and since that time the lead for pencils has been prepared by a process invented by Conté, of Paris, at the close of the last century, or some adaptation of that process. Briefly, his method was to powder the graphite ore and mix it with a powdered clay. These materials, mixed in varying proportions, constitute the marking portion of the modern lead pencil. The grades of hardness and softness are secured by using more graphite and less clay to produce the softer grades, and more clay and less graphite for the harder grades. While Conté, a Frenchman, originated this process, it was left to the Germans to perfect it, which they accomplished so completely during the first part of the past century, that Germany can well be called the home of the modern graphite pencil.

Graphite or plumbago, the material now universally used for true surface writing, has been known for more than five hundred years. This material resembles lead no more than chalk does. Graphite is a nearly pure form of carbon and has many peculiar qualities. It is only one-fourth as heavy as lead; can not be fused; is one of the softest minerals dug from the earth; and if subjected to a very hot fire it will not melt nor be consumed, but it will gradually waste. This substance is found in its purest form at Ticonderoga, N. Y. The variety mined at this place contains 99.9 per cent carbon, while the best quality taken from the Ceylon mines is 99 per cent, and that found in the Barrowdale mine in England had but 87 per cent carbon. The inferior grades of graphite contain from 50 to 60 per cent of foreign matter. For the manufacture of pencils only the finer grades of graphite are used. In addition to the places mentioned, graphite is mined in Siberia, where an excellent quality is found; at Harnon, Sweden; at Passau, Bavaria; at Schwarzback, Germany; in the province of Nelson, New Zealand; and in Mexico. In the United States, impure grades are found at Raleigh and Asheville, N. C., and at Cumberland Hill and Cranston, R. I.[2] The clay used to mix with the graphite is a peculiar kind of pipe clay imported from Germany and Holland. The wood chiefly used for the holders is soft, straight-grained, red cedar, found in Florida, Georgia, Alabama, Mississippi, and Texas, and is used not only by American manufacturers but by all the pencil makers of the world.

Prior to the coming of the Fabers to the United States lead pencils were manufactured here, but to a very limited extent. The first step in starting the industry was made by William Monroe, of Concord, Mass., in 1812. At the commencement of the War of 1812 he was engaged as a cabinetmaker, but the nonintercourse, nonimportation, and embargo acts had so depressed business generally that he turned his attention to the making of pencils. The price for them was exceedingly high, owing to their scarcity, and success in making them meant large rewards. He procured a few lumps of black lead, pulverized them with a hammer, and separated the finer portions by suspension in a tumbler full of water. From the material thus prepared he made his first experimental mixture in a spoon, and out of it attempted to make a pencil. The result was so discouraging that he returned to his old occupation of making cabinets. He managed, however, to devote some time each day to his experiments, and after four months' work in this way he secured a better lead, which he incased in cedar-wood holders, thus producing the first American-made pencils. On the 2d day of July, 1812, he proceeded to Boston with a modest sample of about 30 pencils, which found a ready sale. The purchaser encouraged him to continue the manufacture. On his next trip to Boston he took with him 3 gross. The dealer then made a contract with him for all the pencils he could make within a certain time, at a certain price. All the mixing of the lead and putting it into pencils was done entirely by his own hands in a small room of his dwelling, thoroughly protected from curious eyes, no one but his wife being permitted to know anything of his methods. He continued his pencil manufacture for about eighteen months, when he was compelled to abandon it, owing to the difficulty of obtaining raw materials. At the close of the war he resumed the manufacture, but the imported article was found superior, and he made but little progress in the

[1] Knight's Mechanical Dictionary.

[2] The Universal Cyclopædia, vol. 5, page 250.

business. Until 1819 he carried on the manufacture as a subsidiary occupation with his cabinetmaking, but in that year, having met with better results, he devoted himself exclusively to the manufacture of lead pencils. After ten years of persistence and study directed toward the improvement of the quality of the pencils, his make grew into favor and supplied a part of the home demand.

It is said on reliable authority that Joseph Dixon attempted the manufacture of lead pencils at Salem, Mass., as early as 1830. Mr. Dixon's first consignment to a Boston firm was not enthusiastically received, but he was told that if he would place a foreign label on the pencils they would meet with ready sale. Rather than do this he had the pencils returned, and never again manufactured any. He gave his attention after that time to the manufacture of crucibles, and formed what is known as the Joseph Dixon Crucible Company. This firm began the manufacture of lead pencils in 1872, and met with exceptional success.

Prior to the manufacture of pencils by the Dixon company, 3 establishments of foreign origin were in operation in the United States. First, came representatives of the Faber plant in Germany, who began the manufacture of lead pencils in 1861. Next, in 1865, the Eagle Pencil Company was established in a similar way, and in the same year and in the same manner the American Lead Pencil Company was established. The above-named companies are now managed and owned by American citizens and have no connection with foreign plants.

After the industry had been established in the United States in the manner described, its progress and growth were very rapid. This was due mainly to the following causes: The existence in the United States of very rich graphite mines; the extraordinary facilities for securing this substance from mines elsewhere; the presence here of the greatest cedar forests of the world; and the introduction of labor-saving machines.

The process employed to-day in the manufacture of the American lead pencil is the Conté system, but the article produced by it has been so infinitely improved in workmanship and detail beyond the original product, that it would seem as if the pencil had almost reached its limit of perfection. As now followed, the process is a difficult, painstaking, and most elaborate one, and there is needed in the manufacture both a practical and theoretical knowledge of its chemistry and mechanics.

The raw material (graphite) used in many American-made lead pencils is mined at Ticonderoga, N. Y. This mine closely resembles an anthracite coal mine both in external and internal appearance. In it there are two formations of the graphite—a large vein of the crystallized variety, and the compact or granulated form of deposit, the latter being the only one used in pencils. This latter kind is found in small veins, or in what miners call "pockets." The graphite is taken, in the lump, direct from the mouth of the mine to the reducing mill, where it is pulverized by stamps under water, the particles floating off with the water through a series of tanks, in which they sink to the bottom, forming a sediment. The water being drained off and the sediment dried, the graphite is finally sent to the factory in barrels in the form of an impalpable powder—lusterless and of a dingy color. At this stage the graphite is finer and softer than flour, and is as evasive to the touch as quicksilver.

The particles are then separated further, according to fineness, by a process known as "floating." To effect this separation the graphite is mixed with sufficient water to run very freely, and then turned into a hopper from which the water runs slowly through a series of tubs so arranged that the top portion of each tub drains off into the tub placed next to it, but on a lower plane than the first. In this manner the coarsest and heaviest particles settle to the bottom of the first tub, the next coarsest and heaviest in the next, and so on, the movement of the water being made very gentle. On reaching the last tub, the powder, being twice as heavy as water, sinks in it, if undisturbed, and so far settles that the water discharges at the top nearly clear. When the flow is stopped and the powder has settled, the clear water is withdrawn by removing successively, beginning with the upper one, a number of plugs inserted in holes in the side of each tub, care being taken not to agitate the contents so as to disturb the deposited dust. The deposits are then removed through gates at the bottom of each tub. The deposit in the last tub is used for the finest grade of pencils, and those in the other tubs for the coarser grades.

The graphite is now ready for the clay, which is of a bluish-gray color, of great strength, and of a fatty appearance when wet. This clay is subjected to the floating process in the same way as the graphite, only the finest being used for mixing with the graphite in proportions varying according to the degree of hardness required. The more clay used, the harder the pencil; but for the medium grade the proportions are about seven parts of clay to ten of graphite, by weight. The graphite and clay are then mixed together with water to the consistency of thick cream, and the mixture is fed to the grinding mills, which consist of two flat stones about two feet in diameter, placed horizontally, only the upper one being in motion. The mass is ground between these stones many times in order to secure the most perfect strength, uniformity, and freedom from grit in the leads. The mass, when ground, is inclosed in stout canvas bags, and the clear water forced out of it by hydraulic pressure until it becomes a thick dough, when it is sent to a forming press. This is a small, vertical, iron cylinder, having a solid plunger or piston, driven by a screw. A plate is inserted in the bottom having an opening of the shape and size of the lead desired, and through this hole the lead is forced something as a stream of water is forced from a syringe and coils itself round and round, like a coil of wire on a board set beneath the press. The coil is taken up, straightened, and broken off into lengths sufficient for 3 leads, which are then laid in order on a board, pressed flat by having a cover put over them, placed in a crucible, and baked in a kiln.

The material is now ready for the wooden cases, for which, in the cheaper pencils, pine is used, and in the better grades, cedar. At the sawmills the wood is cut into blocks about 7 inches long, and these are sawed into strips about 3½ inches wide and three-sixteenths of an inch thick. Each of these strips is sufficient to make the halves of 6 pencils. As the pencils are made six at a time, imperfect strips are put together so as to make a full strip out of the parts. These are packed closely in boxes and shipped to the factory. When they reach the factory they are passed in a continuous line under a cutter, which smooths their faces and cuts 6 little grooves—round or square—for the leads at the same stroke. The putting in of the leads is done by three operators. The first places the lead in the grooves and passes it to a second, who receives another strip with the grooves and surface coated with glue from the third operator, and puts them together. The united pairs are laid in rows, pressed together by a screw, and left to dry. The rough ends of the strips and the projecting leads are then ground smooth against a wheel covered with sandpaper. Next, the slips are fed one by one under a revolving cutter, which separates each into 6 rough pencil forms, and rounds these on one side by cutting away the superfluous wood. As they come from under the cutter they are turned over and passed under a second one, which rounds them on the other side, so that they fall in a continuous stream of finished pencils.

The planing machine in this process uses revolving knives, which make a succession of little gouges in the wood. These gouges, which would otherwise leave the surface very irregular, leave it smooth by following one another so closely that they become one long cut. So perfect is the operation of these revolving cutters, which make 9,000 strokes upon the wood a minute, that they leave the surface not only "true," but so smooth that the finest sandpaper would scratch it. The pencils are then counted, a gross at a time, by an operator, who simply arranges them by the handful in grooves, each large enough to contain 1 pencil. If the pencils are to be colored, they are immersed in dye and then sent to the varnishing machines. Here they are fed into a little hopper, from which they settle through sidewise and are seized between two wheels, which thrust them endwise, one at a time, through a hole in a tube wherein they are varnished. Each pencil, pushed on by its follower in the single-file movement, emerges from the tube and drops on a horizontal belt. It then moves slowly with the belt some 30 feet, drying as it goes, when the belt, reaching a pulley, releases the pencil and it drops into a receptacle. Pencils are varnished in this machine at the rate of 100 a minute. The other operations are of minor consequence, consisting in shaving a little from the end, sharpening certain styles on a wheel, stamping, and packing. Except for the lead makers and a few attendants, the labor is done by women, the machines being automatic, so that little strength and skill is necessary. The work is singularly cleanly and in no respect unhealthy, and the factory is peculiar in being permeated by the aromatic odor of the red cedar.

Table 30 presents in detail the statistics for the manufacture of lead pencils, by states, 1900.

Table 30.—PENCILS, LEAD: BY STATES, 1900.

	United States.	New York.	All other states.[1]
Number of establishments	7	3	4
Character of organization:			
Individual	4	1	3
Firm and limited partnership			
Incorporated company	3	2	1
Capital:			
Total	$2,227,406	$1,493,381	$734,025
Land	$151,800	$131,500	$20,300
Buildings	$253,500	$119,000	$134,500
Machinery, tools, and implements	$244,725	$126,000	$118,725
Cash and sundries	$1,577,381	$1,116,881	$460,600
Proprietors and firm members	4	1	3
Salaried officials, clerks, etc.:			
Total number	81	46	35
Total salaries	$111,890	$69,602	$42,288
Officers of corporations—			
Number	8	5	3
Salaries	$34,600	$25,000	$9,600
General superintendents, managers, clerks, etc.—			
Total number	73	41	32
Total salaries	$77,290	$44,602	$32,688
Men—			
Number	58	32	26
Salaries	$68,860	$39,960	$28,900
Women—			
Number	15	9	6
Salaries	$8,430	$4,642	$3,788
Wage-earners, including pieceworkers, and total wages:			
Greatest number employed at any one time during the year	2,261	1,472	789
Least number employed at any one time during the year	2,029	1,330	699
Average number	2,162	1,415	747
Wages	$683,281	$492,546	$190,735
Men, 16 years and over—			
Average number	758	523	235
Wages	$352,563	$291,032	$61,531
Women, 16 years and over—			
Average number	1,087	758	329
Wages	$263,118	$179,798	$83,320
Children, under 16 years—			
Average number	317	134	183
Wages	$67,600	$21,716	$45,884
Average number of wage-earners, including pieceworkers, employed during each month:			
Men, 16 years and over—			
January	752	519	233
February	769	528	241
March	768	533	235
April	753	535	218
May	777	536	241
June	721	493	228
July	756	522	234
August	770	521	249
September	762	527	235
October	767	524	243
November	756	518	238
December	745	516	229
Women, 16 years and over—			
January	1,086	738	348
February	1,093	755	338
March	1,097	766	331
April	1,114	788	326
May	1,099	790	309
June	1,053	744	309
July	1,084	756	328
August	1,087	760	327
September	1,087	758	329
October	1,086	751	335
November	1,079	746	333
December	1,079	745	334
Children, under 16 years—			
January	304	126	178
February	318	133	185
March	320	136	184
April	325	137	188
May	322	138	184
June	310	135	175
July	316	136	180
August	379	195	184
September	314	135	179

	United States.	New York.	All other states.[1]
Average number of wage-earners, etc.—Con.			
Children, under 16 years—Continued.			
October	327	135	192
November	314	132	182
December	255	75	180
Miscellaneous expenses:			
Total	$278,176	$191,382	$86,794
Rent of works	$1,320	$720	$600
Taxes, not including internal revenue	$16,172	$13,289	$2,883
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$260,684	$177,373	$83,311
Materials used:			
Total cost	$1,030,917	$755,549	$275,368
Principal materials—			
Total cost	$714,557	$457,733	$256,824
Purchased in raw state	$79,233	$79,033	$200
Purchased in partially manufactured form	$635,324	$378,700	$256,624
Fuel	$13,757	$8,489	$5,268
Mill supplies	$32,566	$29,890	$2,676
All other materials	$255,587	$244,987	$10,600
Freight	$14,450	$14,450	
Products:			
Total value	$2,222,276	$1,581,351	$640,925
Pencils and pens—			
Total value	$1,820,166	$1,328,886	$491,280
Pencils—			
Total gross	1,383,822	911,138	472,684
Total value	$1,705,065	$1,213,785	$491,280
Lead (complete)—			
Number of gross	1,381,329	909,170	472,159
Value	$1,641,975	$1,151,495	$490,480
Silver—			
Number of gross	1,486	1,486	
Value	$43,496	$43,496	
Plated—			
Number of gross	482	482	
Value	$18,794	$18,794	
Other varieties—			
Number of gross	525		525
Value	$800		$800
Pens—			
Total gross	432,759	432,759	
Total value	$115,101	$115,101	
Fountain (complete)—			
Number of gross	447	447	
Value	$39,125	$39,125	
Gold—			
Number of gross	31	31	
Value	$2,202	$2,202	
Steel—			
Number of gross	432,230	432,230	
Value	$71,318	$71,318	
Stylographic—			
Number of gross	51	51	
Value	$2,456	$2,456	
Value of all other products	$402,110	$252,465	$149,645
Comparison of products:			
Number of establishments reporting for both years	6	3	3
Value for census year	$2,212,276	$1,581,351	$630,925
Value for preceding business year	$1,890,174	$1,408,854	$481,320
Power:			
Number of establishments reporting	4	2	2
Total horsepower	1,360	1,100	260
Owned—			
Engines—			
Steam—			
Number	4	2	2
Horsepower	1,360	1,100	260
Establishments classified by number of persons employed, not including proprietors and firm members:			
Total number of establishments	7	3	4
No employees			
Under 5	1		1
5 to 20	3	1	2
21 to 50			
51 to 100			
101 to 250			
251 to 500	1	1	
501 to 1,000	1		1
Over 1,000	1	1	

[1] Includes establishments distributed as follows: Illinois, 1; Massachusetts, 1; New Jersey, 2.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 213. WASHINGTON, D. C. June 27, 1902.

AGRICULTURE.

ILLINOIS.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture in the state of Illinois, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It also includes the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Illinois, June 1, 1900, numbered 264,151, and were valued at $1,765,581,550, of which amount $251,467,580, or 14.2 per cent, represents the value of buildings, and $1,514,113,970, or 85.8 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $44,977,310, and of live stock, $193,758,037. These values, added to that of farms, give $2,004,316,897, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of all such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $345,649,611, of which amount $130,816,905, or 37.8 per cent, represents the value of animal products, and $214,832,706, or 62.2 per cent, the value of crops, including forest products cut or produced on farms. The total value of farm products for 1899 exceeds that for 1889 by $160,890,598, or 87.1 per cent. A part of this increase is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting the value of the products fed to live stock on the farms of the producers from the total value of farm products. In 1899 the reported value of products fed was $81,897,180, leaving $263,752,431 as the "gross farm income." The ratio which this latter amount bears to the "total value of farm property" is referred to in the text as the "percentage of gross income upon investment." For Illinois, in 1899, it was 13.2 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Illinois.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN ILLINOIS.

GENERAL STATISTICS.

Illinois has a total land area of 56,000 square miles, or 35,840,000 acres, of which 32,794,728 acres, or 91.5 per cent, are included in farms.

Illinois is one of the most level states in the Union, with water courses flowing generally from the north and northeast to the southwest and south. In portions of the south and southwest the surface is slightly rough and broken, as it is also in the northwest in which is found the highest elevation.

The soil consists of a rich, black loam or mold, underlaid by drift deposits from 25 to 100 feet deep in places. This, with a favorable climate, makes Illinois one of the leading agricultural states in the Union.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the per cent of farm land improved.

Table 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	264,151	32,794,728	27,699,219	5,095,509	124.2	84.5
1890	240,681	30,498,277	25,669,060	4,829,217	126.7	84.2
1880	255,741	31,673,645	26,115,154	5,558,491	123.9	82.4
1870	202,803	25,882,861	19,329,952	6,552,909	127.6	74.7
1860	143,310	20,911,989	13,096,374	7,815,615	145.9	62.6
1850	76,208	12,037,412	5,039,545	6,997,867	158.0	41.9

Since 1850 both the number of farms and the total farm acreage have increased rapidly, the rates of gain in the last decade being 9.8 per cent and 7.5 per cent, respectively. The greater rapidity of the gain in the total number of farms has resulted, in each decade except from 1880 to 1890, in a decrease in the average size of farms. A gain in the percentage of farm land improved is shown for each decade. That the increase shown for the last decade is comparatively small is due, in part, to the use of a more strict construction of the term "improved land" in 1900 than in previous census years.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

Table 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$2,004,316,897	$1,765,581,550	$44,977,310	$193,758,037	$345,649,611
1890	1,477,759,187	1,262,870,587	34,456,938	180,431,662	184,759,013
1880	1,175,772,293	1,009,594,580	33,739,951	132,437,762	203,980,137
1870[2]	1,104,839,631	920,506,346	34,576,587	149,756,698	[3] 210,860,585
1860	498,680,730	408,944,033	17,235,472	72,501,225	
1850	126,748,109	96,133,290	6,405,561	24,209,258	

[1] For year preceding that designated.

[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years, they must be diminished one-fifth.

[3] Includes betterments and additions to live stock.

Between 1850 and 1900, the total value of farm property increased very rapidly, the increase in the last decade amounting to $526,557,710, or 35.6 per cent. Since 1890 the value of farms has increased $502,710,963, or 39.8 per cent; that of live stock, $13,326,375, or 7.4 per cent; and that of implements and machinery, $10,520,372, or 30.5 per cent. The value of farm products for 1899 exceeds that reported for 1889 by $160,890,598, or 87.1 per cent, but a portion of this increase, and of that noted in the case of implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous census years.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	264,151	255,285	32,794,728	27,699,219	$1,514,113,970	$251,467,580	$44,977,310	$193,758,037	$263,752,431	$22,182,550	$830,660
Adams	4,224	4,088	495,762	387,497	18,318,240	3,858,990	597,320	2,539,475	3,131,734	267,000	6,710
Alexander	772	739	89,758	50,914	1,642,110	286,110	95,180	213,472	361,312	56,680	3,180
Bond	1,908	1,869	216,794	186,184	4,732,970	1,161,700	212,960	951,040	1,000,315	48,900	370
Boone	1,321	1,300	173,674	143,371	8,849,830	2,097,590	312,320	1,416,053	1,762,016	184,150	27,300
Brown	1,605	1,573	180,953	120,575	5,246,740	1,141,830	192,500	1,058,095	922,352	53,300	850
Bureau	3,214	3,171	522,962	453,244	28,567,980	4,739,390	780,470	3,883,146	4,799,181	389,930	8,960
Calhoun	1,061	1,011	144,978	74,708	3,332,280	574,660	117,470	397,269	656,472	34,320	410
Carroll	1,852	1,816	276,451	235,582	11,697,590	2,788,770	431,750	2,172,814	2,305,656	208,350	1,790
Cass	1,432	1,365	216,869	165,330	9,765,640	1,429,080	219,640	1,243,724	1,463,428	148,920	4,460
Champaign	4,316	4,107	627,785	610,186	45,345,010	4,948,770	1,029,400	3,624,025	7,311,102	491,550	31,840
Christian	3,137	3,009	425,942	409,057	21,634,330	2,725,050	488,890	2,669,545	3,132,578	275,900	3,010
Clark	3,416	3,266	311,613	254,344	8,391,930	1,719,030	362,430	1,579,762	1,968,096	86,710	900
Clay	2,783	2,647	266,536	217,990	5,235,850	1,292,110	216,740	1,141,931	1,153,931	32,050	2,850
Clinton	2,004	1,963	279,163	235,200	6,771,280	1,573,720	281,890	982,825	1,135,249	92,070	3,130
Coles	2,739	2,634	310,500	279,733	15,864,090	2,568,750	498,960	2,168,636	3,476,388	329,340	14,540
Cook	5,827	5,614	407,043	349,519	68,265,260	8,839,960	1,105,610	2,823,741	6,577,969	1,071,710	90,460
Crawford	2,585	2,472	258,044	221,914	7,036,450	1,389,110	298,970	1,228,115	1,513,507	69,180	4,380
Cumberland	2,484	2,404	215,094	188,808	5,955,160	1,171,130	262,540	1,101,105	1,346,702	77,260	2,060
Dekalb	2,560	2,519	394,283	352,180	21,959,730	4,295,970	732,470	3,083,545	3,940,525	468,760	10,100
Dewitt	1,691	1,641	243,735	219,880	15,382,310	1,639,710	360,180	1,541,273	2,559,394	212,710	17,860
Douglas	2,025	1,928	258,065	241,316	16,479,640	2,101,640	474,350	1,732,318	3,216,843	327,780	10,600
Dupage	1,704	1,676	195,193	162,798	13,422,310	2,896,920	436,940	1,707,095	2,097,004	321,460	9,870
Edgar	3,105	2,962	381,026	357,157	20,581,030	2,738,990	472,060	2,644,427	4,082,964	275,040	26,530
Edwards	1,219	1,189	139,880	118,619	3,138,970	776,930	131,510	621,780	683,600	33,880	6,450
Effingham	2,421	2,337	286,653	231,303	5,581,910	1,325,630	286,630	1,117,608	1,261,771	55,270	7,080
Fayette	4,056	3,904	408,583	332,199	8,421,700	1,592,680	333,620	1,597,902	1,662,565	78,320	1,890
Ford	1,901	1,808	308,455	298,335	19,443,660	2,017,030	480,420	1,604,672	3,106,015	264,570	2,940
Franklin	3,050	2,952	232,102	185,415	3,442,990	835,110	206,880	975,079	1,093,524	32,970	2,920
Fulton	4,271	4,167	515,396	372,298	21,253,230	4,272,110	723,420	3,731,492	4,155,144	282,870	2,830
Gallatin	1,675	1,536	159,366	130,107	3,894,530	671,700	208,180	588,830	1,037,895	75,280	510
Greene	2,320	2,204	316,633	251,064	11,655,860	1,951,190	322,630	1,840,832	1,992,332	207,730	12,920
Grundy	1,672	1,573	252,257	233,608	14,323,590	1,960,650	456,150	1,401,485	2,394,580	160,730	9,020
Hamilton	3,156	3,063	236,320	194,194	3,697,110	843,980	186,720	1,025,721	1,157,744	23,280	700
Hancock	4,003	3,848	475,535	405,631	20,041,760	3,905,200	635,970	3,322,039	3,250,192	235,210	3,680
Hardin	954	924	100,391	66,137	980,300	235,950	62,570	263,910	334,541	18,790	390
Henderson	1,382	1,296	219,296	167,075	8,933,990	1,397,150	215,130	1,723,748	1,616,513	145,940	2,680
Henry	3,250	3,207	501,076	448,648	24,472,610	4,249,700	655,420	3,966,914	4,186,223	384,510	5,440
Iroquois	4,332	4,209	697,412	646,324	40,726,710	4,577,620	1,036,850	3,749,478	6,726,873	385,210	10,920
Jackson	2,675	2,553	292,662	202,256	5,927,530	1,450,430	330,140	885,187	1,597,718	130,020	2,210
Jasper	2,960	2,802	280,158	241,086	6,330,500	1,370,730	307,960	1,354,082	1,233,303	49,750	3,480
Jefferson	4,065	3,871	322,055	262,433	5,977,590	1,279,080	274,300	1,451,114	1,476,694	28,830	2,290
Jersey	1,538	1,514	206,267	142,193	6,160,630	1,389,390	238,630	856,415	1,185,386	126,260	6,690
Jo Daviess	2,389	2,353	365,176	247,206	12,415,490	2,860,280	421,550	2,455,553	2,497,503	171,880	7,230
Johnson	2,080	2,026	192,777	132,333	2,329,610	710,900	148,650	611,780	727,416	31,510	490
Kane	2,370	2,322	311,470	248,364	17,811,560	4,450,540	693,390	3,118,811	3,951,477	617,720	41,890
Kankakee	2,565	2,502	415,127	363,133	22,330,840	3,152,430	649,580	2,239,398	3,397,350	286,860	11,510
Kendall	1,319	1,293	200,850	185,555	11,257,220	2,246,660	450,050	1,362,695	2,129,142	189,160	3,480
Knox	3,006	2,902	432,949	355,066	23,384,330	3,881,600	587,090	3,311,626	3,809,150	347,480	7,910
Lake	2,229	2,194	259,544	190,106	13,802,240	3,605,560	493,540	1,919,514	2,180,210	299,600	4,450
Lasalle	4,661	4,495	706,039	625,450	45,689,360	6,703,680	1,226,070	4,401,443	7,201,557	640,500	9,720
Lawrence	2,183	2,112	218,831	186,934	5,757,200	1,211,260	253,630	895,055	1,388,016	87,700	1,960
Lee	2,860	2,762	453,624	409,362	23,613,060	4,449,770	757,590	2,959,994	4,115,733	380,090	8,630
Livingston	4,284	4,116	649,495	625,401	45,503,330	4,875,310	1,088,120	3,588,573	7,088,482	414,880	9,450
Logan	2,405	2,332	381,037	357,205	26,062,690	2,773,050	609,420	2,194,692	3,910,859	370,250	5,060
McDonough	2,816	2,748	358,153	307,108	18,446,010	3,157,520	712,650	3,122,025	3,508,406	206,460	6,010
McHenry	2,774	2,742	369,225	271,017	18,433,990	4,399,160	718,270	3,555,698	3,878,377	483,380	23,910
McLean	4,873	4,624	737,578	697,828	54,532,730	6,628,510	1,192,240	5,079,327	8,831,515	667,210	31,750
Macon	2,650	2,581	352,109	333,016	22,125,720	2,887,190	519,750	2,139,980	3,490,295	274,800	6,500
Macoupin	4,179	4,065	525,587	415,125	17,693,750	3,510,730	494,160	2,658,818	2,732,993	256,040	7,060
Madison	3,563	3,486	408,879	351,353	18,432,400	4,227,640	690,330	1,884,163	3,149,868	483,930	17,190
Marion	3,369	3,267	328,734	269,293	6,393,830	1,686,880	274,190	1,318,184	1,557,103	84,100	6,870
Marshall	1,416	1,384	234,973	206,485	13,848,110	1,793,440	319,730	1,513,969	2,253,344	186,990	5,980
Mason	1,766	1,668	309,182	260,145	12,317,100	1,581,950	339,270	1,123,576	2,143,298	193,400	5,430
Massac	1,251	1,192	126,990	85,087	2,138,080	570,580	166,410	382,537	523,823	39,230	1,700
Menard	1,281	1,236	191,761	173,060	10,767,580	1,422,050	252,360	1,546,251	1,707,133	196,220	4,730
Mercer	2,213	2,098	330,702	258,074	13,722,830	2,470,640	391,350	2,956,054	2,744,117	156,100	10,770
Monroe	1,568	1,540	207,265	154,066	5,755,110	1,267,890	294,150	662,519	1,336,930	121,330	5,980
Montgomery	3,353	3,199	433,555	377,644	14,207,880	2,679,870	422,530	2,036,979	2,119,644	165,100	8,020
Morgan	2,666	2,561	346,854	315,278	18,268,840	3,019,970	401,680	2,758,920	2,739,831	279,810	10,300
Moultrie	1,693	1,640	203,946	188,968	11,185,790	1,326,160	255,920	1,275,824	2,058,164	157,330	4,060
Ogle	3,093	3,024	467,723	399,175	23,617,050	4,414,780	684,560	3,349,294	4,313,708	393,600	20,200
Peoria	2,813	2,749	357,091	280,996	19,177,020	3,302,920	567,060	2,400,701	3,453,188	271,400	10,840
Perry	1,962	1,904	226,381	171,916	3,892,870	900,260	217,820	660,531	902,424	44,140	3,000
Piatt	1,740	1,686	272,027	262,714	17,469,810	2,089,450	459,750	1,761,405	3,158,502	315,340	8,790
Pike	3,995	3,733	491,818	387,999	13,951,400	2,730,530	437,170	2,461,213	2,902,910	242,500	16,840
Pope	1,977	1,915	204,920	131,786	1,811,350	548,130	138,750	555,931	710,846	28,620	6,320
Pulaski	1,227	1,172	89,129	64,825	1,994,370	490,100	122,240	350,996	614,936	97,660	5,310
Putnam	567	549	95,405	73,967	5,038,800	651,130	87,900	612,801	807,433	81,690	1,270
Randolph	2,458	2,410	315,857	240,660	7,288,450	1,986,550	425,660	1,045,272	1,770,210	151,710	5,890
Richland	2,187	2,111	216,634	187,839	5,083,430	1,250,830	248,610	934,900	1,146,355	39,980	2,450

TABLE 3.—NUMBER AND ACREAGE OF FARMS AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Rock Island	2,058	2,019	247,766	185,755	$10,401,910	$2,192,370	$333,740	$1,852,455	$1,958,568	$156,650	$2,750
St. Clair	3,282	3,223	369,108	313,649	18,098,330	3,323,390	571,580	1,546,418	3,034,287	264,010	7,280
Saline	2,934	2,770	219,361	178,724	3,819,950	900,260	217,090	835,927	1,094,029	52,520	2,770
Sangamon	3,907	3,753	514,256	478,809	31,376,790	4,145,670	608,360	3,642,514	4,349,124	459,750	2,740
Schuyler	2,162	2,092	262,884	181,856	9,244,520	1,660,510	295,190	1,607,463	1,597,101	90,040	1,380
Scott	1,131	1,082	144,772	117,882	6,089,640	1,059,210	151,330	857,047	1,053,279	97,580	6,460
Shelby	4,254	4,135	465,341	407,781	17,478,990	2,630,880	504,410	2,624,146	3,312,446	189,560	2,990
Stark	1,164	1,123	181,875	155,993	10,212,930	1,619,990	247,430	1,253,845	1,560,100	110,890	3,620
Stephenson	2,901	2,832	348,799	305,913	17,965,000	4,148,850	647,510	2,683,354	3,138,082	236,590	4,070
Tazewell	2,840	2,770	384,146	324,712	25,651,620	3,477,450	574,380	2,262,738	3,928,930	351,620	8,330
Union	2,162	2,109	193,933	135,820	4,214,190	954,340	225,580	667,670	1,292,169	133,800	8,570
Vermilion	4,138	3,949	575,182	501,098	33,597,900	4,025,500	868,930	3,490,620	5,801,233	449,220	13,790
Wabash	1,139	1,100	128,629	107,253	4,247,060	934,090	164,120	540,580	842,867	43,100	920
Warren	2,157	2,085	331,845	284,236	19,283,510	2,649,940	440,180	3,312,627	3,020,718	298,910	8,520
Washington	2,496	2,441	327,200	258,835	6,580,520	1,566,450	308,140	1,042,860	1,440,512	108,510	3,770
Wayne	4,061	3,957	371,584	308,381	7,297,440	1,684,740	304,200	1,664,384	1,634,850	40,470	8,350
White	2,912	2,768	286,813	253,169	7,873,990	1,259,150	344,460	1,194,451	1,963,150	125,520	8,990
Whiteside	2,836	2,758	425,231	371,229	19,837,530	3,939,240	673,720	3,396,463	3,896,151	371,990	2,930
Will	3,584	3,529	502,331	441,803	33,525,720	5,327,990	911,690	3,029,842	4,291,299	390,680	7,940
Williamson	3,146	3,065	247,117	201,035	4,307,630	1,085,750	277,320	912,554	1,287,469	44,060	6,500
Winnebago	2,245	2,200	315,761	271,245	15,123,440	3,653,910	505,250	2,209,991	2,889,087	257,640	1,190
Woodford	2,176	2,101	318,677	276,140	21,451,200	3,240,760	515,340	1,941,367	3,347,401	211,250	650

In the majority of counties the number of farms increased in the last decade, but ten counties, most of which are situated in the central part of the state, reported decreases. Only three counties, Kankakee, Sangamon, and Warren, report decreases in total farm area. The remaining counties show considerable increases. The decrease reported in improved acreage in some of the counties is due to a more intensive cultivation of the soil, and to the use of a more strict construction of the term "improved" by the Twelfth than by any preceding census. The average size of farms for the state is 124.2 acres. As a rule, the northwestern counties have the largest farms while smaller averages are shown for the southern counties.

All counties but one report large increases since 1890 in the total value of farms. For the state, the average value is $6,684 per farm. Implements and machinery decreased in value in Cass, Clinton, and Putnam counties. More than four-fifths of the counties show an increase in the value of live stock, but a few of the central counties report decreases.

FARM TENURE.

Table 4 gives a comparative exhibit of farm tenure for 1880, 1890, and 1900. The farms operated by tenants are divided into two groups designated as farms operated by "cash tenants" and "share tenants." The groups comprise, respectively: (1) Farms operated by individuals who pay a rental in cash or a stated amount of labor or farm produce, and (2) farms operated by individuals who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, and the farms operated by owners are subdivided into four groups, designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other, or others, owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	264,151	160,453	38,173	65,525	60.7	14.5	24.8
1890	240,681	158,848	29,182	52,651	66.0	12.1	21.9
1880	255,741	175,497	20,620	59,624	68.6	8.1	23.3

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	264,151	121,715	34,375	2,413	1,950	38,173	65,525
White	262,662	121,172	34,203	2,401	1,945	37,956	64,985
Colored[1]	1,489	543	172	12	5	217	540

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	46.1	13.1	0.9	0.7	14.4	24.8
White	100.0	46.1	13.0	0.9	0.7	14.5	24.8
Colored[1]	100.0	36.5	11.5	0.8	0.3	14.6	36.3

[1] Comprising 3 Chinese and 1,486 negroes.

The percentages in Table 4 show that the number of farms operated by owners has not increased so rapidly in the last twenty years as the number operated by tenants. Between 1890 and 1900 the total number of farms increased 23,470, or 9.8 per cent; the number operated by owners increased 1,605, or 1.0 per cent; cash-tenant farms, 8,991, or 30.8 per cent; and share-tenant farms, 12,874, or 24.5 per cent. In 1890, 64.3 per cent of all tenants were share tenants, and in 1900, 63.2 per cent were share tenants.

Of the white farmers, 60.1 per cent own all or a part of the land they operate, and 39.9 per cent operate farms owned by others. The corresponding percentages for colored farmers are 48.8 and 51.2. The greatest relative numbers of cash tenants are in counties near Chicago and other cities where land is very valuable and usually cultivated in small tracts.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," and "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	264,151	124.2	32,794,728	100.0	$2,004,316,897	100.0
White farmers	262,662	124.5	32,711,516	99.7	2,000,987,066	99.8
Colored farmers[1]	1,489	55.9	83,212	0.3	3,329,831	0.2
Owners	121,715	118.1	14,374,612	43.8	847,763,370	42.3
Part owners	34,375	142.9	4,913,163	15.0	275,037,180	13.7
Owners and tenants	2,413	159.1	383,827	1.2	18,807,850	0.9
Managers	1,950	233.0	454,378	1.4	33,163,583	1.7
Cash tenants	38,173	124.2	4,740,769	14.4	367,748,107	18.4
Share tenants	65,525	121.0	7,927,979	24.2	461,796,807	23.0

[1] Comprising 3 Chinese and 1,486 negroes.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$5,732	$952	$170	$734	$999	13.2
White farmers	5,755	956	171	736	1,003	13.2
Colored farmers[1]	1,737	229	58	212	334	14.9
Owners	4,974	1,065	166	760	933	13.4
Part owners	6,069	936	187	809	1,081	13.5
Owners and tenants	5,577	1,114	189	914	1,021	13.1
Managers	13,004	1,829	246	1,928	1,877	11.0
Cash tenants	7,703	973	193	765	1,188	12.3
Share tenants	5,605	707	153	583	940	13.3

[1] Comprising 3 Chinese and 1,486 negroes.

Of the farms of the state, 99.4 per cent are operated by white farmers and 0.6 per cent by colored farmers. The average size of the farms of colored farmers is less than half that of farms of white farmers, and the average value of all forms of their farm property and products is approximately one-third as great. The slightly higher percentage of gross income shown for colored farmers is in keeping with the small average size of their farms, a factor which naturally involves more intensive cultivation than is practiced by the operators of the larger farms. This view is sustained by the percentages given in Table 9, which show a decrease in gross income as the size of farms increases.

The farms of managers, though fewest in number, have the largest average area, and the highest average value, but as the values are high, the per cent of gross income is lowest for this group. The averages are generally lower for owners and share tenants.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	264,151	124.2	32,794,728	100.0	$2,004,316,897	100.0
Under 3 acres	1,854	2.0	3,771	(1)	4,365,763	0.2
3 to 9 acres	7,221	6.3	45,167	0.1	13,768,612	0.7
10 to 19 acres	10,560	13.8	145,417	0.5	22,255,942	1.1
20 to 49 acres	41,160	34.8	1,431,732	4.4	87,488,216	4.4
50 to 99 acres	65,851	75.6	4,979,857	15.2	285,817,605	14.3
100 to 174 acres	81,338	136.0	11,065,345	33.7	676,928,727	33.8
175 to 259 acres	35,579	211.2	7,513,342	22.9	464,589,320	23.2
260 to 499 acres	18,255	326.9	5,967,783	18.2	362,743,805	18.1
500 to 999 acres	2,051	613.4	1,258,084	3.8	69,227,656	3.4
1,000 acres and over	282	1,362.5	384,230	1.2	17,131,251	0.8

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$5,732	$952	$170	$734	$999	13.2
Under 3 acres	1,154	1,020	70	111	568	24.1
3 to 9 acres	1,089	639	52	127	288	15.1
10 to 19 acres	1,382	503	58	165	292	13.8
20 to 49 acres	1,423	400	68	235	342	16.1
50 to 99 acres	3,132	655	122	431	621	14.3
100 to 174 acres	6,312	1,047	196	767	1,107	13.3
175 to 259 acres	10,123	1,452	269	1,214	1,675	12.8
260 to 499 acres	15,564	1,959	351	1,997	2,372	11.9
500 to 999 acres	26,144	3,056	467	4,086	3,836	11.4
1,000 acres and over	47,315	4,447	570	8,417	6,195	10.2

The group of farms containing 100 to 174 acres each, contains the largest number of farms, and comprises more than one-third of the value of all farm property and of the total farm acreage.

For the group of farms containing less than 3 acres each, the average values given in Table 9 are relatively high, as this group contains most of the florists' establishments of the state, and a number of city dairies and vegetable farms. It should be borne in mind that the income from these industries is determined not so much by the acreage of land used, as by the amount of capital invested in buildings, live stock, and implements, and by the amounts expended for labor and fertilizers.

The average gross incomes per acre for the various groups classified by area are as follows: Farms under 3 acres, $279.20; 3 to 9 acres, $46.01; 10 to 19 acres, $21.16; 20 to 49 acres, $9.83; 50 to 99 acres, $8.22; 100 to 174 acres, $8.14; 175 to 259 acres, $7.93; 260 to 499 acres, $7.26; 500 to 999 acres, $6.25; 1,000 acres and over, $4.55.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40 per cent of the value of the products not fed to live stock, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive their principal income from any one class of farm products. Farms for which no income was reported are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS. Average.	Total.	Per cent.	VALUE OF FARM PROPERTY. Total.	Per cent.
The State	264,151	124.2	32,794,728	100.0	$2,004,316,897	100.0
Hay and grain	107,020	143.1	15,315,711	46.7	991,851,452	49.5
Vegetables	6,656	40.4	268,846	0.8	43,997,057	2.2
Fruits	2,411	59.1	142,458	0.4	8,970,369	0.5
Live stock	113,674	120.3	13,673,753	41.7	744,327,774	37.1
Dairy produce	15,602	107.2	1,673,279	5.1	129,402,044	6.5
Tobacco	138	86.3	11,904	0.1	589,222	(1)
Sugar	60	84.9	5,096	(1)	428,329	(1)
Flowers and plants	499	4.0	1,992	(1)	4,648,056	0.2
Nursery products	126	61.6	7,760	(1)	1,743,586	0.1
Miscellaneous	17,965	94.3	1,693,929	5.2	78,359,008	3.9

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$5,732	$952	$170	$734	$999	13.2
Hay and grain	7,442	961	197	668	1,187	12.8
Vegetables	5,455	837	109	209	766	11.6
Fruits	2,512	838	107	264	659	17.7
Live stock	4,598	936	153	861	879	13.4
Dairy produce	5,822	1,325	202	945	1,056	12.7
Tobacco	3,036	674	109	451	639	15.0
Sugar	5,687	853	190	409	956	13.4
Flowers and plants	4,888	4,202	182	43	3,739	40.1
Nursery products	11,446	1,982	234	176	4,741	34.3
Miscellaneous	3,182	636	124	420	608	14.0

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $936.61; nursery products, $76.98; vegetables, $18.98; sugar, $11.26; fruits, $11.15; dairy produce, $9.84; hay and grain, $8.29; tobacco, $7.41; live stock, $7.31; and miscellaneous, $6.46. In computing these averages, the total area of the farms of each group is used, and not merely the acreage devoted to the crop from which the principal income is derived.

The wide variations shown in the averages and in the percentages of gross income are due, largely, to the fact that in computing gross income no deduction is made for expenses involved in operation. For florists' establishments, nurseries, and market gardens, the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than for "hay and grain," "live-stock," or "miscellaneous" farms.

Were it possible to present the average net income the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	264, 151	124. 2	32, 794, 728	100. 0	$2, 004, 316, 897	100. 0
$0	1, 043	61. 7	64, 354	0. 2	3, 545, 700	0. 2
$1 to $49	3, 367	35. 7	120, 129	0. 4	5, 387, 780	0. 3
$50 to $99	7, 484	34. 7	259, 332	0. 8	10, 992, 020	0. 5
$100 to $249	34, 208	47. 0	1, 607, 911	4. 9	65, 116, 570	3. 2
$250 to $499	52, 110	75. 7	3, 943, 542	12. 0	165, 968, 680	8. 3
$500 to $999	69, 377	115. 3	8, 001, 324	24. 4	418, 516, 330	20. 9
$1,000 to $2,499	78, 593	171. 8	13, 501, 505	41. 2	925, 901, 970	46. 2
$2,500 and over	17, 969	294. 8	5, 296, 631	16. 1	408, 887, 847	20. 4

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$5, 732	$952	$170	$734	$999	13.2
$0	2, 622	368	61	349		
$1 to $49	1, 161	271	32	136	35	2.2
$50 to $99	1, 013	281	39	136	75	5.1
$100 to $249	1, 290	351	53	210	174	9.1
$250 to $499	2, 225	521	92	347	369	11.6
$500 to $999	4, 442	848	152	590	722	12.0
$1,000 to $2,499	9, 087	1, 378	252	1, 064	1, 551	13.2
$2,500 and over	17, 667	2, 327	419	2, 342	3, 669	16.1

The absence of income in the first group is due in part to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The persons in charge of such farms, on June 1, 1900, could not always give definite information concerning the products of the preceding year. The same statement is true, also, of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete exhibit of farm income in 1899. Other farms with small reported incomes are doubtless the suburban or summer homes of city merchants and professional men who derive their principal income from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	723, 322	$7, 195, 897	$9. 95	10, 220
Steers	1 and under 2	364, 103	8, 251, 444	22. 66	2, 279
Steers	2 and under 3	299, 238	11, 557, 852	38. 62	5, 802
Steers	3 and over	88, 548	4, 628, 175	52. 27	32, 251
Bulls	1 and over	59, 732	2, 284, 576	38. 25	2, 082
Heifers	1 and under 2	332, 472	6, 735, 360	20. 26	3, 464
Cows kept for milk	2 and over	1, 007, 664	34, 279, 218	34. 02	56, 827
Cows and heifers not kept for milk.	2 and over	228, 931	7, 238, 385	31. 62	2, 109
Colts	Under 1	107, 967	2, 518, 050	23. 32	2, 654
Horses	1 and under 2	115, 377	4, 575, 418	39. 66	2, 327
Horses	2 and over	1, 126, 875	62, 604, 632	55. 56	237, 938
Mule colts	Under 1	13, 804	401, 070	29. 05	113
Mules	1 and under 2	13, 194	585, 666	44. 39	139
Mules	2 and over	97, 646	6, 433, 775	65. 89	6, 216
Asses and burros	All ages	2, 529	223, 147	88. 24	429
Lambs	Under 1	401, 431	989, 897	2. 47	10, 536
Sheep (ewes)	1 and over	548, 853	2, 341, 230	4. 27	29, 048
Sheep (rams and wethers).	1 and over	80, 297	375, 515	4. 68	15, 307
Swine	All ages	5, 915, 468	23, 616, 781	3. 99	166, 944
Goats	All ages	8, 877	19, 932	2. 25	2, 984
Fowls:[1]					
Chickens[2]		16, 600, 728	6, 415, 033		
Turkeys		446, 020			
Geese		307, 657			
Ducks		382, 857			
Bees (swarms of)		179, 953	486, 164	2. 70	
Unclassified			820		
Value of all live stock			193, 758, 037		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The value of all live stock on farms, June 1, 1900, was $193,758,037. Of this amount, 36.0 per cent represents the value of horses; 24.7 per cent, that of neat cattle other than dairy cows; 17.7 per cent, that of dairy cows; 12.2 per cent, that of swine; 3.8 per cent, that of mules; 3.3 per cent, that of poultry; 1.9 per cent, that of sheep; and 0.4 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of live stock not on farms was $18,938,334, about 10 per cent as great as the value of live stock on farms. The value of all live stock in the state, exclusive of poultry and bees not on farms, was, approximately, $212,696,371.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the numbers of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	1,007,664	2,096,346	1,350,219	127,173	629,150	5,915,468
1890	1,087,886	1,975,233	1,335,289	107,875	922,631	5,924,818
1880	865,913	1,518,409	1,023,082	123,278	1,037,073	5,170,266
1870	640,321	1,075,265	853,738	85,075	1,568,286	2,703,343
1860	522,634	1,061,179	563,736	38,539	769,135	2,502,308
1850	294,671	617,365	267,653	10,573	894,043	1,915,907

[1] Lambs not included.

All classes of live stock, except sheep, show great increases in number since 1850. The number of sheep has fluctuated, reaching the maximum in 1870. Since that time the decrease has been rapid, amounting to 31.8 per cent in the ten years between 1890 and 1900.

An increase in the number of dairy cows is shown for each decade until the last, but the census of 1900 shows a decrease of 7.4 per cent. The increased production of milk in the last decade, however, leads to the belief that the decrease in the number of cows is merely apparent, owing to a difference in the methods of enumeration used in 1890 and 1900. In the latter year, many cows, milked at some time in the year, but not "kept for milk" primarily, were classed with "cows and heifers not kept for milk," and consequently with "other neat cattle." The numbers of other neat cattle and horses have increased steadily since 1850. The rates of gain since 1890 were 6.1 per cent and 1.1 per cent, respectively. The number of mules and asses increased every decade, except from 1880 to 1890. For the last decade the increase was 17.9 per cent. A decrease of 0.2 per cent in number of swine is also shown for the last decade, the only decrease for that class of stock since 1850.

The prevailing high prices just previous to the enumeration, caused farmers to reduce their flocks and herds greatly, as is shown by the fact that for 1899 more than half the total value of animal products was derived from the sale of live animals on farms, and the value of animals sold in 1899 was one-third as great as that of all live stock remaining on farms, June 1, 1900.

In 1900 the enumerators were directed to report no fowls under three months old, but no such instruction was given in former census years. This accounts, in part at least, for the following decreases in numbers of all classes of domestic fowls between 1890 and 1900: Geese, 57.6 per cent; turkeys, 57.3 per cent; ducks, 48.0 per cent; and chickens, 22.7 per cent. The increased production of eggs for the same time clearly indicates that the decrease in numbers of fowls is only apparent.

ANIMAL PRODUCTS.

Table 16 is a summarized exhibit of the animal products of 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	4,799,742	$966,746
Mohair and goat hair	Pounds	2,793	751
Milk	Gallons	[1]457,106,995	
Butter	Pounds	52,493,450	[2]29,638,619
Cheese	Pounds	323,485	
Eggs	Dozens	86,402,670	8,942,401
Poultry			11,307,599
Honey	Pounds	2,961,080	343,200
Wax	Pounds	75,290	
Animals sold			69,462,993
Animals slaughtered			10,154,596
Total			130,816,905

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of milk sold and consumed, and of butter and cheese made.

The value of the animal products for 1899 was $130,816,905, or 37.8 per cent of the value of all farm products and 49.6 per cent of the gross farm income. This value was also two-thirds as great as that of all live stock on farms, June 1, 1900. Of the total amount, 60.9 per cent represents the value of animals sold and animals slaughtered on farms; 22.6 per cent, that of dairy products; 15.5 per cent, that of poultry and eggs; 0.7 per cent, that of wool, mohair, and goat hair; and 0.3 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms, $79,617,589, is 23.0 per cent of all farm products and 30.2 per cent of the gross farm income. Of all farmers in the state, 214,094, or 81.0 per cent, report animals slaughtered on farms, the average value per farm being $47.43. Sales of live animals are reported by 198,944 farmers, or 75.3 per cent of the whole number, the average receipts per farm being $349.16. McLean county was first in amount of sales, reporting $1,997,978 from 3,957 farms, an average of $504.92 per farm. Twenty-eight counties in the state each reported more than a million dollars received from sales of live animals.

DAIRY PRODUCE.

In 1899 the proprietors of 15,602 farms, or 5.9 per cent of all in the state, derived their principal income from the sale of dairy produce, the total value of which constituted 22.7 per cent of that of all animal products. The production of milk in 1899 was 89,837,531 gallons greater than in 1889, a gain of 24.5 per cent. McHenry, Kane, Cook, Lake, and Du Page counties were first in the production of milk, ranking in the order named.

Of the $29,638,619, given in Table 16 as the value of dairy produce, $19,067,797, or 64.3 per cent, represents the value of the portion sold, and $10,570,822, or 35.7 per cent, the value of that consumed on farms. Of the former amount, $14,477,813 was received from the sale of 186,549,335 gallons of milk; $4,306,553, from 26,395,166 pounds of butter; $258,581, from 560,532 gallons of cream; and $24,850, from 263,237 pounds of cheese.

Since 1889 the amount of butter produced on farms has decreased 8.1 per cent, and that of cheese produced on farms, 5.8 per cent. These changes are due, in part, to the transfer of butter and cheese making from the farm to the creamery, and in part to the increasing quantities of milk and cream consumed in cities.

POULTRY AND EGGS.

The value of the products of the poultry industry in 1899 was $20,250,000. Of this amount, 55.8 per cent represents the value of poultry raised, and 44.2 per cent, that of eggs produced. The production of eggs for 1899 was 26,051,605 dozens greater than in 1889, a gain of 43.2 per cent. Shelby, Cook, and Lasalle counties were first in the production of eggs in 1899, while 30 counties reported more than a million dozens each.

WOOL.

The production of wool for 1899 was 4,799,742 pounds, an increase of 6.9 per cent since 1889. This increase is more apparent than real, owing to the fact that the fleeces of at least 273,237 sheep were omitted from the tables in 1890, but included in a general estimate of wool shorn after the census enumeration. One-fourth of the state total was reported by the nine following counties which rank in the order named: De Kalb, Macoupin, Pike, McLean, Vermilion, Jo Daviess, Crawford, Shelby, and Wayne.

HONEY AND WAX.

For 1899 there was a decrease of 35.7 per cent in the amount of honey produced and an increase of 49.3 per cent in the amount of wax, compared with the production of 1889. Honey and wax were reported, in 1899, from 34,932 farms.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	246,614	1,350,219	5.5	230,625	1,007,664	4.4
White farmers	245,461	1,347,090	5.5	229,854	1,006,236	4.4
Colored farmers	1,153	3,129	2.7	771	1,428	1.9
Owners[1]	146,435	800,596	5.5	142,953	619,895	4.3
Managers	1,775	15,367	8.7	1,607	9,986	6.2
Cash tenants	37,397	215,337	5.8	33,086	181,075	5.5
Share tenants	61,007	318,919	5.2	52,979	196,708	3.7
Under 20 acres	14,560	28,004	1.9	11,332	20,439	1.8
20 to 99 acres	97,381	333,822	3.4	88,034	235,100	2.7
100 to 174 acres	79,345	461,943	5.8	77,052	374,499	4.9
175 to 259 acres	35,073	287,706	8.2	34,402	224,128	6.5
260 acres and over	20,255	238,744	11.8	19,805	153,498	7.8
Hay and grain	101,194	616,953	6.1	90,484	319,401	3.5
Vegetable	5,608	14,138	2.5	3,889	7,428	1.9
Fruit	1,933	5,480	2.8	1,481	3,070	2.1
Live-stock	108,181	579,388	5.4	104,250	428,249	4.1
Dairy	13,282	70,666	5.3	15,602	205,846	13.2
Tobacco	105	462	4.4	91	378	4.2
Sugar	44	184	4.2	31	97	3.1
Miscellaneous[2]	16,267	62,948	3.9	14,797	43,195	2.9

[1] Including "part owners" and "owners and tenants."
[2] Including florists' establishments and nurseries.

CROPS.

The following table gives the statistics of the principal crops grown in 1899.

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES, OF PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantities.	Value.
Corn	10,266,335	Bushels	398,149,140	$115,092,567
Wheat	1,826,143	Bushels	19,795,500	11,937,458
Oats	4,570,034	Bushels	180,305,630	36,990,019
Barley	21,375	Bushels	686,580	242,834
Rye	78,869	Bushels	1,104,670	509,688
Buckwheat	6,220	Bushels	65,050	36,225
Flaxseed	394	Bushels	4,336	4,705
Kafir corn	34	Bushels	808	312
Clover seed		Bushels	97,544	376,262
Grass seed		Bushels	455,161	274,201
Hay and forage	3,343,910	Tons	4,256,211	25,569,169
Tobacco	2,242	Pounds	1,447,150	85,411
Hemp	783	Pounds	515,400	21,784
Hops	2	Pounds	690	68
Broom corn	95,137	Pounds	60,665,520	2,357,066
Peanuts	49	Bushels	879	939
Dry beans	3,451	Bushels	30,122	46,084
Castor beans	2,688	Bushels	15,695	16,139
Dry pease	12,982	Bushels	103,386	110,554
Potatoes	136,464	Bushels	12,951,971	4,702,033
Sweet potatoes	7,534	Bushels	511,695	303,980
Onions	2,563	Bushels	546,681	284,755
Miscellaneous vegetables	108,282			5,028,148
Maple sugar		Pounds	4,090	478
Maple sirup		Gallons	9,357	9,363
Sorghum cane	9,158	Tons	5,165	14,257
Sorghum sirup		Gallons	625,939	209,087
Sugar beets	1,370	Tons	9,109	36,223
Small fruits	16,794			1,293,233
Grapes	[1] 4,281	Centals	200,094	[2] 383,169
Orchard fruits	[1] 341,675			[3] 3,778,811
Nuts				6,520
Forest products				2,522,332
Flowers and plants	679			1,894,960
Seeds	416			71,456
Nursery products	3,142			578,306
Miscellaneous	2,400			44,110
Total	20,865,406			214,832,706

[1] Estimated from number of trees or vines.
[2] Including value of raisins, wine, etc.
[3] Including value of cider, vinegar, etc

Of the total value of crops, cereals, including Kafir corn, contributed 76.7 per cent; hay and forage, 11.9 per cent; miscellaneous vegetables, 2.3 per cent; potatoes, 2.2 per cent; orchard fruits, 1.8 per cent; forest products, 1.2 per cent; broom corn, 1.1 per cent; flowers and plants, 0.9 per cent; small fruits, 0.6 per cent; and all other products, 1.3 per cent.

The average values per acre of the principal crops are as follows: Flowers and plants, $2,791; nursery products, $184; onions, $111; grapes, $90; small fruits, $77; miscellaneous vegetables, $46; sweet potatoes, $40; tobacco, $38; potatoes, $34; hemp, $28; broom corn, $25; dry beans, $13; cereals, including Kafir corn, $10; and hay and forage, $8. The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production required a relatively great amount of labor, and large expenditure for fertilizers.

CEREALS.

Table 19 is an exhibit of the changes in cereal production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	21,375	6,220	10,266,335	4,570,034	78,869	1,826,143
1889	41,390	9,763	7,863,025	3,870,702	165,598	2,240,932
1879	55,267	16,457	9,019,381	1,959,889	192,138	3,218,542

[1] No statistics of acreage were secured prior to 1879.

PART 2.—BUSHELS PRODUCED.

YEAR.	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	686,580	65,050	398,149,140	180,305,630	1,104,670	19,795,500
1889	1,197,206	107,080	289,697,256	137,624,828	2,628,046	37,389,444
1879	1,229,523	178,859	325,792,481	63,189,200	3,121,785	51,110,502
1869	2,480,400	168,862	129,921,395	42,780,851	2,456,578	30,128,405
1859	1,036,338	324,117	115,174,777	15,220,029	951,281	23,837,023
1849	110,795	184,504	57,646,984	10,087,241	83,364	9,414,575

The total area devoted to cereals in 1879 was 14,461,674 acres; in 1889, 14,191,410 acres; and in 1899, 16,768,976 acres. The increases in the acreages devoted to cereals in the last decade were: Corn, 30.6 per cent; and oats, 18.1 per cent. The decreases were: Wheat, 18.5 per cent; rye, 52.4 per cent; barley, 48.4 per cent; and buckwheat, 36.3 per cent. The total number of bushels grown in 1849 was 77,527,463, and in 1899, 600,106,570.

Of the total area under cereals in 1899, 61.2 per cent was devoted to corn; 27.3 per cent, to oats; 10.9 per cent, to wheat; and 0.6 per cent, to barley, buckwheat, and rye.

A comparison by counties shows that McLean and Champaign counties each produced over 15,000,000 bushels of corn. Livingston and Lasalle counties produced over 13,000,000 each; Iroquois, more than 12,000,000; Vermilion, more than 11,000,000; 27 counties produced from 5,000,000 to 10,000,000; and 58 counties, from 1,000,000 to 5,000,000 bushels each. Oats were raised in all the counties, but particularly in the eastern part of the state, where McLean county shows a yield of over 9,000,000 bushels, and Iroquois over 8,000,000, with Lasalle and Champaign counties following with large yields, in the order named. Wheat is grown in all sections, and rye is generally reported. Buckwheat was raised principally in Hancock, Iroquois, and Adams counties, the acreages for other counties being small.

HAY AND FORAGE.

In 1900, 181,534 farmers, or 68.7 per cent of the total number, reported hay and forage crops. They obtained an average yield of 1.18 tons per acre, exclusive of cornstalks. The total area in hay and forage in 1899 was 3,343,910 acres, or 5.1 per cent less than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 198,809 acres and 227,528 tons; millet and Hungarian grasses, 65,625 acres and 111,176 tons; alfalfa or lucern, 9,290 acres and 9,572 tons; clover, 362,044 acres and 438,887 tons; other tame and cultivated grasses, 2,444,268 acres and 2,762,546 tons; grains cut green for hay, 142,248 acres and 182,337 tons; crops grown for forage, 121,626 acres and 216,517 tons; and cornstalks, 225,416 acres and 307,648 tons.

In Table 18 the production of cornstalks is included under "hay and forage," but the acreage is included under "corn," as the forage secured was only an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table.

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900.	1890.	1899.	1889.
Apples	13,430,006	6,949,336	9,178,150	9,600,785
Apricots	14,444	4,466	1,437	393
Cherries	727,973	288,836	204,279	86,254
Peaches	2,448,013	783,910	66,805	341,178
Pears	795,551	84,067	133,745	57,090
Plums and prunes	572,774	104,111	157,941	31,341

The total number of orchard trees increased from 8,214,726 to 18,047,931 in the decade 1890 to 1900. The number of apple trees nearly doubled, while all other varieties show even larger gains.

Of the total number of trees in 1900, 74.4 per cent were apple trees; 13.6 per cent, peach trees; 4.4 per cent, pear trees; 4.0 per cent, cherry trees; 3.2 per cent, plum and prune trees; and 0.4 per cent, apricot and unclassified trees.

Apples were grown in all parts of the state by 156,709 farmers, or 59.3 per cent of the total number in the state. Marion, Clay, Wayne, and Jefferson counties in the southern part of the state reported one-fifth of the total number. Peach growing is confined principally to the central and southwestern counties, but the other fruits are generally distributed over the state.

In addition to the trees shown in Table 20, unclassified fruit trees to the number of 59,170 are reported, with a yield of 24,854 bushels of fruit. The value of orchard products given in Table 18 includes the value of 75,089 barrels of cider, 19,135 barrels of vinegar, and 1,526,420 pounds of dried and evaporated fruits. The four adjoining counties of Hamilton, Williamson, Saline, and Franklin report considerably over half of this fruit.

The quantity of fruit produced in any year is determined largely by the nature of the season, and comparisons between the crops of the different years have little significance.

VEGETABLES.

The value of all vegetables grown in the state in 1899, including potatoes, sweet potatoes, and onions, was $10,318,916. Of this amount, 45.6 per cent represents the value of potatoes. This important crop was reported by 182,031 farmers, or 68.9 per cent of the total number in the state. Aside from the land devoted to potatoes, sweet potatoes, and onions, 108,282 acres were used in the growing of miscellaneous vegetables. Of this area the products of 56,858 acres were not reported in detail. Of the remaining 51,424 acres, of which detailed reports were received, 19,829 were devoted to sweet corn; 7,317, to watermelons; 7,082, to cabbages; 6,863, to tomatoes; 3,646, to muskmelons; 2,580, to cucumbers; 767, to asparagus; 599, to pease; 494, to rhubarb; 334, to carrots; 333, to celery; 292, to beans; 291, to beets; and 997, to other vegetables.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 16,794 acres, distributed among 56,763 farms. The value of the fruits grown was $1,293,233, an average of $23 per farm. Of the total area, 7,113 acres, or 42.4 per cent, were in strawberries, and 5,032 acres, or 30.0 per cent, in blackberries and dewberries. The yields of these fruits were 13,151,330, and 7,294,990 quarts, respectively. The acreage and production of other berries were as follows: Raspberries and Logan berries, 2,909 acres and 3,458,000 quarts; currants, 640 acres and 842,000 quarts; gooseberries, 491 acres and 779,730 quarts; and other berries, 609 acres and 603,166 quarts.

TOBACCO.

The present census shows that in 1899 tobacco was grown by 2,106 farmers on 2,242 acres of land, an average of 1.1 acres for each farm reporting. From this area they produced 1,447,150 pounds. There were decreases in ten years of 46.0 per cent in acreage, and of 52.4 per cent in production. The average production for the five census years, 1849 to1889, was 3,990,938 pounds, the largest crop being in 1859, when 6,885,262 pounds were reported. From that time to the present there has been a steady decrease. The average yield per acre was 645.5 pounds in 1899, and 732.4 pounds in 1889. The total value of the crop of 1899 was $85,411, an average of $40.56 per farm reporting, and $38.10 per acre.

The crop was grown in 77 counties, Saline county leading, with 642 acres, or 28.6 per cent of the entire acreage, and 30.2 per cent of the total production.

SORGHUM CANE.

The present census shows that in 1899, 16,203 farmers raised 9,158 acres of sorghum, from which they sold 5,165 tons of cane for $14,257, and from the remaining product manufactured 625,939 gallons of sirup, valued at $209,087, making the total value of sorghum products for 1899, $223,344, an average of $13.78 for each farm reporting. There was a decrease in acreage from 1889 of 40.5 per cent.

The crop was distributed over 101 counties of the state, the area ranging from 3 acres in Boone to 358 acres in Saline county, which reported the largest acreage. The average area for each farm reporting was 0.57 acre.

BROOM CORN.

In 1899, 95,137 acres, reported by 3,018 farmers, produced 60,665,520 pounds of broom corn, valued at $2,357,066. This is nearly four times the amount reported in 1890. The average area per farm reporting was 31.5 acres; the average yield per acre, 638 pounds; the average value per acre, $24.78; and the average value per pound, 4 cents. The five counties of Coles, Douglas, Moultrie, Edgar, and Cumberland, situated in the east central part of the state, and ranking in the order named, produced more than five-sixths of the total crop.

CASTOR BEANS.

Castor beans were grown in 1899 by 300 farmers, who devoted 2,688 acres to their cultivation and secured therefrom a product of 15,695 bushels, an average of 5.8 bushels per acre. Of the total acreage, 94.0 per cent was reported from the southern counties of Clinton, Franklin, Jefferson, Bond, and Wayne, ranking in the order named.

SUGAR BEETS.

Though begun in the last decade, the growing of sugar beets is rapidly becoming an important branch of agriculture in Illinois. In 1899, 78 farmers devoted to this crop an area of 1,370 acres, an average of 17.6 acres per farm. They obtained and sold from this land 9,109 tons of beets, an average yield of 6.6 tons per acre, and received therefrom $36,223, an average of $464 per farm, $26 per acre, and $3.98 per ton. The cultivation of sugar beets was carried on in 15 counties, but to a very limited extent except in Tazewell county, which reported 72.8 per cent of the total acreage.

NURSERIES.

The total value of nursery stock sold in 1899 was $578,306, reported by the operators of 288 farms and nurseries. Of this number, 126 derived their principal income from the nursery business. They had 7,760 acres of land, valued at $1,442,220; buildings, $249,745; implements and machinery, $29,431; and live stock, $22,190. Their total income, exclusive of products fed to live stock, was $597,351, of which $544,944 represents the value of nursery stock, and $52,407 that of other products. The expenditure for labor was $143,173, and for fertilizers, $5,115. The average gross income was $4,741.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 679 acres, and the value of the products sold therefrom, $1,894,960. These flowers and plants were grown by 646 farmers and florists. Of this number, 499, who made commercial floriculture their principal business, had invested in the aggregate $4,648,056, of which $2,439,163 represents the value of land and improvements other than buildings; $2,096,652, the value of buildings; $90,651, that of implements and machinery; and $21,590, that of live stock. Their sales of flowers and plants amounted to $1,823,809, and other products, $41,913. They expended for labor $420,538, and for fertilizers, $24,222. The average gross income was $3,739.

In addition to the 499 principal florists, 1,199 farmers and market gardeners made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 2,433,114 square feet, making, with the 6,310,906 square feet belonging to the florists' establishments, a total of 8,744,020 square feet.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $22,182,550, an average of $84 per farm. The average was highest on the most intensively cultivated farms, being $1,136 for nurseries, $843 for florists' establishments, $134 for dairy farms, $132 for sugar farms, $119 for vegetable farms, $94 for fruit farms, $91 for hay and grain farms, $69 for live-stock farms, and $49 for tobacco farms. "Managers" expended for labor, $340; "cash tenants," $105; "owners," $77; and "share tenants," $71. White farmers expended $84 per farm, and colored farmers, $23.

Fertilizers purchased in 1899 cost $830,660, an average of $3 per farm, and nearly seven times the amount reported in 1890. The average expenditure was $49 for florists' establishments, $41 for nurseries, $15 for vegetable farms, $6 for dairy farms, $3 for hay and grain farms, $2 for live-stock farms, and $1 for tobacco farms.

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 214. WASHINGTON, D. C. June 28, 1902.

MANUFACTURES.

CARS, STEAM RAILROAD.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on the manufacture of steam railroad cars, not including those made by steam railroad companies, and of cars and general shop construction and repairs by steam railroad companies, for the census year, 1900, prepared under my direction by Mr. George A. Hutchins, of the Census Office.

The modern tendency toward concentration of industrial enterprises is well exemplified in the establishments engaged in car construction, not operated by railroad companies. During the twenty years prior to 1900, the number of establishments decreased from 130 to 65, a decrease of 50 per cent, while the capital and product increased 834.9 per cent and 233.3 per cent, respectively, during the same period.

The statistics are presented in 16 tables. Table 1 shows, for the census year, a combined summary of the operations of the two industries, the manufacture of steam railroad cars, not including those made by steam railroad companies, and of cars and general shop construction and repairs by steam railroad companies. Table 2 shows comparative figures for the two industries at the several censuses. The statistics for steam railroad cars, not including operations of steam railroad companies, are presented in Tables 3 to 9, inclusive, as follows: Table 3, showing a comparative summary of steam railroad cars, not including operations of railroad companies, for 1880, 1890, and 1900; Table 4, showing a comparative summary of the statistics of capital for 1890 and 1900; Table 5, showing the cost of materials used in 1900; Table 6, showing a comparative summary by states, 1890 and 1900; Table 7, showing the statistics for this industry in four geographic divisions of the United States; Table 8, showing the exports of cars for 1880, 1890, and 1900; and Table 9, showing the detailed statistics for the industry in 1900, by states and territories. Tables 10 to 16, inclusive, present the statistics for cars and general shop construction and repairs by steam railroad companies, as follows: Table 10, showing a comparative summary of cars and general shop construction and repairs by steam railroad companies for 1890 and 1900; Table 11, showing a comparative summary of the statistics of capital for 1890 and 1900; Table 12, showing the cost of materials used in 1900; Table 13, showing a comparative summary, by states and territories for 1890 and 1900; Table 14, showing the statistics of repair shops in seven geographic divisions of the United States; Table 15, showing a combined summary of the products for 1900; Table 16, showing the detailed statistics for the industry in 1900, by states and territories.

Table 2 shows the growth of the industry for the half century which terminates with the Twelfth Census. The manufacturing statistics of the censuses prior to 1850 were too imperfect and fragmentary in character to make it proper to reproduce them in such a table as a measure of industrial growth in the first half of the century. Owing to changes in the method of taking the census, comparisons between the earlier and later decades, represented in Table 2, should be drawn only in the most general way. Nevertheless, the rate of growth in the manufacture of steam railroad cars may be fairly inferred from the figures given.

The schedules of inquiry for the census of 1900 were designed to elicit complete data relative to this industry, while at the same time care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

The 1,361 establishments represented in the combined summary of the two industries, with a capital of $207,904,125 and a product aggregating $308,748,457, employed 207,105 wage-earners during the census year. To these employees the sum of $113,049,623 was paid in wages. In addition to the wage-earners, employment was given to 8,462 salaried officials, clerks, etc., to whom salaries amounting to $7,748,379 were paid. There was expended by these establishments for miscellaneous expenses, $9,131,216, and for the total cost of materials utilized in the manufacture of the product, $171,281,760. It is not to be assumed, however, that a combination of these figures of expenses, subtracted from the total reported value of products, is, in any way, indicative of the profits in the manufacture of these products during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of the interest on capital invested, or of mercantile losses incurred in the business, or of depreciation in plant. Establishments operated by steam railroad companies, constructing and repairing cars for their own use, have, in most cases, considered the value of the product equal to the cost of labor, materials, and miscellaneous expenses incident to the manufacture of same. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures.

THE MANUFACTURE OF STEAM RAILROAD CARS.

By George A. Hutchins.

HISTORICAL AND DESCRIPTIVE.

A report of the manufacture of cars and general shop construction and repairs by steam railroad companies, and of steam railroad cars, not including those made by railroad companies, should be prefaced by a brief account of the marvelous growth of that industry, effected by invention, experience, and changed requirements. The development and importance of railroads in the United States have been commensurate with the economic growth and political power of the nation.

The railroad is an important factor in human progress, and has promoted the unification of the nation, by bringing men more closely together, and by furnishing the means of satisfying their wants with the varied treasures and products of the earth. Indeed, this vast network of railways has become the arterial system of national life, carrying to and fro the commerce of the nation and making the world one vast market. Every sphere of the social, industrial, and political world reflects the marvelous achievements of this agent of transportation.

The American railroad car is the outcome of a remarkable yet gradual development. Invention has followed invention, discovery has succeeded discovery, until, from the old-fashioned stage-coach placed on an unstable frame, with four flanged wheels, and heated with a warming pan, has been developed the luxury of the private car of to-day.

The railway was the invention of England, at that time leader of the world in the knowledge of the useful arts. There the power of steam was first utilized and first applied to locomotion. The use of cars for transportation can be traced as far back as the year 1734, when Ralph Allen constructed a stone car which was clearly the forerunner of the freight car of to-day. The first passenger car was constructed in 1814. It consisted simply of the body of a stage-coach mounted on a wooden frame with flanged wheels. It was natural that the stage-coach should be selected as a model, for in it the conveniences of travel had been most highly developed, and it was also a matter of economy, for the stage owners became railroad promoters and transformed their displaced vehicles into railway coaches.[1]

[1] One Hundred Years of American Commerce, Vol. I, page 113.

In 1825 the Stockton and Darlington Railway of England was opened, and trains of coal cars with one passenger coach were run regularly. The coach was well patronized for a time, but when the novelty wore off the faster stage-coaches carried the passengers.

The railway system which had its origin in England was quickly adopted in the United States. In 1827 a crude railway was constructed between Quincy and Boston for the purpose of transporting granite for Bunker Hill monument. The Delaware and Hudson Canal Company, in 1829, opened a road from Honesdale, to Carbondale, Pa., a distance of 16 miles, over which the first locomotive was run in this country. About the same time the South Carolina Railroad was begun. The first division of the Baltimore and Ohio road was opened in 1830. It was at first operated by horsepower, but steam locomotion was substituted in 1832. As early as 1840 a well defined system of railroads had been established in New England, and prior to 1845 the Pennsylvania and Reading was in operation, running to the coal fields of Pennsylvania. By means of these and subsequently constructed lines, the Atlantic states were put in close communication with the vast mineral supplies upon which is based the industrial and commercial development of the country.

In America the changes in car construction have been marked. The first important modifications were made necessary by the speed developed in the locomotive. With increased speed, the light, cast-iron wheels first demanded attention. The shape of the tread and flange was developed by Knight. Edgar and Winans developed the "chilled" features, and Davis altered the disposition of the metal and introduced into the cast-iron wheel a wrought-iron ring, thus perfecting the chill and strengthening the wheel. The light, unsteady cars easily adapted themselves to the unevenness of the road, but the new conditions of speed demanded a stronger rail, a more stable car frame, a flexible truck, and improvement in brakes. Indeed, the development of the locomotive has necessitated a scientific development of the entire railway system.

Adaptation to circumstances has changed the rail from the rude wooden stringer with a piece of strap iron spiked along the top, to the present refined section of steel, whose every dimension, angle, and curve are exactly suited to the tremendous strain it has to bear.

In 1833, Ross Winans, of Baltimore, built three long cars, each capable of seating 60 passengers. With these originated the American passenger car of the present day, and to Winans is due the adoption of cars with longer and more stable frames, having bogie or swiveling four-wheeled trucks at each end. These cars were a marked improvement upon the old coach, yet they have been aptly called "combinations of inconveniences." Until late in the fifties the springs were made of india rubber. These were unsatisfactory because of their tendency to harden with age, and gradually they were replaced by steel springs. The cars had no raised roof. The windows were glazed in solid without any sash, because of the fear that accidents would surely follow should they be opened. The methods of ventilation supplied an abundance of dust and cinders. The lighting was poor. The heat was supplied by cast-iron stoves which broiled those who sat near them, while they failed to warm those who did not.

The proper ventilation of cars is a problem that has not yet been satisfactorily solved. The successful system must at all times supply a sufficient quantity of air, without creating a draft, lowering the temperature, or admitting dust, cinders, smoke, or gases. Probably the best system provides for the admission of air from the exterior of the car to steam pipes where it may be heated before it reaches the interior.

The demand for adequate lighting has resulted in the adoption of a number of different systems. Electric lights are clean, cool, safe, and very desirable, but in their present stage of development they are too expensive for general use. The Pintsch system of lighting, which uses a high quality of oil gas, furnishes a desirable light and one which works well practically. It is safe, clean, of nominal cost, and in case of collisions or derailment does not furnish fuel to the flames.

Many of the dangers of the old platform, buffer, and coupler were eliminated by the patents of Colonel Miller, in 1867, but it was not until after the dining car was introduced that the importance of a safe, covered passageway came to be fully recognized. This need was met by Mr. Pullman in his "vestibuled train," which not only provides for the convenience and safety of the passengers while going from one car to another, but at the same time furnishes a buffer extending from platform to roof, thus producing one of the best anti-telescoping features and greatly lessening the danger to human life in case of collision. The brake, with its wonderful development from the old hand brake to the air brake patented by Westinghouse; and the modern coupler, which is the result of countless experiments and over 6,500 patented inventions, have eliminated many of the dangers of the old methods and devices. Each year shows a marked improvement in features contributing to the comfort and safety of the passenger, and in providing cheap, speedy, regular, and adequate transportation in cars especially adapted to the needs of the public.

In the construction of freight cars, the change has been equally marked. Many devices for the protection of life and property have been readily adopted. There is a general tendency toward specialization. No longer are grain, beef, fruits, and oil shipped in the same kind of cars. The transportation of various kinds of products has called into being cars peculiarly adapted to each class of freight, so that scores of different kinds of cars are now constructed to meet the demands of shippers. Perishable articles are now conveyed in cars which insure their preservation.

The tendency of the changes in the modern freight car is toward increased weight, strength, size, and convenience. In developing these qualities steel has been used in some cases to replace wood, and, in other cases, steel plates have been used to strengthen wooden construction. Ten years ago the steel car industry was in its infancy, but its growth during the decade has been phenomenal. At present the Pressed Steel Car Company, of Pittsburg, Pa., using in the manufacture of its product over 1,600 tons of steel a day, is the largest single consumer of steel in the world. The changes have resulted in an increased carrying capacity of the cars, a decrease in the relative dead weight moved, and a better paying load. Marked advances in the average capacity per car have been made in the last few years. The normal capacity in the sixties was about 15,000 pounds. The capacity increased to 28,000 in 1873; to 40,000 in 1875; to 60,000 in 1885; to 70,000 in 1895; while at the present time cars with a capacity of 80,000 to 100,000 pounds are in every-day use.

The economy of heavy loading has been indisputably proved. According to figures of the Industrial Commission, the average train load for the United States, as a whole, increased from about 175 tons of paying freight in 1890 to 243.5 tons in 1899.

The movement toward combination began among the railroads earlier than in industrial lines, and made possible "through trains" by which goods could be shipped long distances rapidly and at low rates.

The changes that have taken place in business methods have been largely due to improved methods of transportation. The traffic of railroads has become the greatest single business ever carried on in the annals of the world, all other business contributing to swell its volume. It has become one of the greatest factors in changing the conditions of supply and demand and revolutionizing the habits and aspirations of mankind.

The service of railroads in the United States may perhaps be best shown by the statement that during 1900 the passenger mileage amounted to upward of 1,600,000,000 miles, a journey of 211 miles per capita for the population of the country. The ton mileage of freight amounted to 141,599,000,000 tons; that is, the freight service of the country was equivalent to the carriage of this amount of freight 1 mile.[1]

The census year was characterized by extraordinary activity in construction. Table 15 shows that in the car department 144,505 cars were constructed for steam railways, and 8,376,769 cars were repaired. In the motive department of the railroad repair shops 272 locomotives were built, and 1,375,265 were repaired. The number of repairs shown for cars and locomotives may include several repairs on the same car or locomotive. It must not be inferred that the number of single cars and locomotives reach so large a total. The total value of all new equipment manufactured and work necessary to keep the vast amount of rolling stock in repair during the year was $308,748,457.

A study of economic history and industrial progress leads to the conclusion that in no other country has the development of the car industry been more rapid than in the United States. Transportation of persons and property with ease, speed, and safety has ever been the aim of railroad promoters and the demand of the American people, and as a result, the railway system of the United States to-day is the most progressive and among the most perfect in the world.

The statistics presented in the following tables embrace the operations of establishments engaged in the construction of "cars, steam railroad, not including operations of railroad companies," and "cars and general shop construction and repairs by steam railroad companies," during the census year. In these tables the figures showing the manufacture of street cars, whether horse, cable, or electric, appear only where they were constructed as a by-product in large plants engaged in the manufacture of steam railway cars. In the motive power and machinery department, the report of the number of locomotives built and repaired does not include the operations of the regular locomotive works in the country, but only those constructed and repaired by the railroad companies in their repair shops. The report of the bridge and building department includes the shop work only.

In reporting the operations of steam railroad companies, where cars were constructed and repaired for the use of the corporation operating the plant, the value of products equals the cost of labor, materials, and miscellaneous expenses incident to the manufacture of same. It was deemed inexpedient to estimate the market value of the cars constructed for, and repair work done on cars owned by the railroad companies operating their own plants; therefore an increase over cost is shown only on cars constructed for other railroad companies or contract work done for other establishments. Table 1 presents a combined summary for the industries—cars, steam railroad, not including operations of railroad companies, and cars and general shop construction and repairs by steam railroad companies.

[1] Report of Industrial Commission, Vol. XIX, page 262 f.

TABLE 1.—CARS, STEAM RAILROAD: COMBINED SUMMARY FOR THE UNITED STATES, 1900.

	Total.	Cars, steam railroad, not including operations of railroad companies.	Cars and general shop construction and repairs by steam railroad companies.
Number of establishments	1,361	65	1,296
Capital:			
Total	$207,904,125	$88,323,852	$119,580,273
Land	$21,283,601	$4,306,808	$16,976,693
Buildings	$45,860,155	$9,229,810	$36,630,345
Machinery, tools, and implements	$37,987,255	$9,538,673	$28,448,582
Cash and sundries	$102,773,214	$65,248,561	$37,524,653
Salaried officials, clerks, etc., number	8,462	1,366	7,096
Salaries	$7,748,379	$1,638,132	$6,210,247
Wage-earners, average number	207,105	33,453	173,652
Total wages	$113,049,623	$16,987,294	$96,062,329
Miscellaneous expenses	$9,131,216	$2,837,229	$6,293,987
Cost of materials used	$171,281,760	$61,742,747	$109,539,013
Value of products[1]	$308,748,457	$90,510,180	$218,238,277

[1] Including custom work and repairing by steam railroad companies.

The combined summary in Table 1 shows that in the census year there were 1,361 establishments, with a capital of $207,904,125, employing 215,567 wage-earners and salaried officials, with wages and salaries aggregating $120,798,002. The materials used cost $171,281,760 and the value of products aggregated $308,748,457.

Of the 1,361 establishments in the combined industry, 1,296, or 95.2 per cent, were operated by railroad companies. These establishments reported a capital invested of $119,580,273, or 57.5 per cent of the capital of the combined industry. Of 8,462 salaried officials, 7,096, or 83.9 per cent, were employed in shops operated by railroad companies, and received $6,210,247, or 80.1 per cent of the total salaries paid in this industry.

The total number of wage-earners, 207,105, received $113,049,623. There were 173,652 wage-earners employed in railroad repair shops, who received $96,062,329; that is, 83.8 per cent of the total number of wage-earners engaged in this industry were employed by establishments operated by railroad companies, and received 85 per cent of the total wages.

Of the total cost of materials, $109,539,013, or 64 per cent, was reported for establishments operated by railroad companies, and of the $308,748,457 reported for the total value of the product, $218,238,277, or 70.7 per cent, was reported for railroad repair shops.

Steam railroad companies engaged in the construction and repair of cars in 1900, had an average capital of $92,191, with 139 salaried officials and wage-earners, and salaries and wages aggregating $78,914. The cost of materials for each plant averaged $84,521, and the average product was $168,394.

The average capital per establishment in plants not operated by steam railroad companies, in 1900, was $1,358,828. The number of wage-earners and salaried officials per establishment was 536, with wages and salaries aggregating $285,007. The cost of materials per establishment was $949,888, and the value of products was $1,392,464.

The amount of capital per wage-earner, as deduced from the report of railroad repair shops, was $689, and in car construction the reports show $2,640 capital per wage-earner. This difference is due mainly to the fact that car-construction plants not operated in connection with railroad companies usually have more cash on hand, bills receivable, unsettled ledger accounts, stock in process of manufacture, and finished products on hand than does the plant whose product is immediately converted to its own use. The cost of materials and the value of the product per wage-earner for railroad repair shops were $631 and $1,257, respectively, while plants not operated by railroad companies reported $1,846 for the cost of materials used, and $2,706 for value of product per wage-earner.

Table 2 presents a comparative summary of the combined industries, as reported at the several censuses from 1850 to 1900, inclusive, with the per cent of increase for each decade.

Since the beginning of the second quarter of the last century, the manufacture and repair of cars for steam railways has developed until it produces an annual product to the value of over $300,000,000. No comparison can be made with 1880, as the operations of establishments by railroad companies were not reported at that census. The fact that the classification has been slightly changed must also be taken into consideration in comparing the reports of 1890 and 1900 with the reports of previous censuses. The summary for 1870 includes the construction and repair of street railway cars. The Eleventh and Twelfth censuses include the construction of street railway cars only when they are manufactured as a by-product in large steam railway car construction plants. There were separate classifications for the construction and repair of street railway cars in 1890 and 1900. The first census at which the statistics of the manufacture and repair of cars were returned with sufficient accuracy and detail to justify a comparison, was that of 1850. In that year 41 establishments were reported, and in 1860 the number was increased to 62, an increase of 21 establishments, or 51.2 per cent. The capital increased $2,057,702, or 229.7 per cent, and during the decade the value of the product increased $1,809,055, or 72.5 per cent. From 1860 to 1870 there was an increase of 109 establishments, or 174.2 per cent, while the capital increased $13,669,075, and the value of the product increased $26,768,121. From 1870 to 1890 the number of establishments increased 617; the capital, $103,200,895; the cost of materials increased $93,118,305; and the value of the product advanced $168,474,701.

Table 2.—CARS, STEAM RAILROAD: COMPARATIVE SUMMARY, 1850 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.						PER CENT OF INCREASE.			
	1900	1890	1880[4]	1870	1860	1850	1890 to 1900	1870 to 1890	1860 to 1870	1850 to 1860
Number of establishments	1,361	787	......	170	62	41	72.9	362.9	174.2	51.2
Capital	$207,904,125	$119,833,687	......	$16,632,792	$2,953,717	$896,015	73.5	620.5	463.1	229.7
Salaried officials, clerks, etc., number	8,462	[3]2,661	......	(1)	(1)	(1)	218.0	....	....	....
Salaries	$7,748,379	[3]$2,343,944	......	(1)	(1)	(1)	230.6	....	....	....
Wage-earners, average number	207,105	137,986	......	15,931	3,179	1,554	50.1	766.1	401.1	104.6
Total wages	$113,049,623	$76,290,262	......	$9,659,992	$1,237,452	$664,708	48.2	689.8	680.6	86.2
Men, 16 years and over	206,345	137,352	......	15,690	3,172	1,554	50.2	775.4	394.6	104.1
Wages	$112,842,153	$76,127,521	......	(1)	(1)	$664,708	48.2	....	....	....
Women, 16 years and over	471	382	......	20	7	....	23.3	1,810.0	185.7	....
Wages	$138,878	$114,939	......	(1)	(1)	....	20.8	....	....	....
Children, under 16 years	289	252	......	221	....	....	14.7	14.0	....	....
Wages	$68,592	$47,802	......	(1)	....	....	43.5	....	....	....
Miscellaneous expenses	$9,131,216	$1,725,113	......	(2)	(2)	(2)	429.3	....	....	....
Cost of materials used	$171,281,760	$111,236,012	......	$18,117,707	$1,841,344	$1,393,676	54.0	514.0	883.9	32.1
Value of products[5]	$308,748,457	$199,545,435	......	$31,070,734	$4,302,613	$2,493,558	54.7	542.2	622.1	72.5

[1] Not reported separately.
[2] Not reported.
[3] Includes proprietors and firm members, with their salaries.
[4] No comparison can be made for 1880.
[5] Including cu om work and repairing by steam railroad companies.

During the last decade the car industry has shown another marked advance. In 1890 there were 787 establishments, with a capital of $119,833,687, and an aggregate product of $199,545,435; in 1900 there were 1,361 establishments, with a capital of $207,904,125, and an aggregate value of product of $308,748,457; an increase of 574, or 72.9 per cent, in the number of establishments, $88,070,438 in capital, and $109,203,022, or 54.7 per cent, in value of product. The total number of wage-earners has increased from 1,554, with wages aggregating $664,708, in 1850, to 207,105, with wages aggregating $113,049,623, in 1900. Of the total number of employees in this industry in 1900, 206,345, or 99.6 per cent, were men over 16 years of age. Thus Table 2 shows the remarkable growth of this industry during the past half century. The striking increase in the number of establishments, from 41 in 1850 to 1,361 in 1900, an increase of 1,320, has not kept pace with the increase in capital, wage-earners, wages, materials, and product during the same period.

The following are the averages per establishment for 1850 and 1900, respectively: Capital, $21,855 and $152,758; wage-earners, 38 and 152; wages, $16,212 and $83,064; cost of materials, $33,992 and $125,850; and product, $60,818 and $226,854.

CARS, STEAM RAILROAD, NOT INCLUDING THE OPERATIONS OF RAILROAD COMPANIES.

Table 3 presents a comparative summary, 1880 to 1900, with percentages of increase.

TABLE 3.—CARS, STEAM RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES: COMPARATIVE SUMMARY, 1880 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.			PER CENT OF INCREASE.	
	1900	1890	1880	1890 to 1900	1880 to 1890
Number of establishments	65	71	130	[1]8.5	[1]45.4
Capital	$88,323,852	$43,641,210	$9,272,680	102.4	370.6
Salaried officials, clerks, etc., number	1,366	[2]708	([3])	92.9	......
Salaries	$1,538,132	[2]$759,702	([3])	102.5	......
Wage-earners, average number	33,453	31,354	14,232	6.7	120.3
Total wages	$16,987,294	$16,076,829	$5,507,753	5.7	191.9
Men, 16 years and over	33,136	30,904	13,885	7.2	122.6
Wages	$16,902,543	$15,966,188	([3])	5.9	......
Women, 16 years and over	107	254	13	[1]57.9	1,853.8
Wages	$32,452	$75,691	([3])	[1]57.1	......
Children, under 16 years	210	196	334	7.1	[1]41.3
Wages	$52,299	$34,950	([3])	49.6	......
Miscellaneous expenses	$2,837,229	$1,725,113	([3])	64.5	......
Cost of materials used	$61,742,747	$44,674,486	$19,780,271	38.2	125.9
Value of products	$90,510,180	$70,083,737	$27,997,591	29.1	150.3

[1] Decrease.
[2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 8.)
[3] Not reported separately.

One of the most notable features in the above table is the decrease in the number of establishments, caused by the combination or consolidation of a number of plants under a single corporate management. While the number of establishments had decreased 50 per cent from 1880 to 1900, the capital increased more than eightfold, or $79,051,172, and the value of the product increased $62,512,589, or 223.3 per cent, during the same period. In 1880 there were 130 establishments, and in 1890 the number had been reduced to 71; a decrease of 59 establishments, or 45.4 per cent, during the decade. From 1890 to 1900 there was a decrease of 6 establishments, or 8.5 per cent. The capital increased from $9,272,680 in 1880 to $43,641,210 in 1890, and in 1900 the aggregate capital was $88,323,852, an increase of $44,682,642, or 102.4 per cent, over 1890. The amount paid to wage-earners showed an increase of $10,569,076, or 191.9 per cent, from 1880 to 1890, and a further increase of 5.7 per cent during the last decade, while the number of wage-earners increased 120.3 per cent from 1880 to 1890 and 6.7 per cent during the succeeding decade.

In comparing the increase in the cost of materials used and the value of the product, we find that from 1880 to 1890 the cost of materials increased $24,894,215, or 125.9 per cent, and the value of the product increased $42,086,146, or 150.3 per cent. In 1890 the cost of materials was $44,674,486, and in 1900 it was $61,742,747, an increase of $17,068,261, or 38.2 per cent. The value of the product increased from $70,083,737 to $90,510,180, or 29.1 per cent. From 1880 to 1890 the number of women employed increased from 13 to 254, but the next decade showed a decrease from 254 to 107, or 57.9 per cent. The number of children employed decreased 41.3 per cent from 1880 to 1890. During the last decade the number of children employed increased from 196 in 1890 to 210 in 1900, or 7.1 per cent, and the wages increased from $34,950 in 1890 to $52,299 in 1900, or 49.6 per cent. The increase in the average wages paid to children is probably due to the fact that more complex machinery is being used, and also to laws enacted by various states, defining and limiting the ages and number of hours per day which a minor shall work in mines or in manufacturing and mechanical industries. The capital, materials, and value of product have increased faster than has the number of wage-earners, showing that with increased equipment of plant an operative can use more material and manufacture a larger product than in 1880 or 1890.

While the number of establishments has decreased from 130 to 65 from 1880 to 1900, the average capital per establishment has increased from $71,328 to $1,358,828. The average cost of materials was $152,156 per establishment in 1880, and $949,888 in 1900, and the value of the product increased from $215,366 per establishment in 1880 to $1,392,464 in 1900. The amount of capital per wage-earner was $652 in 1880; $1,392 in 1890; and $2,640 in 1900. The cost of materials per wage-earner was $1,390 in 1880; $1,425 in 1890; and $1,846 in 1900. The value of the product manufactured by each wage-earner was $1,967 in 1880; $2,235 in 1890; and $2,706 in 1900.

Table 4 presents a comparative summary of the capital for 1890 and 1900 with the per cent that each item is of the total, and the per cent of increase during the decade.

TABLE 4.—CARS, STEAM RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES: COMPARATIVE SUMMARY OF CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$88,323,852	100.0	$43,641,210	100.0	102.4
Land	4,306,808	4.9	3,811,086	8.7	13.0
Buildings	9,229,810	10.4	7,878,189	18.1	17.2
Machinery, tools, and implements	9,538,673	10.8	7,626,804	17.5	25.1
Cash and sundries	65,248,561	73.9	24,325,131	55.7	168.6

The total capital for 1900 was $88,323,852, while in 1890 it was $43,641,210; an increase of $44,682,642, or 102.4 per cent, during the decade. In 1890 the value of land was $3,811,086, which was 8.7 per cent of the total capital, and in 1900 the value was $4,306,808, or 4.9 per cent of the total; an increase of $495,722, or 13 per cent. The value of buildings increased from $7,878,189 in 1890 to $9,229,810 in 1900, an advance of 17.2 per cent. An increase of 25.1 per cent, or $1,911,869, in the value of machinery, tools, and implements makes that item now exceed the value of buildings, and more than double the total value of land. The most marked increase is found in the item of capital, which includes cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries. In 1890 the value of this item was $24,325,131, or 55.7 per cent of the total. The item increased $40,923,430, or 168.2 per cent, during the decade, and in 1900 formed 73.9 per cent of the total capital. It can readily be seen that the constant demand for new varieties of cars, and the tendency to use steel in place of wood requires new and more expensive equipment, as well as a greater amount invested in materials in process of manufacture, and an increased value of finished products on hand.

Table 5 presents the cost of all materials used.

TABLE 5.—CARS, STEAM RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES: COST OF MATERIALS USED, 1900.

MATERIALS USED.	Amount.	Per cent of total.
Total	$61,742,747	100.0
Principal materials[1]	59,773,393	96.8
Fuel	1,021,046	1.7
Rent of power and heat	313	(2)
Freight	947,995	1.5

[1] Includes mill supplies, and all other materials, which are shown separately in Table 8.
[2] Less than one-tenth of 1 per cent.

The cost of partially manufactured materials, or those which have passed through one or more stages of production, such as lumber, iron, steel, etc., constituted the principal item, aggregating more than nine-tenths the total cost. The amount paid for rent of power and heat was very small, showing that practically all of the power used in car construction was owned by the company operating the plant. The cost of fuel was $1,021,046, or 1.7 per cent, and the amount of freight paid was $947,995, or 1.5 per cent of the total cost. During the decade the cost of materials increased $17,068,261, or 38.2 per cent.

The miscellaneous expenses, comprising rent of works, taxes, contract work, rent of offices, interest, insurance, ordinary repairs to buildings and machinery, and expenses incurred in the manufacture of the product, other than those reported for wages and materials, aggregated $2,837,229. (See Table 9.) The amount paid for ordinary repairs of buildings and machinery, and for insurance, interest, advertising, etc., is the principal item of the miscellaneous expenses, aggregating $2,240,558, or 79 per cent of the total. Of the remaining items, contract work forms 14.3 per cent of the total expenses; taxes, 5.6 per cent; and rent of works only 1.1 per cent. No comparison of the separate items of miscellaneous expenses can be made with previous censuses, as in 1890 reports were made of total expenses only, and no figures were presented previous to the Tenth Census.

In 1890 there were in the United States 71 establishments engaged in car construction other than those operated by steam railroad companies, and during the decade 17 new establishments were constructed, but in 1900 only 65 establishments were in operation. This condition clearly illustrates the industrial changes which are constantly taking place in the commercial world. It does not necessarily indicate that 23 establishments formerly engaged in car construction have gone out of business and their plants are idle. In many cases the larger manufacturers have purchased the plants of their smaller competitors, and now use them for the manufacture of supplies for the central plants. Thus the product has been changed, and they can no longer be classified as establishments engaged in car construction and repairs. In some instances an establishment which was classified under "foundry and machine shop products" in 1890 had so changed its product that "car construction" predominated in 1900. This may account for the fact that, in some states, there was an increased number of establishments engaged in this industry, without a corresponding increase in the number of plants constructed during the decade.

In considering the location of the various plants it is interesting to note that a large part of the manufacturing was done near the various supply centers as well as in places convenient to commercial centers. In 1890 Pennsylvania was the leading state, with 15 establishments; in 1900 the number was reduced to 11. In Illinois the number of establishments has increased from 9 to 17, with a corresponding increase in production, and both in the number of plants engaged in the industry, and in the value of the product, this state has now taken first place. The North Central and the North Atlantic states, on account of their close proximity to coal fields, lumber districts, and the great commercial centers, have special advantages in the manufacture of cars, and in them are found the greatest number of well-equipped plants, and the greatest activity in the construction of new plants during the decade.

From the accompanying tables it will be seen that a large percentage of the establishments engaged in the manufacture of steam railroad cars, exclusive of those made by railroad companies, were located within a comparatively small area. The cities of Chicago, Joliet, Madison, Mt. Vernon, Litchfield, and East St. Louis, in Illinois, and St. Louis and St. Charles, in Missouri, reported a product of $32,568,374, or 36 per cent of the total product for the United States. Michigan City, Terre Haute, Indianapolis, and Jeffersonville, in Indiana, reported a product of $9,006,577, or 10 per cent of the total. Establishments in Allegheny, Pittsburg, McKees Rocks, Berwick, and Milton, in Pennsylvania, showed a product of $17,724,290, or 19.6 per cent of the total. The cities of Rochester, Buffalo, and Depew, in New York, showed a product of $5,228,351, or 5.8 per cent of the total. Detroit, Mich., Dayton, Ohio, and Wilmington, Del., reported a product of $16,707,419, or 18.5 per cent of the total.

The larger plants are, for the most part, located in the suburb of some large city, near the coal and iron districts, and in places where supplies of lumber are easily obtained. These conditions give the plant so located the advantage of being close to the great commercial centers and in a position to obtain skilled labor on short notice. The value of products, for the cities enumerated above, aggregated $81,235,012 or 89.8 per cent of the total for this branch of industry.

Table 6 presents a comparative summary of the number of establishments, capital, salaried officials and salaries, wage-earners and wages, miscellaneous expenses, cost of materials, and products, for states having 3 establishments and over, in 1890 and 1900.

TABLE 6.—CARS, STEAM RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES: COMPARATIVE SUMMARY, BY STATES, 1890 AND 1900.

STATES.	Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
United States	1900	65	$88,323,852	1,366	$1,538,132	33,453	$16,987,294	$2,837,229	$61,742,747	$90,510,180
	1890	71	43,641,210	708	769,702	23,292	11,571,617	1,725,113	44,674,486	70,083,737
Delaware	1900	3	2,429,007	73	83,528	2,032	1,041,088	121,819	1,876,435	3,274,922
	1890	3	2,839,733	46	66,469	2,001	1,039,739	87,677	1,528,528	3,291,293
Illinois	1900	17	18,732,466	279	330,409	9,314	5,360,756	483,271	17,075,461	24,846,606
	1890	9	10,070,784	176	128,712	4,583	2,768,989	217,384	10,093,125	17,117,223
Indiana	1900	4	6,062,000	96	111,858	3,337	1,550,764	224,009	6,287,256	9,006,577
	1890	4	5,199,706	34	50,880	2,650	1,319,741	150,782	4,924,342	7,073,329
Michigan	1900	4	6,693,209	107	146,795	3,187	1,409,580	227,774	7,272,761	9,920,780
	1890	5	3,769,483	85	115,868	3,406	1,376,037	245,660	8,007,974	11,078,281
Missouri	1900	4	4,530,982	117	125,561	2,772	1,373,353	198,160	5,101,335	7,722,768
	1890	5	1,442,927	50	52,247	1,354	869,104	75,773	2,655,320	3,974,173
New York	1900	4	4,299,251	92	75,920	2,091	1,038,948	81,996	3,744,911	5,228,351
	1890	5	1,835,321	53	63,342	1,792	978,102	92,779	2,382,777	3,166,771
Ohio	1900	5	2,581,894	61	75,616	1,806	862,011	45,450	2,791,908	3,942,372
	1890	5	2,843,166	21	38,890	1,326	594,505	92,007	2,817,578	4,784,136
Pennsylvania	1900	11	33,828,723	414	426,399	5,840	3,111,556	1,265,456	12,188,811	19,260,910
	1890	15	7,060,466	128	141,866	3,524	1,397,176	465,900	6,496,268	10,080,722
All other states	[1]1900	13	9,166,320	127	163,046	3,075	1,239,238	189,294	6,403,869	7,307,894
	[2]1890	20	8,579,624	115	101,438	2,656	1,228,224	297,251	5,768,584	9,517,810

[1] Includes establishments distributed as follows: Alabama, 2; Georgia, 2; Kentucky, 1; Maryland, 1; Massachusetts, 2; New Hampshire, 1; New Jersey, 2; Tennessee, 1; West Virginia, 1.
[2] Includes establishments distributed as follows: Alabama, 3; California, 1; Florida, 1; Kansas, 2; Kentucky, 2; Massachusetts, 3; Minnesota, 2; New Hampshire, 1; North Carolina, 1; Tennessee, 2; Virginia, 1; West Virginia, 1.

The states which show a decrease in both capital and product are Delaware and Ohio. The state of Michigan, while showing an increase in capital, reported a decrease in value of product of $1,157,501, or 10.4 per cent. In Illinois the capital increased from $10,070,784 in 1890 to $18,732,466 in 1900, or 86 per cent. The value of the product in 1890 was $17,117,223, and in 1900 an increase of $7,728,383, or 45.1 per cent, was shown. Indiana reported an increase of $862,294, or 16.6 per cent, in capital, and the product increased $1,933,248, or 27.3 per cent, during the decade. Missouri in 1890 reported a capital of $1,442,927; in 1900 the capital was $4,530,982, an increase of $3,088,055, or 214 per cent. The product increased from $3,974,173 in 1890 to $7,722,768 in 1900, or 94.3 per cent. The capital in New York increased 134.3 per cent, and the value of the product showed an increase of $2,061,580, or 65.1 per cent. Pennsylvania showed an increase of 379.1 per cent in capital, and an increase of $9,180,188, or 91.1 per cent, in the value of the product. The marked increase in capital in Pennsylvania was caused by the construction of new plants for the manufacture of pressed steel cars. The value of the products shown for the establishments which had been in operation only a few months during the census year was only a small fraction of their annual capacity, and therefore the value of plant and cost of equipment, together with the other items of capital, makes it appear that the increase in capital was disproportionate to that of products.

Alabama and Massachusetts each had 3 establishments in 1890, but in 1900 only 2 establishments were reported, operating independent of railroad repair shops, and no comparison can be made for the two censuses for these states.

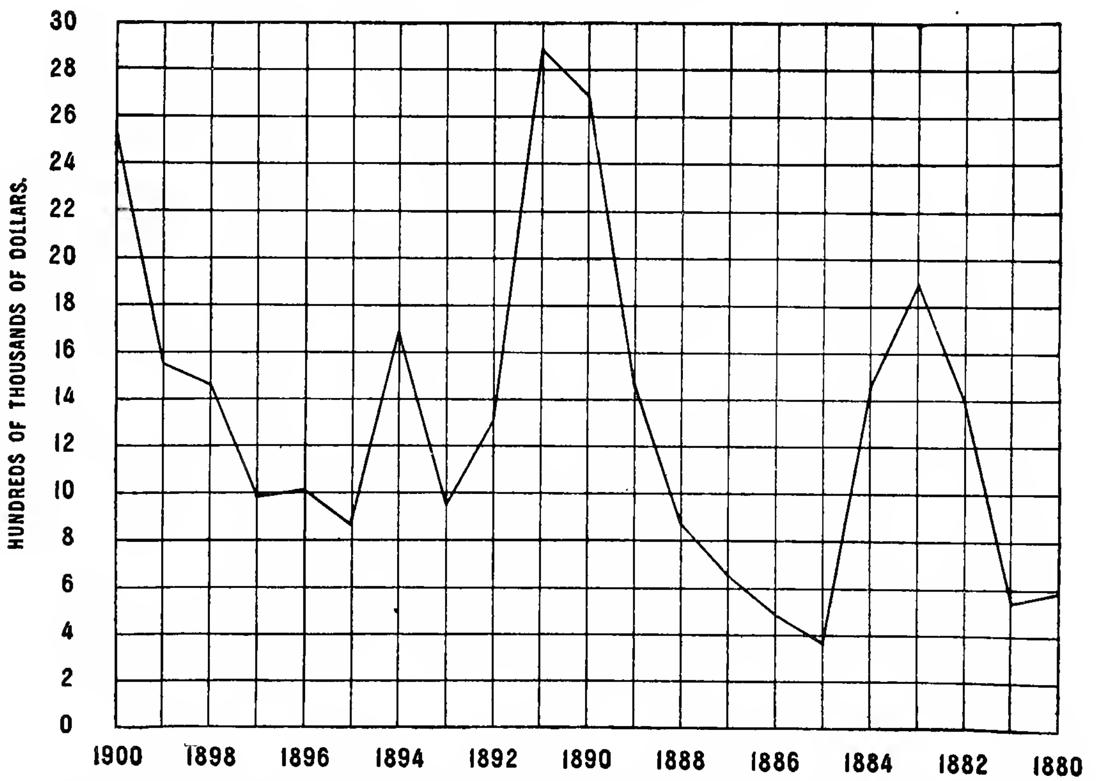
Table 7 presents the operations of establishments engaged in car construction, exclusive of plants operated by railroad companies, in four geographic divisions.

TABLE 7.—CARS, STEAM RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES: COMPARATIVE SUMMARY, BY GEOGRAPHIC DIVISIONS, 1900.

	Number of establishments.	CAPITAL.					SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS, INCLUDING PIECEWORKERS, AND TOTAL WAGES.		Miscellaneous expenses.	Cost of materials used.	Value of products (including custom work and repairing).
		Total.	Land.	Buildings.	Machinery, tools, and implements.	Cash and sundries.	Total number.	Total salaries.	Average number.	Total wages.			
United States	65	$88,323,852	$4,306,808	$9,229,810	$9,538,673	$65,248,561	1,366	$1,538,132	33,453	$16,987,294	$2,837,229	$61,742,747	$90,510,180
New England states	3	787,490	42,868	128,747	107,038	508,837	11	17,113	374	174,160	19,305	578,840	825,012
Middle states	21	45,191,780	1,680,033	3,067,463	2,751,533	37,692,751	606	629,197	10,719	5,433,698	1,500,241	19,666,277	30,121,982
Southern states	7	3,744,031	420,000	878,498	900,598	1,544,935	89	102,583	1,945	822,972	139,019	2,968,909	4,125,083
Central states	34	38,600,551	2,163,907	5,155,102	5,779,504	25,502,038	660	789,239	20,415	10,556,464	1,178,664	38,528,721	55,438,103

In the United States there were 65 establishments, with the value of products aggregating $90,510,180. The New England states, with 3 establishments, or 4.6 per cent of the total, manufactured a product of $825,012, or 0.9 per cent of the total value. In the Middle states there were 21 establishments, with an aggregate product of $30,121,982, or 33.3 per cent of the total. The Southern states, with 10.8 per cent of the total number of establishments engaged in this industry, manufactured a product of $4,125,083, or 4.6 per cent of the total. The Central states reported 34 establishments, with a product of $55,438,103, or 61.2 per cent of the total. In the New England division each establishment reported an average of 4 salaried officials, with an average salary of $1,556. The Middle states reported 29 salaried officials per establishment, with an average salary of $1,038. The salaries of 660 officials in the Central states averaged $1,196, and in the Southern states the average establishment had 13 officials, with an average salary of $1,153.

EXPORTS OF PASSENGER AND FREIGHT CARS FOR STEAM RAILROADS 1880 TO 1900.



The constantly increasing traffic in this country rapidly absorbs the product of the car shops, but there is also a foreign demand of considerable magnitude for American-built cars. This demand changes with the varying industrial conditions and commercial activity of the countries importing these products, as well as with the economic conditions existing in this country.

The above graphic chart shows the value of cars, passenger and freight, for steam railroads, exported, 1880 to 1900.

In 1890 and 1891 the value of exported cars exceeded the value in 1900. During the business depression which followed there was a marked decrease in the number of cars constructed, both for foreign and domestic use. The construction of freight cars was the first to be affected. The number of passenger cars constructed in this country did not decrease materially until after the Columbian Exposition in 1893. The foreign demand and the exposition were potent factors in keeping many of the shops running during 1893. A year or two later the demand for freight cars began to increase, and since 1897 the demand for both passenger and freight cars for foreign and domestic use has shown a constant growth. The exports for 1900, aggregating $2,558,323, exceeded the average yearly exports from 1880 to 1890 by $1,581,872; those from 1890 to 1900 by $756,484; and the average for twenty years by $1,169,178.

Table 8 presents the statistics of exports of cars and parts of cars, passenger and freight, for steam railways, 1880, 1890, and 1900.

TABLE 8.—CARS, PASSENGER AND FREIGHT, AND PARTS OF: EXPORTS, 1880, 1890, AND 1900, BY COUNTRIES.[1]

COUNTRIES TO WHICH EXPORTED.	1900	1890	1880
	For steam railroads.	For steam railroads.	For steam railroads.
Total	$2,558,323	$2,689,698	$583,723
ASIA.			
Chinese Empire	16,838		
East Indies—British	2,947		
Japan	12,589		48,562
Russia—Asiatic	898		
Turkey in Asia	220		
OCEANIA.			
British Australasia	50,754	9,000	10,204
Hawaii	15,100	5,000	
AFRICA.			
British Africa	4,744		18,100
Turkey in Africa—Egypt	401,151		
EUROPE.			
Belgium	30,713		
Denmark	125		
France	280,939	33,000	
Germany	62,319		26,800
Gibraltar			500
Italy	52,507		
Netherlands	1,925		
Portugal	1,583	16,792	1,565
Russia—Baltic and White Seas	1,300		
Spain		43,920	
Sweden and Norway	3,788		
Switzerland	4,848		
United Kingdom	124,585	190,773	61,467
NORTH AMERICA.			
Dominion of Canada:			
Nova Scotia, New Brunswick, etc	$15,464		
Quebec, Ontario, Manitoba, etc	349,078	$19,900	$2,100
British Columbia	12,070		4,716
Newfoundland and Labrador	232		
Central American states	16,495	33,865	23,613
Costa Rica	6,149		
Guatemala	1,271	3,500	
Honduras	2,664		
Nicaragua	4,704	26,365	
Salvador	1,707	4,000	
Mexico	714,329	492,326	28,743
West Indies:			
British	253	1,747	7,400
Cuba	79,723	163,455	39,450
Porto Rico	8,763		1,863
Santo Domingo	12,862	1,710	
SOUTH AMERICA.			
Argentina	105,147	1,063,319	21,162
Brazil	133,378	347,222	276,683
Chile	8,007	169,879	
Colombia	13,107	9,300	4,800
Ecuador	1,990		
Guiana—British	12,500	700	4,485
Peru	2,692	2,800	1,510
Uruguay	2,150	47,500	
Venezuela	210	7,490	

[1] Annual Reports United States Treasury Department on Commerce and Navigation of the United States, 1880, 1890, and 1900.

The exports to South American countries decreased from $1,648,210 in 1890 to $279,181 in 1900. This was probably due to the fact that there was less activity in railway construction than at the beginning of the decade; also to the fact that the railways which were in process of construction in 1890 were in a position to supply their own equipment. The exports to North American countries during the decade increased $466,266; to Europe, $280,147; and to Oceania, $51,854. No cars or parts of cars were exported to Asia or Africa in 1890, but in 1900 these exports to Asia were valued at $33,492, and those to Africa at $405,895.

Table 9 presents in detail, for 1900, the statistics relating to the manufacture of cars, steam railroad, not including operations of railroad companies, by states and territories.

TABLE 9.—CARS, STEAM RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES: BY STATES, 1900.

	United States.	Delaware.	Illinois.	Indiana.	Michigan.	Missouri.	New York.	Ohio.	Pennsylvania.	Other states.[1]
Number of establishments	65	3	17	4	4	4	4	5	11	13
Character of organization:										
Individual	1									1
Firm and limited partnership	3								3	
Incorporated company	60	3	17	4	4	4	3	5	8	12
Miscellaneous	1						1			
Capital:										
Total	$88,323,852	$2,429,007	$18,732,466	$6,062,000	$6,693,209	$4,530,982	$4,299,251	$2,581,894	$33,828,723	$9,166,320
Land	$4,306,808	$239,828	$795,701	$190,000	$736,000	$393,229	$420,305	$48,977	$944,900	$537,868
Buildings	$9,229,810	$364,493	$2,563,234	$765,000	$824,875	$755,476	$816,129	$246,517	$1,780,000	$1,114,086
Machinery, tools, and implements	$9,538,673	$348,170	$3,475,151	$675,000	$780,330	$711,140	$881,616	$137,883	$1,424,595	$1,104,788
Cash and sundries	$65,248,561	$1,476,516	$11,898,380	$4,432,000	$4,352,004	$2,671,137	$2,181,201	$2,148,517	$29,679,228	$6,409,578
Proprietors and firm members	7								6	1
Salaried officials, clerks, etc.:										
Total number	1,366	73	279	96	107	117	92	61	414	127
Total salaries	$1,538,132	$83,528	$330,409	$111,858	$145,795	$125,561	$75,920	$75,616	$426,399	$163,046
Officers of corporations—										
Number	112	7	25	6	6	2	2	10	35	19
Salaries	$535,161	$27,750	$94,409	$30,495	$33,340	$25,000	$10,883	$36,320	$219,214	$57,750
General superintendents, managers, clerks, etc.—										
Number	1,254	66	254	90	101	115	90	51	379	108
Salaries	$1,002,971	$55,778	$236,000	$81,363	$112,455	$100,561	$65,037	$39,296	$207,185	$105,296
Men—										
Number	1,200	64	244	85	99	101	87	50	368	102
Salaries	$974,179	$54,528	$230,333	$78,363	$110,955	$92,691	$63,777	$38,876	$203,658	$100,998
Women—										
Number	54	2	10	5	2	14	3	1	11	6
Salaries	$28,792	$1,250	$5,667	$3,000	$1,500	$7,870	$1,260	$420	$3,527	$4,298
Wage-earners, including pieceworkers, and total wages:										
Greatest number employed at any one time during the year	44,447	2,494	10,677	3,866	3,972	3,288	3,380	2,181	10,636	3,953
Least number employed at any one time during the year	27,192	1,556	8,874	2,730	2,282	2,134	1,092	1,584	4,810	2,131
Average number	33,453	2,032	9,314	3,337	3,187	2,772	2,091	1,805	5,840	3,075
Wages	$16,987,294	$1,041,088	$5,360,756	$1,550,764	$1,409,580	$1,373,353	$1,038,948	$862,011	$3,111,556	$1,239,238
Men, 16 years and over—										
Average number	33,136	1,978	9,171	3,337	3,187	2,766	2,072	1,800	5,753	3,072
Wages	$16,902,543	$1,028,731	$5,326,964	$1,550,764	$1,409,580	$1,371,198	$1,033,313	$860,799	$3,083,636	$1,238,558
Women, 16 years and over—										
Average number	107	29	50			6	17	5		
Wages	$32,452	$8,925	$15,041			$2,155	$5,119	$1,212		
Children, under 16 years—										
Average number	210	25	93				2		87	3
Wages	$52,299	$3,432	$19,751				$516		$27,920	$680
Average number of wage-earners, including pieceworkers, employed during each month:										
Men, 16 years and over—										
January	34,113	2,226	9,394	3,362	2,775	3,055	2,641	1,967	5,440	3,253
February	33,553	2,288	9,339	3,450	2,573	3,209	2,512	2,022	4,767	3,393
March	35,796	2,289	9,691	3,433	4,155	2,853	2,877	2,090	5,205	3,203
April	33,851	2,033	9,607	3,368	3,122	2,808	2,866	1,754	5,164	3,129
May	34,647	2,098	9,408	3,394	3,658	2,705	2,852	1,740	5,446	3,346
June	34,517	1,873	9,350	3,413	3,904	2,750	2,767	1,737	5,530	3,193
July	32,659	1,874	9,330	3,535	3,789	2,314	1,716	1,678	5,437	2,986
August	30,632	1,656	8,512	3,373	3,363	2,269	1,462	1,666	5,517	2,814
September	29,913	1,629	8,689	3,083	2,532	2,690	1,473	1,680	5,349	2,788
October	30,877	1,751	8,878	3,103	2,365	2,929	1,344	1,698	5,883	2,926
November	32,496	1,900	8,774	3,204	2,582	2,806	1,260	1,743	7,356	2,871
December	34,578	2,124	9,082	3,324	3,424	2,800	1,093	1,830	7,939	2,962
Women, 16 years and over—										
January	147	36	58			8	39	6		
February	137	29	58			8	37	5		
March	143	29	65			7	37	5		
April	136	31	58			7	36	4		
May	127	29	59			7	27	5		
June	123	30	53			7	25	8		
July	79	30	43			3		3		
August	75	23	45			3		4		
September	68	23	36			5		4		
October	79	29	39			7		4		
November	77	28	38			7		4		
December	93	31	47			9		6		
Children, under 16 years—										
January	194	27	93				5		65	4
February	189	33	95				4		55	2
March	198	31	86				4		74	3
April	202	30	85				5		80	2
May	179	28	77				5		65	4
June	199	23	90				4		80	2
July	209	21	108						78	2
August	215	24	109						80	2
September	201	23	95						80	3
October	223	22	91						105	5
November	253	18	92						140	3
December	258	21	95						140	2
Miscellaneous expenses:										
Total	$2,837,229	$121,819	$483,271	$224,009	$227,774	$198,160	$81,996	$45,450	$1,265,466	$189,294
Rent of works	$31,597		$4,021			$3,263		$2,170	$20,804	$1,339
Taxes, not including internal revenue	$159,440	$7,100	$38,899	$12,978	$34,023	$7,463	$8,446	$13,876	$20,806	$15,849
Rent of offices, insurance, interest, etc.	$2,240,558	$114,719	$436,717	$211,031	$191,751	$187,434	$73,550	$29,404	$823,846	$172,106
Contract work	$405,634		$3,634		$2,000				$400,000	
Materials used:										
Aggregate cost	$61,742,747	$1,876,435	$17,076,461	$6,287,256	$7,272,761	$5,101,335	$3,744,911	$2,791,908	$12,188,811	$5,403,869
Total	$52,637,603	$1,744,990	$14,050,032	$5,581,378	$6,370,394	$4,558,343	$3,056,390	$2,449,025	$10,175,148	$4,661,903
Purchased in raw state	$45,730		$8,704	$3,468	$11,684	$8,801	$3,910		$8,975	$188
Purchased in partially manufactured form	$52,591,873	$1,744,990	$14,041,328	$5,577,910	$6,358,710	$4,549,542	$3,052,480	$2,449,025	$10,166,173	$4,661,716
Fuel	$1,021,046	$22,339	$303,164	$102,094	$94,390	$101,527	$64,629	$36,489	$195,927	$100,487
Rent of power and heat	$313		$313							
Mill supplies	$214,639	$15,819	$91,712	$9,636	$8,413	$8,263	$9,193	$5,847	$22,350	$43,406
All other materials	$6,921,151	$81,617	$2,542,123	$121,390	$795,629	$433,202	$614,699	$9,906	$1,791,675	$530,911
Freight	$947,995	$11,670	$88,117	$472,758	$3,935			$290,642	$3,711	$77,162

[1] Includes establishments distributed as follows: Alabama, 2; Georgia, 2; Kentucky, 1; Maryland, 1; Massachusetts, 2; New Hampshire, 1; New Jersey, 2; Tennessee, 1; West Virginia, 1.

TABLE 9.—CARS, STEAM RAILROAD, NOT INCLUDING OPERATIONS OF RAILROAD COMPANIES: BY STATES, 1900—Continued.

	United States.	Delaware.	Illinois.	Indiana.	Michigan.	Missouri.	New York.	Ohio.	Pennsylvania.	Other states.[1]
Products:										
Aggregate value	$90,510,180	$3,274,922	$24,845,606	$9,006,577	$9,920,780	$7,722,768	$5,228,351	$3,942,372	$19,260,910	$7,307,894
Total number of cars constructed	118,504	738	30,842	15,234	22,000	9,903	4,425	4,944	20,682	9,736
Total value	$70,620,166	$1,953,151	$19,616,128	$8,521,954	$9,281,671	$6,317,744	$3,052,189	$3,710,477	$12,718,711	$5,448,141
Passenger cars—										
Total number	979	233	349	64		113	16	198		6
Total value	$7,368,299	$1,363,500	$3,624,251	$328,538		$546,106	$266,696	$1,219,428		$19,780
Baggage and express, number	72	16	6	13		10		24		3
Value	$238,554	$66,692	$18,373	$38,522		$17,760		$91,207		$6,000
Chair and coach, number	181	6	10	19		78		66		2
Value	$957,526	$54,000	$78,680	$82,872		$396,374		$335,320		$10,280
Dining and buffet, number	37		9	6		3		19		
Value	$404,503		$103,166	$66,716		$28,720		$205,902		
Mail, number	42		10	10		14		8		
Value	$197,465		$50,933	$44,109		$66,748		$35,675		
Parlor, number	37		6			5		26		
Value	$272,403		$45,665			$26,377		$200,361		
Passenger, number	331	192	86	11		3		39		
Value	$1,975,469	$1,190,224	$524,187	$59,629		$10,127		$191,302		
Private, number	11		7	1				3		
Value	$154,709		$107,136	$11,211				$36,362		
Sleeping, number	194	4	158	2			16	13		1
Value	$2,767,061	$22,002	$2,339,474	$12,090			$266,696	$123,299		$3,500
Other varieties, number	74	15	57	2						
Value	$400,609	$30,582	$356,637	$13,390						
Freight cars—										
Total number	116,590	42	30,314	15,170	22,000	9,790	4,409	4,660	20,682	9,523
Total value	$62,161,013	$22,235	$15,856,625	$8,193,416	$9,281,671	$5,771,638	$2,785,493	$2,324,700	$12,718,711	$5,206,524
Box, number	47,838	32	17,262	9,716	6,630	7,111	1,347	1,784	297	3,659
Value	$26,562,893	$16,532	$9,118,277	$5,341,287	$3,679,362	$4,183,860	$740,414	$955,762	$228,361	$2,299,038
Coal and coke, number	28,857		1,674	2,721	7,289	1,116	1,384	1,770	10,486	2,417
Value	$18,414,718		$892,400	$1,449,891	$4,223,713	$615,205	$822,847	$865,335	$8,213,729	$1,331,598
Flat, number	4,525	2	1,339	575	260	399		534	172	1,244
Value	$1,923,525	$960	$497,843	$249,304	$112,132	$214,094		$226,756	$92,698	$529,738
Fruit, number	1,620		1,182						1	437
Value	$665,354		$591,705						$676	$72,974
Furniture, number	1,717		700	654	210	228	25			
Value	$1,148,265		$506,265	$332,013	$135,020	$160,160	$14,807			
Gondolas, number	11,821		2,230	10	1,200	10	1,250	555	5,531	1,035
Value	$6,873,145		$926,640	$6,984	$588,700	$5,850	$803,152	$258,055	$3,683,359	$600,405
Refrigerator, number	2,354		1,693		300	169	103	12		77
Value	$1,956,097		$1,224,583		$307,300	$278,272	$93,373	$13,992		$38,577
Stock, number	2,760	8	1,713	525		11			6	497
Value	$1,426,800	$4,743	$889,314	$229,162		$5,665			$4,387	$293,529
Caboose, number	193		23	60	2	51		5	39	13
Value	$184,865		$19,814	$56,940	$1,500	$62,464		$4,800	$31,700	$7,647
Other varieties, number	14,905		2,498	1,009	6,109	695	300		4,150	144
Value	$3,005,351		$1,189,784	$527,835	$233,944	$246,068	$310,900		$463,802	$33,018
Street cars—										
Total number	935	463	179					86		207
Total value	$1,090,854	$567,416	$135,252					$166,349		$221,837
Electric, number	902	455	154					86		207
Value	$1,062,172	$559,966	$114,020					$166,349		$221,837
Open, number	371	156	76					9		130
Value	$300,709	$129,679	$42,477					$12,660		$115,893
Closed, number	487	283	77					51		76
Value	$693,143	$400,687	$70,793					$116,494		$105,169
Combination, number	44	16	1					26		1
Value	$68,320	$29,600	$750					$37,195		$775
Cable, closed, number	25		25							
Value	$21,232		$21,232							
Horse, number	8	8								
Value	$7,450	$7,450								
All other products	$19,890,014	$1,321,771	$5,229,478	$484,623	$639,109	$1,405,024	$2,176,162	$231,895	$6,542,199	$1,859,753
Comparison of products:										
Number of establishments reporting for both years	54	3	16	4	4	4	3	2	7	11
Value for census year	$82,879,333	$3,274,922	$24,805,707	$9,006,577	$9,920,780	$7,722,768	$4,204,081	$3,472,473	$13,756,290	$6,715,735
Value for preceding business year	$59,418,873	$1,812,928	$19,406,789	$7,220,572	$7,752,887	$5,929,329	$3,624,994	$2,553,254	$5,898,126	$5,219,994
Power:										
Number of establishments reporting	60	3	15	4	3	4	4	4	10	13
Total horsepower	34,687	1,623	11,161	3,748	2,760	2,439	3,110	2,005	4,426	3,415
Owned—										
Engines—										
Steam, number	242	13	65	30	11	17	17	12	41	36
Horsepower	32,293	1,623	9,917	3,740	2,360	2,439	2,995	1,640	4,386	3,193
Gas or gasoline, number	3		1					1	1	
Horsepower	85		20					25	40	
Waterwheels, number	9				5					4
Horsepower	392				295					97
Electric motors, number	62		31	3	2		2	19		6
Horsepower	1,292		664	8	105		50	340		125
Other kind, number	6		3				3			
Horsepower	565		500				65			
Rented—										
Horsepower	5									5
Furnished to other establishments—Horsepower	60		60							
Establishments classified by number of persons employed, not including proprietors and firm members:										
Total number of establishments	65	3	17	4	4	4	4	5	11	13
Under 5	1							1		
21 to 50	10		3		1			2	1	3
51 to 100	8		3		1				2	2
101 to 250	13		5			1	1	1	2	3
251 to 500	8		2	1	1	1			1	2
501 to 1,000	9	2	1	1			1		2	2
Over 1,000	16	1	3	2	1	2	2	1	3	1

[1] Includes establishments distributed as follows: Alabama, 2; Georgia, 2; Kentucky, 1; Maryland, 1; Massachusetts, 2; New Hampshire, 1; New Jersey, 2; Tennessee, 1; West Virginia, 1.

CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM RAILROAD COMPANIES.

Table 10 presents the statistics for general shop construction and repairs by steam railroad companies as returned at the censuses of 1890 and 1900, with the percentages of increase during the decade.

TABLE 10.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM RAILROAD COMPANIES: COMPARATIVE SUMMARY, 1890 TO 1900, WITH PER CENT OF INCREASE.

	DATE OF CENSUS.		PER CENT OF INCREASE.
	1900	1890	1890 to 1900
Number of establishments	1,296	716	81.0
Capital	$119,580,273	$76,192,477	56.9
Salaried officials, clerks, etc., number	7,096	1,953	263.3
Salaries	$6,210,247	$1,584,242	292.0
Wage-earners, average number	173,652	106,632	62.9
Total wages	$96,062,329	$60,213,433	59.5
Men, 16 years and over	173,209	106,448	62.7
Wages	$95,939,610	$60,161,333	59.5
Women, 16 years and over	364	128	184.4
Wages	$106,426	$39,248	171.2
Children, under 16 years	79	56	41.1
Wages	$16,293	$12,852	26.8
Miscellaneous expenses	$6,293,987	(1)	....
Cost of materials used	$109,539,013	$66,561,526	64.6
Value of products, including custom work and repairing	$218,238,277	$129,461,698	68.6

1 Not reported.

The census of 1890 was the first at which the statistics of the manufacture of cars by steam railroad companies were reported separate from the statistics of the operations of plants, engaged in car construction, not conducted by railroad companies. During the decade the number of establishments has increased from 716 to 1,296, an increase of 480, or 81 per cent, while the capital has increased $43,387,796, or 56.9 per cent. The cost of materials used increased from $66,561,526 in 1890, to $109,539,013 in 1900, or 64.6 per cent; and the value of the product, including custom work and repairing, was $129,461,698 in 1890, and $218,238,277 in 1900, an increase of $88,776,579, or 68.6 per cent.

The most striking increase was shown in the number of salaried officials, clerks, etc., and their salaries. In 1890 the number of salaried officials was 1,953, and in 1900 there were 7,096 officials, an increase of 5,143, or 263.3 per cent. During the same period the salaries increased $4,626,005, or 292 per cent. This increase is all the more striking, when it is remembered that the number for 1900 does not include the firm members and officials not drawing a salary. The total number of wage-earners increased 62.9 per cent, while the wages increased from $60,213,433 in 1890 to $96,062,329 in 1900, or 59.5 per cent.

Improved facilities for transportation by steam railways have resulted in constantly lessening the competition of canal and river transportation, and now they have ceased to be effective for high-grade freight transportation. The extraordinary increase in traffic requires new equipment at the rate of about 500 cars and 10 locomotives per day. The repair work both on locomotives and cars has constantly increased. During the census year the 1,296 establishments operated by railroad companies reported a capital of $119,580,273, and a product aggregating $218,238,277, and employed 180,748 wage-earners and officials. In this branch of the industry the product of the several establishments was manufactured or repaired for their own use. In the motive power and machinery department the total value of product was $94,447,260, or 43.3 per cent of the aggregate. The product in the car department was valued at $118,376,552, or 54.2 per cent, and the value of the shop work in the bridge and building department was $5,414,465, or 2.5 per cent of the aggregate product.

Table 11 presents a comparative summary of the capital for 1890 and 1900, with the percentage of each item to the total and the per cent of increase during the decade.

TABLE 11.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM RAILROAD COMPANIES: COMPARATIVE SUMMARY OF CAPITAL, 1890 AND 1900.

	1900		1890		Per cent of increase.
	Amount.	Per cent of total.	Amount.	Per cent of total.	
Total	$119,580,273	100.0	$76,192,477	100.0	56.9
Land	16,976,693	14.2	10,860,668	14.3	56.3
Buildings	36,630,345	30.6	25,399,382	33.3	44.2
Machinery, tools, and implements	28,448,582	23.8	18,473,121	24.2	54.0
Cash and sundries	37,524,653	31.4	21,459,306	28.2	74.9

In 1890 the total capital was $76,192,477, and in 1900 it was $119,580,273, an increase of $43,387,796, or 56.9 per cent. The value of land, buildings, machinery, tools, and implements, cash on hand, etc., relative to the total, has not changed materially during the decade. Of the total capital in 1890 the value of land composed 14.3 per cent; buildings, 33.3 per cent; and machinery, tools, etc., 24.2 per cent. In 1900 the value of land was 14.2 per cent; buildings, 30.6 per cent; and machinery, tools, etc., 23.8 per cent of the total capital. The largest per cent of increase was in the item including stock in process of manufacture, unfinished products on hand, etc., the aggregate value of which was $21,459,306, or 28.2 per cent of the total in 1890, and in 1900 the value was $37,524,653, or 31.4 per cent of the total, an increase of $16,065,347, or 74.9 per cent. During the decade the amount of capital invested in land increased 56.3 per cent; buildings, 44.2 per cent; and machinery, tools, and implements, 54 per cent.

Table 12 presents the cost of materials used, with per cent which each item forms of the total cost.

TABLE 12.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM RAILROAD COMPANIES: COST OF MATERIALS USED, 1900.

MATERIALS USED.	Amount.	Per cent of total.
Total	$109,539,013	100.0
Principal materials[1]	106,554,718	97.3
Fuel	2,443,987	2.2
Rent of power and heat	27,565	(2)
Freight	512,743	0.5

[1] Includes mill supplies and all other materials, which are shown separately in Table 16.
[2] Less than one-tenth of 1 per cent.

The partially manufactured materials, such as lumber, iron, and steel, etc., constitute the principal item, aggregating 97.3 per cent of the total. The cost of fuel was $2,443,987. The amount paid for rent of power and heat was $27,565, or less than one-tenth of 1 per cent of the total cost of materials, showing that nearly all of the power used was owned by the company operating the plant. The expenses, other than those for wages and materials, incurred in the manufacture of the product are reported in detail under miscellaneous expenses in Table 16. Of the total expense, $3,094,941, or 49.2 per cent, was paid for contract work. The second item in importance, aggregating $2,329,924, was paid for rent of offices, interest, insurance, ordinary repairs of buildings and machinery, advertising, etc. Of the remaining items, rent of works formed only 0.7 per cent, while the amount paid for taxes constituted 13.1 per cent of the miscellaneous expenses, showing that a large percentage of the plants were owned by the corporations operating them.

Table 13 presents a comparative summary between 1890 and 1900, by states and territories.

TABLE 13.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM RAILROAD COMPANIES: COMPARATIVE SUMMARY, BY STATES AND TERRITORIES, 1890 AND 1900.

STATES AND TERRITORIES.	Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products, including custom work and repairing.
				Number.	Salaries.	Average number.	Total wages.			
United States	1900	1,296	$119,580,273	7,096	$6,210,247	173,652	$96,062,329	$6,293,987	$109,539,013	$218,238,277
	1890	716	76,192,477	1,953	1,684,242	106,632	60,213,433	(1)	66,661,526	129,461,698
Maine	1900	19	921,905	37	31,332	671	300,755	35,436	487,604	857,136
	1890	10	150,672	5	4,500	239	135,276	....	82,536	224,113
New Hampshire	1900	9	850,873	30	24,201	966	516,990	36,763	523,347	1,101,301
	1890	4	205,465	2	2,120	141	86,804	....	30,612	119,666
Vermont	1900	7	711,261	32	23,744	779	446,017	4,614	350,401	824,776
	1890	8	534,729	....	....	290	157,573	....	163,976	311,549
Massachusetts	1900	16	3,056,043	111	103,962	3,031	1,822,959	32,544	1,752,564	3,712,029
	1890	14	1,988,676	25	18,711	2,264	1,279,617	....	1,390,705	2,712,763
Rhode Island[2]	1900	3	120,900	17	14,490	215	133,300	1,770	48,596	203,326
Connecticut	1900	9	1,639,134	100	78,392	1,557	943,503	41,879	1,366,281	2,430,056
	1890	8	690,265	9	5,920	682	418,317	....	274,237	698,474
New York	1900	82	11,244,747	443	344,596	13,062	6,762,504	203,221	8,879,813	16,194,850
	1890	46	4,213,639	91	75,535	8,585	4,420,441	....	4,527,381	9,046,025
New Jersey	1900	18	2,819,759	179	137,191	4,594	2,399,675	195,707	2,301,699	5,034,267
	1890	18	2,766,957	99	63,775	6,134	2,813,713	800	3,172,891	6,051,179
Pennsylvania	1900	144	19,182,001	1,065	810,857	28,554	15,825,640	3,280,079	23,147,674	43,065,171
	1890	61	17,475,056	346	230,894	22,649	12,301,884	82,909	15,822,037	28,769,728
Delaware	1900	5	751,213	17	20,824	880	529,025	2,315	460,519	1,012,683
	1890	3	767,875	29	19,178	821	489,690	....	748,656	1,280,485
Maryland	1900	19	2,877,954	134	100,843	3,620	1,849,737	55,163	2,567,486	4,573,229
	1890	10	2,904,677	36	52,806	2,978	1,437,658	....	3,588,572	5,079,035
District of Columbia[3]	1890	3	44,700	37	33,810	253	126,360	1,878	140,582	370,154
West Virginia	1900	23	1,040,311	90	67,646	2,605	1,256,640	32,355	1,586,916	2,943,557
	1890	7	533,305	14	9,217	1,022	433,335	....	467,841	910,393
Virginia	1900	28	1,733,389	283	248,425	4,922	2,452,195	45,406	3,531,283	6,277,279
	1890	8	583,022	22	13,730	1,643	833,254	....	658,011	1,504,995
North Carolina	1900	12	539,513	47	38,463	1,141	550,504	29,259	893,150	1,511,376
	1890	9	210,458	8	6,640	434	186,262	....	200,335	393,576
South Carolina	1900	6	354,842	27	21,379	776	363,041	12,555	294,334	691,361
	1890	5	420,859	7	5,500	828	394,411	....	287,862	688,191
Georgia	1900	32	1,408,692	97	98,003	3,175	1,602,208	89,380	1,272,692	3,062,283
	1890	11	450,512	23	19,140	966	522,657	....	349,844	892,610
Florida	1900	13	414,390	33	26,663	958	486,488	19,224	579,870	1,112,245
	1890	10	158,960	7	7,160	280	144,997	1,800	201,514	354,043

[1] Not reported.
[2] Not reported separately in 1890.
[3] Includes establishments distributed as follows: Alaska, 1; District of Columbia, 2.

TABLE 13.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM RAILROAD COMPANIES: COMPARATIVE SUMMARY, BY STATES AND TERRITORIES, 1890 AND 1900—Continued.

STATES AND TERRITORIES.	Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products, including custom work and repairing.
				Average number.	Salaries.	Average number.	Total wages.			
Kentucky	1900	25	$1,761,958	96	$82,689	3,572	$1,841,778	$55,984	$2,267,578	$4,248,029
	1890	9	305,229	11	10,240	623	353,200	....	225,485	588,925
Tennessee	1900	16	1,319,628	65	58,606	2,817	1,459,319	66,765	1,528,363	3,113,053
	1890	10	1,198,940	15	16,672	1,772	995,287	....	593,819	1,605,778
Alabama	1900	19	2,019,434	118	112,795	4,030	1,941,031	86,045	2,032,166	4,172,192
	1890	12	909,911	4	2,820	1,373	761,134	....	784,304	1,581,207
Mississippi	1900	9	741,753	45	40,754	1,534	807,899	18,336	464,034	1,331,401
	1890	5	612,744	18	19,580	1,076	677,093	....	632,876	1,329,549
Arkansas	1900	21	720,907	103	97,935	1,927	1,203,761	27,124	765,003	2,095,447
	1890	8	355,747	22	20,028	847	563,187	....	715,340	1,299,558
Louisiana	1900	19	782,588	43	46,344	1,378	800,398	19,699	562,658	1,429,099
	1890	6	156,136	10	7,235	61	43,421	101	61,592	112,847
Indian Territory[1]	1900	3	8,080	3	2,820	64	35,504	87	18,224	56,635
Oklahoma[1]	1900	3	9,350	3	2,405	22	13,333	117	6,736	22,591
Texas	1900	56	3,730,792	263	292,398	6,633	4,004,769	138,838	3,878,536	8,314,691
	1890	31	1,140,049	58	61,775	2,354	1,574,786	....	1,223,674	2,860,235
Ohio	1900	91	5,701,129	576	456,971	11,534	6,087,052	391,581	5,963,808	12,975,182
	1890	64	3,907,278	150	107,675	7,397	3,968,797	....	3,930,052	8,096,905
Michigan	1900	42	2,527,256	182	147,119	3,938	2,026,000	39,642	2,120,166	4,332,927
	1890	17	1,226,163	32	33,340	2,098	1,119,487	....	1,492,487	2,645,314
Indiana	1900	54	4,730,231	348	290,197	8,081	4,325,101	171,355	5,454,676	10,242,422
	1890	48	3,929,805	116	93,963	6,613	3,274,288	....	3,904,281	7,289,382
Illinois	1900	98	11,726,424	618	568,702	13,803	7,422,527	267,497	8,286,776	16,580,424
	1890	70	7,791,234	264	198,680	10,277	5,855,481	5,629	5,909,493	12,208,617
Wisconsin	1900	46	4,206,285	272	245,163	4,502	2,398,144	138,270	3,525,144	6,306,823
	1890	22	1,681,255	50	44,778	2,148	1,217,632	....	898,673	2,221,152
Minnesota	1900	39	4,933,805	264	243,448	4,700	2,599,387	95,561	3,380,441	6,319,876
	1890	18	2,926,860	66	56,706	1,951	1,219,325	....	1,305,136	2,628,174
Iowa	1900	68	3,277,617	278	249,948	5,497	2,948,947	124,453	2,896,269	6,221,378
	1890	41	2,404,648	81	65,312	3,812	2,121,824	300	2,244,274	4,473,089
Missouri	1900	43	3,645,260	242	219,292	5,581	3,182,753	102,500	3,019,674	6,524,121
	1890	27	1,394,974	77	67,945	2,859	1,737,771	1,637	2,082,326	3,890,542
Montana	1900	7	524,725	49	50,382	621	397,552	5,138	301,338	754,410
	1890	4	317,765	12	10,354	301	226,013	....	193,201	429,568
Idaho[1]	1900	4	177,912	12	13,326	399	293,396	2,743	214,166	623,631
Wyoming[1]	1900	7	591,725	28	29,374	853	623,046	37,194	480,199	1,169,813
North Dakota[1]	1900	3	171,043	7	6,726	126	67,922	1,400	64,847	140,894
South Dakota[1]	1900	7	68,079	9	8,354	117	79,661	3,049	86,567	177,631
Nebraska	1900	23	3,635,267	114	100,401	2,458	1,421,284	92,946	1,009,830	2,624,461
	1890	9	1,245,519	28	20,877	2,041	1,146,206	....	900,825	2,067,908
Nevada	1900	6	404,577	8	9,800	214	168,102	7,446	110,637	295,985
	1890	6	428,999	6	8,460	209	194,643	....	231,893	435,084
Utah[1]	1900	10	496,149	46	49,389	908	636,076	16,219	604,907	1,306,591
Colorado	1900	29	1,681,860	137	148,040	2,687	1,676,500	38,863	1,278,299	3,141,602
	1890	10	1,651,311	26	47,700	1,366	1,023,809	....	894,090	1,965,696
Kansas	1900	37	2,931,699	175	167,786	5,592	3,476,400	101,457	3,071,173	6,816,816
	1890	26	1,683,210	60	46,949	2,819	1,722,326	....	1,874,646	3,644,038
Arizona	1900	7	430,119	14	21,300	576	437,238	16,454	412,490	887,482
	1890	3	72,724	2	1,414	140	112,990	....	74,985	189,390
New Mexico	1900	7	386,721	19	18,784	1,061	685,401	1,913	463,182	1,069,280
	1890	6	137,389	4	2,525	254	174,038	....	177,503	354,066
Washington	1900	16	944,800	55	51,353	956	653,206	14,264	760,858	1,479,680
	1890	4	272,195	9	7,440	342	278,628	....	175,492	461,561
Oregon	1900	14	725,935	29	31,678	751	495,169	15,688	483,644	1,026,169
	1890	5	2,815,997	28	26,700	1,101	907,739	....	781,217	1,750,926
California	1900	29	4,429,951	119	141,798	4,920	3,507,028	76,590	3,825,340	7,553,626
	1890	10	3,139,514	29	23,840	2,858	2,151,594	....	2,777,306	4,923,071
All other states	[2]1900	3	470,387	14	13,160	394	205,475	1,100	157,255	376,990
	[3]1890	11	487,054	15	12,598	731	610,586	....	379,064	1,002,248

[1] Not reported separately in 1890.
[2] Includes establishments distributed as follows: Alaska, 1; District of Columbia, 2.
[3] Includes establishments distributed as follows: Indian Territory, 2; North Dakota, 2; Rhode Island, 2; South Dakota, 2; Utah, 2; Wyoming, 1.

In 1890 there were in the United States 716 railroad repair shops, and during the decade the number increased 580, or 81 per cent. The New England states reported 63 establishments in 1900, an increase of 17, or 43.2 per cent, since 1890. The Middle states increased 129, or 91.5 per cent; the Southern, 152, or 114.3 per cent; the Central, 164, or 53.4 per cent; the Western, 77, or 110 per cent, while the Pacific states increased 40, or 200.0 per cent. The largest actual increase during the decade has been in the Central and Southern states, which have also shown the greatest activity in the establishment of new plants during the census year.

The only decreases in number of plants were found in Vermont and the District of Columbia. The other states and territories except New Jersey and Nevada show an increase. The largest percentages of increase were in the Western and Pacific states.

In 1890 the 3 states having the greatest number of plants were Illinois with 70, Ohio with 64, and Pennsylvania with 61. In 1900 Pennsylvania led with 144 establishments, Illinois was second with 98, and Ohio third, reporting 91 plants in operation.

Of the 51 states and territories included in the comparative table, 6 have shown a decrease in the value of the product. The value of the products in New Jersey decreased $1,016,912; in Delaware, $267,802; in Maryland, $505,806; in Nevada, $139,099; and in Oregon, $724,757. The decrease in the product in the District of Columbia can not be shown, on account of disclosing the operations of individual establishments.

There has been a remarkable increase in value of products—$88,776,579, or 68.6 per cent, during the decade. Pennsylvania led with an increase of $14,295,443, New York was second with an increase of $7,148,825, and Texas third with a product of $8,314,691, an advance $5,454,456 over 1890. The states which show an increase of from three to five millions in the manufactured product are Virginia, Kentucky, Ohio, Illinois, Minnesota, Wisconsin, and Kansas; while those which show an increase of from one to three millions are Connecticut, West Virginia, North Carolina, Georgia, Tennessee, Alabama, Louisiana, Michigan, Indiana, Iowa, Missouri, Colorado, Washington, and California.

Table 14 presents the statistics by geographic divisions for the manufacture and repair of steam railroad cars, by establishments operated by steam railroad companies.

TABLE 14.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM RAILROAD COMPANIES: COMPARATIVE SUMMARY, BY GEOGRAPHIC DIVISIONS, 1900.

	Number of establisbments.	CAPITAL.					SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS, INCLUDING PIECEWORKERS, AND TOTAL WAGES.		Miscellaneous expenses.	Cost of materials used.	Value of products (including custom work and repairing).
		Total.	Land.	Buildings.	Machinery, tools, and implements.	Cash and sundries.	Total number.	Total salaries.	Average number.	Total wages.			
United States	1,296	$119,580,273	$16,976,693	$36,630,345	$28,448,582	$37,524,653	7,096	$6,210,247	173,652	$96,062,329	$6,293,987	$109,539,013	$218,238,277
New England states	63	7,300,116	1,582,658	2,207,912	1,518,379	1,991,167	327	276,121	7,119	4,163,524	153,005	4,528,793	9,128,624
Middle states	270	37,238,830	4,486,574	11,553,117	8,900,838	12,298,301	1,850	1,425,471	51,047	27,516,297	3,737,385	37,447,686	70,132,571
Southern states	285	16,585,527	1,633,172	4,450,487	4,673,024	5,828,844	1,316	1,237,325	35,554	18,818,868	641,174	19,681,543	40,381,239
Central states	471	40,748,007	5,670,261	13,526,620	8,465,795	13,085,331	2,780	2,420,840	57,636	30,989,911	1,330,859	34,646,854	69,503,153
Western states	147	11,499,876	2,965,043	3,114,372	3,062,243	2,358,218	618	623,661	15,612	9,862,578	324,822	8,097,635	18,908,596
Pacific states[1]	60	6,207,917	638,985	1,777,837	1,828,303	1,962,792	205	226,829	6,684	4,711,151	106,742	5,136,502	10,184,094

[1] Includes Alaska.

The Middle states led in the manufacture of products in this branch of the industry, with 20.8 per cent of the total number of establishments, 31.1 per cent of the capital invested, and with products valued at $70,132,571, or 32.1 per cent of the total value. The Central states, with 36.3 per cent of the establishments and 34.1 per cent of the capital invested in the industry, manufactured a product valued at $69,503,153, or 31.8 per cent of the total. The Southern states manufactured 18.5 per cent; the Western, 8.7 per cent; the Pacific states, including Alaska, 4.7 per cent; and the New England states, 4.2 per cent of the total product.

The establishments of New England had an average capital of $115,875; those of the Middle states, $137,922; of the Southern states, $58,195; of the Central states, $86,514; of the Western states, $78,230; and of the Pacific states, $103,465. The average value of products for the various geographic divisions were as follows: New England, $144,899; Middle states, $259,750; Southern, $141,689; Central, $147,565; Western, $128,630; and Pacific states, $169,735.

The average wages in New England were 5.8 per cent above the average for the United States; in the Middle states, 2.5 per cent below the average; in the Southern states, 4.3 per cent below; in the Central states, 2.7 per cent below; in the Western states, 14.3 per cent above; and in the Pacific division the average wages were $705, or 27.5 per cent above the average wages for the industry.

Table 15 presents the statistics of the products for the combined industries, cars and general shop construction and repairs by railroad companies, and cars, steam railroad, not including the operations of railroad companies.

TABLE 15.—CARS, STEAM RAILROAD: COMBINED SUMMARY OF PRODUCTS, BY STATES AND TERRITORIES, 1900.

STATES AND TERRITORIES.	Aggregate value.	MOTIVE POWER AND MACHINERY.							
		Total value.	Locomotives.				Work for other corporations.	All other products.
			Built.		Repaired.			
			Number.	Value.	Number.	Value.	Value.	Value.
United States	$308,748,457	$94,447,260	272	$3,276,393	1,375,265	$57,383,143	$3,338,589	$30,449,135
Alabama	4,921,987	1,544,805			1,414	986,867	31,055	526,883
Arizona	887,482	542,525			1,608	439,413	9,643	93,469
Arkansas	2,095,447	873,835	3	23,169	25,197	666,911	46,928	136,827
California	7,553,626	1,783,739			2,977	1,630,941	20,167	132,631
Colorado	3,141,602	1,648,308			19,142	1,309,052	198,618	140,638
Connecticut	2,430,056	1,198,797	6	53,728	350	511,352		633,717
Delaware	4,287,605	490,921			1,368	249,941	12,357	228,623
Florida	1,112,245	575,228			1,060	465,954	816	108,458
Georgia	3,407,047	1,126,034			2,926	892,086	26,411	207,537
Idaho	523,631	294,333			1,329	223,694	5,433	65,206
Illinois	41,426,030	7,402,600	27	338,826	162,810	4,497,144	391,048	2,175,582
Indiana	19,248,999	4,363,977	1	6,709	102,604	2,983,445	143,509	1,231,314
Indian Territory	56,635	31,701			6,867	30,055		1,646
Iowa	6,221,378	2,898,775	8	59,149	62,664	2,251,443	60,406	527,777
Kansas	6,816,816	2,519,320	12	140,800	78,597	1,801,317	36,003	539,200
Kentucky	4,418,889	1,753,703			5,699	1,099,216	28,209	626,278
Louisiana	1,429,099	959,941			1,435	329,551	21,101	609,289
Maine	857,136	344,536			5,400	216,874	2,955	124,707
Maryland	6,087,752	2,695,668			5,588	1,236,343	61,155	1,398,170
Massachusetts	3,820,819	1,709,229			902	1,196,487	430	512,312
Michigan	14,253,707	1,506,894	16	107,011	3,239	1,137,222	20,783	241,878
Minnesota	6,319,876	3,256,252			29,071	1,826,432	469,236	960,584
Mississippi	1,331,401	481,510			1,818	337,734	22,881	120,895
Missouri	14,246,889	2,482,874	2	13,545	61,233	1,559,718	229,877	679,734
Montana	754,410	524,006			3,541	327,637	1,869	194,500
Nebraska	2,624,461	1,476,402			54,281	1,208,860	47,931	219,611
Nevada	295,985	111,856			132	90,834	12,587	8,435
New Hampshire	1,817,623	576,751			812	449,949	323	126,479
New Jersey	5,877,543	2,551,960			8,064	1,181,002	29,432	1,341,526
New Mexico	1,069,280	631,029			16,598	591,129	25,400	14,500
New York	21,423,201	6,864,940	2	25,114	131,290	4,218,942	324,190	2,296,694
North Carolina	1,511,376	494,561			15,044	430,099	2,128	62,334
North Dakota	140,894	102,101			194	34,941		67,160
Ohio	16,917,554	4,726,651			160,306	3,175,272	52,023	1,499,356
Oklahoma	22,591	9,400			1,672	9,400		
Oregon	1,026,169	276,894			252	233,750	10,375	31,769
Pennsylvania	62,326,081	20,409,988	166	2,303,712	223,987	8,878,878	521,698	8,705,700
Rhode Island	203,326	87,529			98	73,655		13,974
South Carolina	691,361	355,726			1,076	288,665	4,839	62,222
South Dakota	177,631	91,917			5,740	66,015	867	25,035
Tennessee	3,605,563	1,333,763			2,673	888,751	48,770	396,242
Texas	8,314,691	4,046,335	9	59,842	7,966	2,239,853	270,132	1,476,508
Utah	1,306,591	703,752			1,996	504,169	2,748	196,835
Vermont	824,776	343,864	1	4,718	1,358	208,441	15,632	115,073
Virginia	6,277,279	1,666,179	6	61,455	75,826	1,396,735	1,901	206,088
Washington	1,479,680	742,945			3,274	339,445	74,919	328,581
West Virginia	5,310,711	910,903			49,169	633,861	16,747	260,296
Wisconsin	6,306,823	1,942,515	13	77,615	12,251	1,125,856	30,876	708,169
Wyoming	1,169,813	831,217			11,470	831,180	37	
Other territories [1]	376,990	149,571			998	76,733	4,144	68,694

[1] Alaska, 1; District of Columbia, 2.

TABLE 15.—CARS, STEAM RAILROAD: COMBINED SUMMARY OF PRODUCTS, BY STATES AND TERRITORIES, 1900—Continued.

STATES AND TERRITORIES.	CAR DEPARTMENT.									BRIDGE AND BUILDING DEPARTMENT (SHOP WORK ONLY).			
	Total value.	Cars built.				Cars repaired.		Work for other corporations.	All other products.	Total value.	Repairs and renewals.	Work for other corporations.	All other products.
		Passenger.		Freight.		Passenger and freight.							
		Number.	Value.	Number.	Value.	Number.	Value.	Value.	Value.		Value.	Value.	Value.
United States	$208,886,732	1,871	$8,810,032	143,134	$77,240,632	8,376,769	$74,665,500	$7,084,857	$41,085,711	$5,414,465	$3,937,170	$241,626	$1,235,669
Alabama	3,316,991	...	...	2,177	1,352,082	121,817	1,515,731	152,416	296,762	60,191	48,227	...	11,964
Arizona	276,625	...	...	...	...	9,029	251,580	16,310	8,735	68,332	67,305	...	1,027
Arkansas	878,798	5	20,272	51	16,723	120,368	657,521	120,139	64,143	342,814	71,685	14,838	256,291
California	5,745,358	4	11,777	667	329,577	58,973	1,576,111	334,609	3,493,284	24,529	13,015	7,868	3,646
Colorado	1,805,898	7	26,583	221	91,801	186,675	959,311	112,503	115,700	187,396	96,238	...	91,158
Connecticut	1,180,996	7	18,343	16	8,976	12,354	757,687	15,216	380,774	50,263	29,230	...	21,033
Delaware	3,790,846	233	1,863,500	42	22,235	8,449	312,530	34,210	2,058,371	5,838	5,838	...	...
Florida	524,304	...	...	65	35,254	39,437	461,255	1,773	26,022	12,713	8,286	700	3,727
Georgia	2,112,365	...	...	1,062	439,621	58,420	1,223,447	119,853	329,444	168,648	102,217	1,200	65,231
Idabo	222,887	...	...	...	...	28,561	192,026	10,967	19,894	6,411	4,529	1,030	852
Illinois	33,617,555	381	3,722,715	32,889	17,234,323	741,728	5,641,067	460,931	6,558,519	405,875	369,133	5,072	31,670
Indiana	14,696,545	69	350,234	17,111	9,185,928	256,131	3,584,005	493,631	1,082,747	188,477	156,665	1,856	29,956
Indian Territory	24,934	...	...	...	...	9,632	24,934	...	...	...	...	...	...
Iowa	2,960,771	...	...	38	26,964	228,415	2,570,313	170,172	193,322	361,832	305,955	1,043	54,834
Kansas	3,955,303	6	21,300	562	353,037	220,673	3,170,853	196,257	213,856	342,193	122,155	10,728	209,310
Kentucky	2,600,076	1	3,079	555	328,786	147,916	1,384,470	138,997	744,744	65,110	52,553	...	12,557
Louisiana	446,507	...	...	25	11,726	48,443	368,974	19,012	46,795	22,651	20,359	...	2,292
Maine	494,151	7	17,241	...	...	20,236	434,363	21,802	20,745	18,449	13,941	273	4,235
Maryland	3,316,164	1	2,265	3,010	1,538,913	38,272	1,221,773	53,526	499,687	75,920	70,341	...	5,579
Massachusetts	2,107,170	20	35,451	330	165,582	72,206	1,342,309	190,228	373,600	4,420	4,420	...	...
Michigan	12,473,201	3	10,055	22,460	9,496,779	72,782	1,855,941	86,269	1,024,157	273,612	247,373	...	26,239
Minnesota	3,009,788	1	13,904	117	56,433	152,941	2,157,271	273,063	509,117	53,836	51,445	...	2,391
Mississippi	828,839	...	...	76	41,189	71,356	530,114	33,712	223,824	21,052	21,052	...	...
Missouri	11,466,623	117	557,001	9,862	5,803,760	262,960	2,595,377	693,548	1,816,937	297,392	82,660	159,536	55,196
Montana	228,796	...	...	...	...	36,850	228,271	...	525	1,608	1,608	...	...
Nebraska	1,074,737	...	...	...	...	44,901	631,541	377,663	65,533	73,322	73,322	...	...
Nevada	176,748	...	...	12	6,157	18,142	51,169	6,954	112,468	7,381	6,866	...	515
New Hampshire	1,207,132	10	36,114	627	334,500	20,579	219,801	54,603	562,114	33,640	25,846	...	7,794
New Jersey	3,199,291	16	111,304	1	435	217,801	1,888,186	107,609	1,091,757	126,292	125,563	125	604
New Mexico	426,913	...	...	...	...	38,429	339,636	70,052	17,225	11,338	5,284	4,478	1,576
New York	14,205,007	89	451,887	5,195	3,114,212	1,792,341	6,319,591	737,088	3,582,229	353,254	310,265	...	42,989
North Carolina	993,194	3	15,538	649	276,476	27,015	633,263	26,483	41,434	23,621	12,292	...	11,329
North Dakota	38,793	...	...	...	...	4,430	36,833	...	1,960	...	...	...	...
Ohio	11,974,609	207	1,266,346	5,994	2,750,343	722,929	5,819,411	391,324	1,747,185	216,294	208,038	...	8,256
Oklahoma	10,191	...	...	...	...	2,387	9,740	...	451	3,000	3,000	...	...
Oregon	721,047	...	...	...	...	65,716	460,654	11,158	249,235	29,228	22,629	...	6,599
Pennsylvania	41,382,083	153	643,113	29,002	18,524,347	1,466,305	12,876,887	611,351	8,726,385	534,010	394,779	5,947	133,284
Rhode Island	112,890	...	...	...	...	5,275	91,343	3,717	17,830	2,907	2,557	...	350
South Carolina	333,781	...	...	...	...	16,470	260,787	2,595	70,399	1,854	1,613	...	241
South Dakota	50,378	...	...	...	...	4,413	42,048	5,730	2,600	35,336	34,993	...	343
Tennessee	2,187,009	...	...	919	513,600	143,876	1,077,097	116,798	479,514	84,791	41,776	...	43,015
Texas	4,159,970	11	55,564	425	191,945	207,906	3,033,077	344,021	535,363	108,386	73,776	23,495	11,115
Utah	598,563	...	...	14	15,187	33,876	320,568	45,649	217,159	4,276	4,076	...	200
Vermont	437,468	...	...	54	27,473	17,179	181,151	100,077	128,767	43,444	21,600	...	21,844
Virginia	4,469,806	1	3,800	1,468	983,971	154,625	1,860,432	89,128	1,532,475	141,294	126,409	50	14,835
Washington	705,243	...	...	216	108,308	58,695	415,609	51,141	130,185	31,492	20,105	2,700	8,687
West Virginia	4,202,884	1	2,378	3,650	2,003,177	163,161	1,085,840	124,244	987,245	196,924	195,020	...	1,904
Wisconsin	4,072,534	18	50,268	3,371	1,792,612	117,161	1,540,355	50,052	639,247	291,774	260,669	104	31,001
Wyoming	337,551	...	...	...	...	15,881	333,149	4,402	...	1,045	462	583	...
Other territories[1]	227,419	...	...	101	58,200	3,152	120,098	3,874	45,247	...	...	...	...

[1] Alaska, 1; District of Columbia, 2.

The above table divides the product into 3 departments—the motive power and machinery, the car department, and the bridge and building department. The construction of new locomotives is almost entirely done by establishments engaged exclusively in that work, but a few were built in the car construction plants. In the motive power and machinery department, Pennsylvania led, both in the number of loco motives constructed and the value of the repair work. In the car department, the value of the street cars which were constructed as a by-product was included under "all other products." Of the 1,371 passenger cars constructed for steam railroads, 381 were manufactured in Illinois, 233 in Delaware, 207 in Ohio, 153 in Pennsylvania, and 117 in Missouri; that is, about four-fifths of the passenger cars were constructed in these 5 states. Illinois, Pennsylvania, Michigan, Indiana, and Missouri manufactured 111,324 freight cars, or 77.8 per cent of the total product of the United States.

The value of the products in the bridge and building department, including shop work only, was $5,414,465. The product in the motive and power department aggregated $94,447,260, and in the car department $208,-886,732. The average value of locomotives constructed was $12,046. The value of 143,134 freight cars was $77,240,632, or an average of $540.

The 10 states leading in the construction and repair of steam railway cars were: Pennsylvania, with a product of $62,326,081; Illinois, with $41,426,030; New York, with $21,423,201; Indiana, $19,248,999; Ohio, $16,917,554; Michigan, $14,253,707; Missouri, $14,-246,889; Texas, $8,314,691; California, $7,553,626; and Kansas, $6,816,816. The aggregate value of the products for these states was $212,527,594, or 68.8 per cent of the total value for the United States. The products for the first five states aggregated $161,341,865, or 52.3 per cent of the total value.

Table 16 presents in detail the statistics relating to cars and general shop construction and repairs by steam railroad companies, by states and territories, in 1900.

TABLE 16.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS

		United States.	Alabama.	Arizona.	Arkansas.	California.	Colorado.	Connecticut.	Delaware.	Florida.	Georgia.
1	Number of establishments	1,296	19	7	21	29	29	9	5	13	32
	Character of organization:										
2	Incorporated company	1,296	19	7	21	29	29	9	5	13	32
	Capital:										
3	Total	$119,580,273	$2,019,434	$430,119	$720,907	$4,429,951	$1,681,860	$1,639,134	$751,213	$414,390	$1,408,592
4	Land	$16,976,693	$169,200	$54,300	$50,950	$300,165	$277,550	$389,500	$256,825	$35,880	$190,110
5	Buildings	$36,630,346	$559,810	$141,289	$114,780	$1,242,009	$576,572	$246,950	$238,025	$79,025	$412,414
6	Machinery, tools, and implements	$28,448,582	$660,570	$130,632	$209,697	$1,409,802	$481,007	$425,412	$97,391	$127,099	$408,005
7	Cash and sundries	$37,524,653	$629,854	$103,998	$345,480	$1,477,975	$346,731	$577,272	$158,972	$172,386	$398,063
	Salaried officials, clerks, etc.:										
8	Total number	7,096	118	14	103	119	137	100	17	33	97
9	Total salaries	$6,210,247	$112,795	$21,300	$97,935	$141,798	$148,040	$78,392	$20,824	$26,663	$98,003
	General superintendents, managers, clerks, etc.—										
10	Total number	7,096	118	14	103	119	137	100	17	33	97
11	Total salaries	$6,210,247	$112,795	$21,300	$97,935	$141,798	$148,040	$78,392	$20,824	$26,663	$98,003
	Men—										
12	Number	6,954	115	14	103	117	137	99	17	33	96
13	Salaries	$6,149,463	$111,290	$21,300	$97,935	$140,718	$148,040	$78,221	$20,824	$26,663	$97,763
	Women—										
14	Number	142	3			2		1			1
15	Salaries	$60,784	$1,505			$1,080		$171			$240
	Wage-earners, including pieceworkers, and total wages:										
16	Greatest number employed at any one time during the year.	191,387	4,388	703	2,155	5,371	3,206	1,662	918	1,111	3,435
17	Least number employed at any one time during the year.	156,865	3,645	478	1,716	4,519	2,184	1,448	846	855	2,941
18	Average number	173,652	4,030	576	1,927	4,920	2,687	1,557	880	958	3,175
19	Wages	$96,062,329	$1,941,031	$437,238	$1,203,761	$3,507,028	$1,676,500	$943,503	$529,025	$486,488	$1,602,208
	Men, 16 years and over—										
20	Average number	173,209	4,019	576	1,927	4,908	2,687	1,551	878	955	3,169
21	Wages	$95,939,610	$1,939,170	$437,238	$1,203,761	$3,502,570	$1,676,500	$941,296	$528,376	$485,768	$1,601,128
	Women, 16 years and over—										
22	Average number	364	11			7		6	2	3	6
23	Wages	$106,426	$1,861			$2,578		$2,207	$649	$720	$1,080
	Children, under 16 years—										
24	Average number	79				5					
25	Wages	$16,293				$1,880					
	Average number of wage-earners, including pieceworkers, employed during each month:										
	Men, 16 years and over—										
26	January	171,763	4,065	653	2,041	4,861	2,680	1,490	862	980	3,213
27	February	172,487	4,131	617	2,040	4,871	2,540	1,511	872	991	3,205
28	March	174,961	4,177	589	2,028	4,723	2,616	1,518	862	976	3,228
29	April	175,886	4,179	590	2,014	4,689	2,652	1,557	885	995	3,235
30	May	175,917	4,199	593	1,966	4,760	2,707	1,559	893	1,052	3,252
31	June	170,060	3,805	506	1,792	4,775	2,450	1,572	877	1,076	3,151
32	July	166,774	3,745	528	1,748	4,868	2,342	1,561	874	848	3,081
33	August	169,680	3,916	545	1,799	4,981	2,550	1,560	876	861	3,075
34	September	171,610	4,020	533	1,857	4,978	2,725	1,543	872	883	3,090
35	October	174,884	4,051	561	1,930	5,060	2,944	1,588	888	916	3,110
36	November	176,568	3,966	577	1,949	5,147	2,948	1,578	882	938	3,220
37	December	177,918	3,970	619	1,956	5,185	3,085	1,574	898	940	3,166
	Women, 16 years and over—										
38	January	364	10			8		6	2	3	6
39	February	364	10			8		6	2	3	6
40	March	363	10			8		6	2	3	6
41	April	364	10			8		6	2	3	6
42	May	375	12			8		6	2	3	6
43	June	367	11			6		7	2	3	6
44	July	362	12			6		6	2	3	6
45	August	362	11			6		6	2	3	6
46	September	355	11			7		6	2	3	6
47	October	357	11			7		6	2	3	6
48	November	361	11			8		6	2	3	6
49	December	374	11			7		6	2	3	6
	Children, under 16 years—										
50	January	73				6					
51	February	73				6					
52	March	78				6					
53	April	79				6					
54	May	81				7					
55	June	78				5					
56	July	80				4					
57	August	81				4					
58	September	81				4					
59	October	80				4					
60	November	85				4					
61	December	79				5					
	Miscellaneous expenses:										
62	Total	$6,293,987	$86,045	$16,454	$27,124	$76,590	$38,863	$41,879	$2,315	$19,224	$89,380
63	Rent of works	$41,134					$21,076				$1,800
64	Taxes, not including internal revenue	$827,988	$12,276	$5,039	$5,504	$53,658	$13,772		$1,692	$10,985	$16,472
65	Rent of offices, etc	$2,329,924	$73,769	$11,415	$21,620	$22,932	$3,468	$41,879	$623	$3,146	$69,934
66	Contract work	$3,094,941					$548			$5,093	$1,174
	Material used:										
67	Total cost	$109,539,013	$2,032,166	$412,490	$765,003	$3,825,340	$1,278,299	$1,366,281	$460,519	$579,870	$1,272,692
68	Purchased in partially manufactured form	$84,290,687	$1,647,622	$339,419	$614,040	$2,516,424	$933,489	$988,571	$122,174	$354,218	$894,144
69	Fuel	$2,443,987	$35,428	$13,033	$20,479	$196,357	$35,890	$13,870	$13,086	$8,294	$15,159
70	Rent of power and heat	$27,565				$17,538		$300			
71	Mill supplies	$1,155,435	$35,625	$6,022	$20,502	$15,174	$18,137	$12,959	$1,283	$5,767	$15,586
72	All other materials	$21,108,596	$260,027	$48,654	$109,982	$899,668	$290,783	$350,581	$323,976	$209,384	$347,803
73	Freight	$512,743	$53,664	$5,362		$180,179				$2,207	

BY STEAM RAILROAD COMPANIES, BY STATES AND TERRITORIES, 1900.

Idaho.	Illinois.	Indiana.	Indian Territory.	Iowa.	Kansas.	Kentucky.	Louisiana.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Mississippi.	Missouri.	
4	98	54	3	58	37	26	19	19	19	16	42	39	9	43	1
4	98	54	3	58	87	25	19	19	19	16	42	39	9	43	2
$177,912	$11,726,424	$4,730,231	$8,080	$3,277,617	$2,931,699	$1,761,958	$782,588	$921,905	$2,877,954	$3,056,043	$2,527,256	$4,933,805	$741,753	$3,645,260	3
$28,000	$2,106,841	$514,788	$750	$232,825	$358,213	$262,430	$72,750	$72,900	$298,490	$886,850	$348,620	$453,700	$52,692	$764,835	4
$67,991	$3,617,599	$1,671,232	$4,180	$1,365,929	$853,770	$484,950	$201,639	$376,850	$1,547,939	$1,061,500	$877,176	$2,117,592	$230,775	$882,094	5
$66,912	$2,214,121	$944,880	$1,550	$816,126	$861,867	$442,561	$260,864	$217,081	$550,609	$343,925	$676,944	$1,117,309	$251,529	$701,632	6
$15,009	$3,787,863	$1,699,331	$1,600	$862,737	$857,849	$582,017	$247,436	$255,074	$480,916	$764,768	$624,516	$1,245,204	$206,757	$1,296,699	7
12	618	348	3	278	175	96	43	37	134	111	182	264	46	242	8
$13,326	$568,702	$290,197	$2,820	$249,948	$167,786	$82,689	$46,344	$31,332	$100,843	$103,962	$147,119	$243,448	$40,754	$219,292	9
12	618	348	3	278	175	96	43	37	134	111	182	264	45	242	10
$13,326	$568,702	$290,197	$2,820	$249,948	$167,786	$82,689	$46,344	$31,332	$100,843	$103,962	$147,119	$243,448	$40,754	$219,292	11
12	598	337	3	275	171	94	43	36	134	109	181	260	43	234	12
$13,326	$560,017	$285,479	$2,820	$248,708	$165,295	$82,343	$46,344	$30,840	$100,843	$102,870	$146,819	$241,198	$39,794	$216,222	13
	20	11		8	4	2		1		2	1	4	2	8	14
	$8,685	$4,718		$1,240	$2,491	$346		$492		$1,092	$300	$2,250	$960	$3,070	15
445	15,122	8,945	73	5,983	6,001	3,802	1,556	618	3,866	3,220	4,439	5,183	1,736	6,020	16
376	12,728	7,240	59	5,015	5,101	3,356	1,193	509	3,293	2,496	3,432	4,306	1,345	5,172	17
399	13,803	8,081	64	5,497	5,692	3,572	1,378	571	3,620	3,031	3,938	4,700	1,534	5,581	18
$293,396	$7,422,527	$4,325,101	$35,504	$2,948,947	$3,476,400	$1,841,778	$800,398	$300,755	$1,849,737	$1,822,959	$2,026,000	$2,599,387	$807,899	$3,182,753	19
399	13,766	8,076	64	5,488	5,590	3,564	1,377	571	3,616	3,028	3,934	4,696	1,534	5,572	20
$293,396	$7,409,512	$4,323,459	$35,504	$2,946,013	$3,476,251	$1,838,893	$800,299	$300,755	$1,848,957	$1,821,912	$2,024,760	$2,598,359	$807,899	$3,180,795	21
	34	5		4		8			4	3	4	1		6	22
	$12,293	$1,642		$1,284		$2,885			$780	$1,047	$1,240	$312		$1,569	23
	3			5	2		1					3		3	24
	$722			$1,650	$149		$99					$716		$389	25
384	13,641	7,943	68	5,333	6,668	3,562	1,407	578	3,619	3,066	3,702	4,657	1,485	5,593	26
378	13,840	8,094	62	5,291	5,654	3,575	1,335	583	3,668	3,040	3,741	4,729	1,448	5,439	27
386	14,095	8,110	67	5,418	5,701	3,566	1,422	587	3,733	3,050	3,838	4,765	1,619	5,519	28
395	14,148	8,179	72	5,501	5,697	3,518	1,407	589	3,743	3,065	3,921	4,863	1,642	5,528	29
386	13,810	7,901	68	5,524	5,602	3,543	1,443	582	3,699	3,095	4,015	4,890	1,691	5,492	30
391	13,407	7,770	62	5,420	5,350	3,529	1,295	580	3,704	3,058	3,908	4,628	1,629	5,402	31
385	13,312	7,692	64	5,443	5,398	3,512	1,349	525	3,413	2,952	3,895	4,565	1,502	5,414	32
389	13,515	8,022	63	5,572	5,442	3,617	1,339	541	3,443	2,936	3,905	4,607	1,530	5,543	33
395	13,707	8,117	61	5,552	5,412	3,635	1,299	541	3,538	2,908	4,016	4,537	1,632	5,586	34
422	13,915	8,319	62	5,648	5,689	3,532	1,332	561	3,545	3,005	4,064	4,681	1,378	5,708	35
443	13,928	8,419	62	5,582	5,708	3,574	1,426	585	3,628	3,064	4,110	4,704	1,408	5,815	36
430	13,868	8,351	62	5,574	5,756	3,607	1,472	601	3,659	3,096	4,094	4,720	1,445	5,825	37
	36	5		4		8			4	4	4	1		6	38
	35	5		4		8			4	4	4	1		6	39
	33	4		4		8			4	4	4	1		6	40
	36	5		4		8			4	4	4	1		6	41
	36	5		4		8			4	3	4	1		6	42
	36	5		4		8			4	3	4	1		6	43
	36	5		4		8			4	3	4	1		6	44
	35	6		4		8			4	3	4	1		6	45
	35	5		4		8			4	3	4	1		6	46
	31	5		4		8			4	3	4	1		6	47
	31	5		4		8			4	3	3	1		6	48
	30	5		4		8			4	3	3	1		12	49
	3			5	2		1					3		6	50
	3			4	2		1					3		3	51
	3			4	2		1					3		3	52
	3			5	2		1					3		2	53
	3			5	2							3		1	54
	3			5								3		3	55
	4			5	2							3		3	56
	4			5	2		1					3		2	57
	4			5	2		1					3		3	58
	3			5	2		1					3		2	59
	3			10	2							3		4	60
	3			4	2		1					3		4	61
$2,743	$267,497	$171,355	$87	$124,453	$101,457	$55,984	$19,699	$35,435	$55,163	$32,544	$39,642	$95,561	$18,336	$102,500	62
	$8,601					$35	$1,348			$2,500	$300			$10	63
$2,723	$84,826	$33,490	$26	$36,894	$37,799	$16,135	$10,082	$6,715	$8,252	$50	$1,827	$15,031	$15,441	$48,637	64
$20	$172,683	$131,072	$61	$87,569	$63,658	$39,814	$8,269	$28,720	$46,911	$29,994	$33,572	$80,530	$2,895	$53,853	65
	$1,387	$6,793									$3,943				66
$214,166	$8,286,776	$5,454,676	$18,224	$2,896,269	$3,071,173	$2,267,578	$562,658	$487,604	$2,567,486	$1,752,564	$2,120,166	$3,380,441	$464,034	$3,019,574	67
$174,649	$6,712,080	$4,253,201	$13,509	$2,097,832	$2,424,789	$1,857,790	$484,497	$361,303	$2,172,354	$1,432,336	$1,630,454	$2,175,062	$362,468	$2,227,563	68
$3,216	$203,403	$97,996	$150	$101,214	$77,365	$49,122	$13,870	$10,846	$28,469	$45,446	$73,121	$119,239	$16,472	$85,702	69
						$400					$200	$1,800	$100	$2,641	70
$815	$113,024	$53,431	$140	$33,173	$23,733	$15,037	$6,826	$2,266	$12,324	$11,426	$15,284	$48,325	$6,402	$39,003	71
$35,299	$1,250,503	$1,004,396	$4,425	$630,467	$489,576	$324,168	$57,465	$112,427	$352,670	$263,356	$386,896	$1,038,015	$78,592	$563,640	72
$187	$7,766	$45,652		$33,583	$55,710	$21,061		$762	$1,669		$14,211			$1,025	73

TABLE 16.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM

		United States.	Alabama.	Arizona.	Arkansas.	California.	Colorado.	Connecticut.	Delaware.	Florida.	Georgia.
	Products:										
74	Aggregate value	$218,238,277	$4,172,192	$887,482	$2,095,447	$7,553,626	$3,141,602	$2,430,056	$1,012,683	$1,112,245	$3,062,283
	Motive power and machinery—										
75	Total value	$94,437,260	$1,544,805	$542,525	$873,835	$1,783,739	$1,648,308	$1,198,797	$490,921	$575,228	$1,126,034
76	Locomotives built, number	272			3			6			
77	Value	$3,276,393			$23,169			$53,728			
78	Locomotives repaired, number	1,375,265	1,414	1,608	25,197	2,977	19,142	350	1,368	1,060	2,926
79	Value	$57,383,143	$986,867	$439,413	$666,911	$1,630,941	$1,309,052	$511,352	$249,941	$465,954	$892,086
80	Work for other corporations, value.	$3,338,589	$31,055	$9,643	$46,928	$20,167	$198,618		$12,357	$816	$26,411
81	Other products, value	$30,449,135	$526,883	$93,469	$136,827	$132,631	$140,638	$633,717	$228,623	$108,458	$207,537
	Car department—										
82	Total value	$118,376,552	$2,567,196	$276,625	$878,798	$5,745,358	$1,305,898	$1,180,996	$515,924	$524,304	$1,767,601
83	Passenger cars built, number	390			5	4	7	7			
84	Value	$1,441,733			$20,272	$11,777	$26,583	$18,343			
85	Freight cars built, number	26,543	1,206		51	667	221	16		65	364
86	Value	$15,079,619	$681,413		$16,723	$329,577	$91,801	$8,976		$35,254	$170,964
87	Cars repaired, number	8,376,769	121,317	9,029	120,368	58,973	186,675	12,354	8,449	39,437	58,420
88	Value	$74,665,500	$1,515,731	$251,580	$657,521	$1,576,111	$959,311	$757,687	$312,530	$461,255	$1,223,447
89	Work for other corporations, value.	$7,084,857	$152,416	$16,310	$120,139	$334,609	$112,503	$15,216	$34,210	$1,773	$119,853
90	Other products, value	$20,104,843	$217,636	$8,735	$64,143	$3,493,284	$115,700	$380,774	$169,184	$26,022	$253,337
	Bridge and building department—										
91	Total value	$5,414,465	$60,191	$68,332	$342,814	$24,529	$187,396	$50,263	$5,838	$12,713	$168,648
92	Repairs and renewals, value	$3,937,170	$48,227	$67,305	$71,685	$13,015	$96,238	$29,230	$5,838	$8,286	$102,217
93	Work for other corporations, value.	$241,626			$14,838	$7,868				$700	$1,200
94	Other products, value	$1,235,669	$11,964	$1,027	$256,291	$3,646	$91,158	$21,033		$3,727	$65,231
	Comparison of products:										
95	Number of establishments reporting for both years.	1,234	16	5	18	29	26	9	5	10	29
96	Value for census year	$215,921,429	$4,067,895	$767,484	$2,088,362	$7,553,626	$2,979,022	$2,430,056	$1,012,683	$1,029,915	$2,950,266
97	Value for preceding business year	$179,268,482	$8,192,798	$707,645	$1,848,661	$6,611,783	$2,365,540	$2,294,962	$928,390	$866,999	$2,632,716
	Power:										
98	Number of establishments reporting	932	16	6	12	19	17	8	2	9	22
99	Total horsepower	99,430	1,588	230	920	3,182	1,153	613	339	433	1,357
	Owned—										
	Engines—										
100	Steam, number	1,556	28	6	14	36	21	12	11	12	25
101	Horsepower	90,342	1,588	140	720	2,150	1,147	498	339	433	1,237
102	Gas or gasoline, number	30				1					
103	Horsepower	703				12					
104	Water wheels, number	7				2	1				
105	Horsepower	56				16	5				
106	Electric motors, number	241		1		1	1				2
107	Horsepower	4,343		15		20	1				120
108	Other kind, number	32		1	1	2					
109	Horsepower	2,096		75	200	125					
	Rented—										
110	Supplied to other establishments, horsepower.	381						75			
111	From other establishments, horsepower.	1,890				859		115			
	Establishments classified by number of employees:										
112	Total number	1,296	19	7	21	29	29	9	5	13	32
113	Under 5	132	1		8	3	2	1		3	7
114	5 to 20	325	4	2	6	9	6	1	2	3	9
115	21 to 50	228	2	1	2	3	9		1	2	2
116	51 to 100	172	2	2	1	6	4	2	1		4
117	101 to 250	201	3	1		2	2	3		4	5
118	251 to 500	154	5	1	3	4	4	1		1	4
119	501 to 1,000	61	1		1	1	2	1	1		1
120	Over 1,000	23	1			1					

RAILROAD COMPANIES, BY STATES AND TERRITORIES, 1900—Continued.

Idaho.	Illinois.	Indiana.	Indian Territory.	Iowa.	Kansas.	Kentucky.	Louisiana.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Mississippi.	Missouri.	
$523,631	$16,580,424	$10,242,422	$56,635	$6,221,378	$5,816,816	$4,248,029	$1,429,099	$857,136	$4,573,229	$3,712,029	$4,332,927	$6,319,876	$1,331,401	$6,524,121	74
$294,333	$7,402,600	$4,863,977	$31,701	$2,898,775	$2,519,320	$1,753,703	$959,941	$344,536	$2,695,668	$1,709,229	$1,506,894	$3,256,252	$481,510	$2,482,874	75
....	27	1	....	8	12	....	....	....	....	....	16	....	....	2	76
....	$338,826	$5,709	....	$59,149	$142,800	....	....	....	....	....	$107,011	....	....	$13,545	77
1,329	162,810	102,604	6,867	62,664	78,597	5,699	1,435	5,400	5,588	902	3,239	29,071	1,818	61,233	78
$223,694	$4,497,144	$2,983,445	$30,055	$2,251,443	$1,801,317	$1,099,216	$329,551	$216,874	$1,236,343	$1,196,487	$1,137,222	$1,826,432	$337,734	$1,559,718	79
$5,433	$391,048	$143,509	....	$60,406	$36,003	$28,209	$21,101	$2,955	$61,155	$430	$20,783	$469,236	$22,881	$229,877	80
$65,206	$2,175,582	$1,231,314	$1,646	$527,777	$539,200	$626,278	$609,289	$124,707	$1,398,170	$512,312	$241,878	$960,584	$120,895	$679,734	81
$222,887	$8,771,949	$5,689,968	$24,934	$2,960,771	$3,955,303	$2,429,216	$446,507	$494,151	$1,801,641	$1,998,380	$2,552,421	$3,009,788	$828,839	$3,743,855	82
....	32	5	....	....	6	1	....	7	1	20	3	1	....	2	83
....	$98,464	$21,696	....	....	$21,300	$3,079	....	$17,241	$2,265	$35,451	$10,055	$13,904	....	$10,895	84
....	2,570	1,941	....	38	662	555	25	....	54	230	460	117	84	72	85
....	$1,377,698	$992,512	....	$26,964	$353,037	$328,786	$11,726	....	$24,390	$96,150	$216,108	$56,433	$41,189	$32,122	86
28,561	741,728	256,131	9,632	228,415	220,673	147,916	48,443	20,236	38,272	72,206	72,782	152,941	71,356	262,960	87
$192,026	$5,641,067	$3,584,005	$24,934	$2,570,313	$3,170,853	$1,384,470	$368,974	$434,363	$1,221,773	$1,342,309	$1,855,941	$2,157,271	$530,114	$2,595,377	88
$10,967	$460,931	$493,631	....	$170,172	$196,257	$138,997	$19,012	$21,802	$53,526	$190,228	$86,269	$273,063	$33,712	$693,548	89
$19,894	$1,193,789	$598,124	....	$193,322	$213,856	$573,884	$46,795	$20,746	$499,687	$334,242	$385,048	$509,117	$223,824	$411,913	90
$6,411	$405,875	$188,477	....	$361,832	$342,193	$65,110	$22,651	$18,449	$75,920	$4,420	$273,612	$53,836	$21,052	$297,392	91
$4,529	$369,133	$156,665	....	$305,955	$122,155	$52,553	$20,359	$13,941	$70,341	$4,420	$247,373	$51,445	$21,052	$82,660	92
$1,030	$5,072	$1,856	....	$1,043	$10,728	....	....	$273	....	....	....	....	....	$159,536	93
$852	$31,670	$29,956	....	$54,834	$209,310	$12,567	$2,292	$4,235	$5,579	....	$26,239	$2,391	....	$55,196	94
4	94	51	3	57	37	25	18	19	18	16	36	39	9	43	95
$523,631	$16,328,465	$10,230,721	$56,635	$5,766,008	$5,816,816	$4,248,029	$1,424,239	$857,136	$4,557,983	$3,712,029	$4,249,136	$6,319,876	$1,331,401	$6,524,121	96
$470,847	$14,148,410	$8,777,904	$51,388	$5,217,045	$6,272,264	$3,173,418	$1,282,317	$802,641	$3,869,289	$3,087,849	$3,435,214	$5,294,207	$1,201,549	$5,586,348	97
2	68	34	....	34	22	19	10	13	13	13	33	30	7	30	98
167	8,038	5,975	....	4,192	2,840	2,063	632	437	3,603	1,583	3,551	3,981	1,040	2,893	99
4	121	71	....	54	33	31	15	10	33	14	65	61	10	39	100
167	6,864	5,503	....	3,662	2,100	2,013	632	341	3,436	1,577	3,305	3,560	680	2,710	101
....	....	1	....	2	....	....	....	1	....	....	1	5	....	....	102
....	....	13	....	18	....	....	....	4	....	....	22	62	....	....	103
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	104
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	105
....	38	16	....	27	....	....	....	1	6	....	....	9	....	5	106
....	1,059	459	....	512	....	....	....	10	167	....	....	185	....	48	107
....	5	....	....	....	5	1	....	2	....	....	3	3	....	....	108
....	115	....	....	....	740	25	....	12	....	....	204	150	....	....	109
....	75	....	....	....	....	....	....	70	....	6	....	5	....	....	110
....	....	....	....	....	....	25	....	70	....	6	20	24	360	135	111
4	98	54	3	58	37	25	19	19	19	16	42	39	9	43	112
1	7	9	....	9	2	3	2	2	....	1	3	4	1	4	113
1	25	16	2	15	8	5	6	7	7	2	14	8	2	10	114
1	22	5	....	11	8	6	7	5	1	....	8	14	1	10	115
....	13	5	1	7	5	4	2	4	4	2	6	....	1	4	116
....	14	6	....	7	6	2	1	1	4	6	4	2	1	8	117
1	11	6	....	7	7	4	....	....	1	5	6	8	2	4	118
....	3	6	....	2	....	....	1	....	1	....	1	3	1	3	119
....	3	1	....	....	1	1	....	....	1	....	....	....	....	....	120

TABLE 16.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM

		Montana.	Nebraska.	Nevada.	New Hampshire.	New Jersey.	New Mexico.	New York.	North Carolina.	North Dakota.	Ohio.	Oklahoma.
1	Number of establishments	7	23	6	9	18	7	82	12	3	91	3
	Character of organization:											
2	Incorporated company	7	23	6	9	18	7	82	12	3	91	3
	Capital:											
3	Total	$524,725	$3,635,267	$404,577	$850,873	$2,819,759	$386,721	$11,244,747	$539,513	$171,043	$5,701,129	$9,350
4	Land	$37,500	$1,947,600	$53,700	$130,808	$404,314	$5,000	$1,200,582	$36,540	$20,180	$659,277	$1,900
5	Buildings	$163,135	$704,550	$104,200	$207,412	$1,218,005	$113,151	$2,679,844	$165,435	$87,214	$1,651,260	$3,600
6	Machinery, tools, and implements	$141,513	$593,118	$83,303	$265,003	$560,030	$227,092	$2,790,025	$166,365	$43,750	$1,304,205	$1,800
7	Cash and sundries	$182,577	$389,999	$163,374	$247,650	$637,410	$41,478	$4,574,296	$171,173	$19,899	$2,086,387	$2,050
	Salaried officials, clerks, etc.:											
8	Total number	49	114	8	30	179	19	443	47	7	576	3
9	Total salaries	$50,382	$100,401	$9,800	$24,201	$137,191	$18,784	$344,596	$38,463	$6,725	$456,971	$2,405
	General superintendents, managers, clerks, etc.—											
10	Total number	49	114	8	30	179	19	443	47	7	576	3
11	Total salaries	$50,382	$100,401	$9,800	$24,201	$137,191	$18,784	$344,596	$38,463	$6,725	$456,971	$2,405
	Men—											
12	Number	48	114	8	30	172	19	433	47	7	561	3
13	Salaries	$49,642	$100,401	$9,800	$24,201	$134,437	$18,784	$341,102	$38,463	$6,725	$451,398	$2,405
	Women—											
14	Number	1				7		10			15	
15	Salaries	$740				$2,754		$3,494			$5,573	
	Wage-earners, including pieceworkers, and total wages:											
16	Greatest number employed at any one time during the year.	700	2,585	277	1,044	6,083	1,215	14,574	1,241	148	12,839	25
17	Least number employed at any one time during the year.	533	2,265	184	925	4,207	912	11,561	1,028	92	10,085	19
18	Average number	621	2,458	214	966	4,594	1,061	13,062	1,141	126	11,534	22
19	Wages	$397,552	$1,421,284	$168,102	$516,990	$2,399,675	$685,401	$6,762,504	$550,504	$67,922	$6,087,062	$13,333
	Men, 16 years and over—											
20	Average number	621	2,458	214	966	4,687	1,061	13,013	1,139	126	11,520	22
21	Wages	$397,552	$1,421,284	$168,102	$516,990	$2,397,518	$585,401	$6,747,126	$550,128	$67,922	$6,082,128	$13,333
	Women, 16 years and over—											
22	Average number					7		49	2		14	
23	Wages					$2,157		$15,378	$376		$4,924	
	Children, under 16 years—											
24	Average number											
25	Wages											
	Average number of wage-earners, including pieceworkers, employed during each month:											
	Men, 16 years and over—											
26	January	638	2,626	186	937	4,565	1,156	12,954	1,139	129	11,423	21
27	February	621	2,483	188	941	4,639	1,108	13,071	1,169	119	11,432	19
28	March	656	2,526	193	946	4,692	1,007	13,305	1,208	124	11,643	18
29	April	626	2,477	266	970	4,761	1,037	13,488	1,197	120	11,732	20
30	May	657	2,506	212	968	4,715	1,050	13,630	1,224	109	11,767	23
31	June	658	2,517	208	946	4,565	946	13,079	1,097	110	11,326	21
32	July	576	2,324	209	939	4,440	1,011	12,322	1,139	99	10,930	19
33	August	614	2,348	204	949	4,485	1,043	12,460	1,106	133	10,987	22
34	September	613	2,388	227	953	4,455	1,047	12,473	1,108	146	11,338	23
35	October	616	2,418	227	985	4,479	1,081	12,824	1,096	139	11,688	25
36	November	565	2,472	230	1,034	4,574	1,116	13,178	1,095	147	11,956	24
37	December	608	2,515	218	1,023	4,680	1,124	13,376	1,094	136	12,015	28
	Women, 16 years and over—											
38	January					7		47	2		15	
39	February					7		47	2		15	
40	March					7		47	2		15	
41	April					7		47	2		13	
42	May					7		67	2		13	
43	June					7		66	2		12	
44	July					6		47	2		13	
45	August					6		48	2		14	
46	September					6		47	2		14	
47	October					6		46	2		14	
48	November					10		47	2		13	
49	December					8		49	2		13	
	Children, under 16 years—											
50	January											
51	February											
52	March											
53	April											
54	May											
55	June											
56	July											
57	August											
58	September											
59	October											
60	November											
61	December											
	Miscellaneous expenses:											
62	Total	$5,138	$92,946	$7,446	$36,763	$195,707	$1,913	$203,221	$29,259	$1,400	$391,581	$117
63	Rent of works							$3,400			$1,350	
64	Taxes not including internal revenue.	$4,728	$24,824	$2,531	$5,013	$17,078	$436	$63,721	$4,831	$1,400	$58,321	$117
65	Rent of offices, etc	$410	$68,122	$4,915	$31,750	$76,411	$1,477	$136,100	$23,861		$327,558	
66	Contract work					$102,218			$567		$4,352	
	Materials used:											
67	Total cost	$301,338	$1,009,830	$110,637	$523,347	$2,301,699	$463,182	$8,879,813	$893,150	$64,847	$5,963,808	$6,736
68	Purchased in partially manufactured form.	$185,328	$746,227	$65,789	$322,192	$1,815,797	$324,462	$6,648,296	$739,081	$39,093	$4,384,232	$4,266
69	Fuel	$19,209	$46,634	$9,284	$14,780	$51,243	$18,153	$158,519	$12,300	$6,195	$111,639	$286
70	Rent of power and heat										$120	
71	Mill supplies	$6,108	$31,801	$1,294	$2,064	$8,012	$21,625	$147,840	$4,307	$975	$52,824	$302
72	All other materials	$90,693	$180,964	$30,316	$184,311	$426,647	$99,042	$1,925,158	$137,462	$18,684	$1,388,967	$1,882
73	Freight		$4,204	$3,954							$26,026	

RAILROAD COMPANIES, BY STATES AND TERRITORIES, 1900—Continued.

Oregon.	Pennsylvania.	Rhode Island.	South Carolina.	South Dakota.	Tennessee.	Texas.	Utah.	Vermont	Virginia	Washington.	West Virginia.	Wisconsin.	Wyoming.	Other states.[1]	
14	144	3	6	7	16	56	10	7	28	16	23	46	7	3	1
14	144	3	6	7	16	56	10	7	28	16	23	46	7	3	2
$725,985	$19,182,001	$120,900	$354,842	$68,079	$1,319,628	$3,730,792	$496,149	$711,261	$1,733,389	$944,800	$1,040,311	$4,206,285	$591,725	$470,387	3
$141,000	$2,128,663	$11,500	$24,050	$6,040	$162,517	$437,873	$141,200	$92,100	$101,572	$194,820	$43,958	$589,376	$36,760	$200,700	4
$202,433	$5,766,904	$41,000	$86,833	$34,600	$447,145	$897,579	$115,460	$274,200	$482,886	$313,270	$279,536	$1,343,738	$152,450	$122,525	5
$161,219	$4,858,929	$50,500	$78,903	$6,941	$287,159	$1,104,483	$147,412	$216,458	$421,488	$243,176	$250,951	$690,578	$278,796	$57,960	6
$221,283	$6,427,505	$17,900	$165,056	$20,498	$422,807	$1,290,857	$92,087	$128,503	$727,443	$193,534	$465,866	$1,582,594	$124,719	$89,202	7
29	1,065	17	27	9	65	263	46	32	283	55	90	272	28	14	8
$31,678	$810,857	$14,490	$21,379	$8,354	$58,606	$292,398	$49,389	$23,744	$248,425	$51,353	$67,646	$245,163	$29,374	$13,160	9
29	1,065	17	27	9	65	263	46	32	283	55	90	272	28	14	10
$31,678	$810,867	$14,490	$21,379	$8,354	$58,606	$292,398	$49,389	$23,744	$248,425	$51,353	$67,646	$245,163	$29,374	$13,160	11
29	1,042	17	26	9	62	259	46	25	280	54	90	270	28	14	12
$31,678	$800,687	$14,490	$20,959	$8,354	$56,896	$289,758	$49,389	$21,978	$247,093	$50,948	$67,646	$244,023	$29,374	$13,160	13
...	23	...	1	...	3	4	...	7	3	1	...	2	...	...	14
...	$10,170	...	$420	...	$1,710	$2,640	...	$1,766	$1,332	$405	...	$1,140	...	...	15
855	31,289	218	889	150	3,070	7,336	1,034	883	5,262	1,153	2,908	5,141	1,049	461	16
705	26,392	206	680	102	2,503	5,879	746	713	4,569	820	2,367	4,027	731	361	17
751	28,564	216	776	117	2,817	6,633	908	779	4,922	956	2,605	4,502	853	394	18
$495,159	$15,825,640	$133,300	$363,041	$79,661	$1,459,319	$4,004,769	$636,076	$446,017	$2,452,195	$653,205	$1,256,640	$2,398,144	$623,046	$205,475	19
751	28,372	215	774	117	2,810	6,633	907	779	4,897	955	2,604	4,499	851	373	20
$495,159	$15,779,638	$133,300	$362,681	$79,661	$1,457,718	$4,004,769	$635,776	$446,017	$2,447,732	$652,780	$1,256,280	$2,396,997	$622,446	$198,601	21
...	144	...	2	...	7	...	1	...	8	1	1	3	...	21	22
...	$38,974	...	$360	...	$1,601	...	$300	...	$1,403	$425	$360	$1,147	...	$6,874	23
...	38	...	...	...	...	...	...	...	17	...	...	...	2	...	24
...	$7,028	...	...	...	...	...	...	...	$3,060	...	...	...	$600	...	25
783	27,636	206	790	113	2,933	6,439	895	742	5,040	965	2,579	4,247	814	356	26
770	28,134	212	807	114	2,911	6,353	906	731	6,003	979	2,672	4,260	810	379	27
763	28,452	211	854	121	2,975	6,479	933	760	5,078	1,025	2,708	4,416	856	419	28
772	28,625	218	856	118	2,934	6,459	958	730	5,044	1,050	2,701	4,554	812	397	29
778	28,540	218	853	112	2,885	6,430	936	859	5,127	1,056	2,734	4,611	795	401	30
713	28,177	217	691	111	2,579	6,407	969	834	4,786	907	2,454	4,496	743	366	31
723	27,617	215	731	103	2,598	6,620	832	799	4,661	884	2,443	4,417	758	349	32
788	27,907	216	751	119	2,658	6,838	830	798	4,748	893	2,500	4,520	844	342	33
737	28,378	217	728	111	2,769	6,805	852	786	4,791	887	2,591	4,623	869	358	34
760	28,801	217	741	120	2,775	6,949	921	770	4,798	918	2,598	4,707	947	376	35
736	28,872	216	740	139	2,841	6,944	897	772	4,796	942	2,605	4,695	955	366	36
739	29,430	217	740	119	2,861	6,870	961	766	4,902	954	2,661	4,543	1,014	371	37
...	142	...	2	...	8	...	1	...	8	1	1	3	...	21	38
...	143	...	2	...	8	...	1	...	8	1	1	3	...	21	39
...	144	...	2	...	8	...	1	...	8	1	1	3	...	21	40
...	144	...	2	...	7	...	1	...	8	1	1	3	...	21	41
...	144	...	2	...	7	...	1	...	8	1	1	3	...	21	42
...	143	...	...	...	7	...	1	...	7	1	1	3	...	21	43
...	145	...	2	...	7	...	1	...	7	1	1	3	...	21	44
...	145	...	2	...	7	...	1	...	7	1	1	3	...	21	45
...	140	...	2	...	7	...	1	...	7	1	1	3	...	19	46
...	144	...	2	...	7	...	1	...	9	1	1	3	...	20	47
...	144	...	2	...	7	...	1	...	9	1	1	3	...	20	48
...	149	...	2	...	7	...	1	...	8	1	1	7	...	21	49
...	28	...	...	...	...	...	...	...	17	...	...	...	2	...	50
...	32	...	...	...	...	...	...	...	17	...	...	...	2	...	51
...	37	...	...	...	...	...	...	...	17	...	...	...	2	...	52
...	38	...	...	...	...	...	...	...	17	...	...	...	2	...	53
...	41	...	...	...	...	...	...	...	17	...	...	...	2	...	54
...	40	...	...	...	...	...	...	...	17	...	...	...	2	...	55
...	40	...	...	...	...	...	...	...	17	...	...	...	2	...	56
...	41	...	...	...	...	...	...	...	17	...	...	...	2	...	57
...	40	...	...	...	...	...	...	...	17	...	...	...	2	...	58
...	41	...	...	...	...	...	...	...	17	...	...	...	2	...	59
...	40	...	...	...	...	...	...	...	17	...	...	...	2	...	60
...	38	...	...	...	...	...	...	...	17	...	...	...	2	...	61
$15,688	$3,280,079	$1,770	$12,555	$3,049	$66,765	$138,838	$16,219	$4,614	$45,406	$14,264	$32,355	$138,270	$37,194	$1,100	62
...	$226	...	...	...	...	...	...	...	$200	$230	$60	...	...	...	63
$9,307	$61,366	$1,770	$4,508	$1,270	$12,478	$45,194	$10,815	$2,092	$12,279	$11,614	$11,831	$15,988	$6,250	$900	64
$6,381	$265,622	...	$8,047	$1,779	$54,287	$77,644	$5,404	$2,522	$32,927	$2,420	$20,464	$122,282	$30,944	$200	65
...	$2,952,866	...	...	...	...	$16,000	...	...	...	...	...	...	...	...	66
$483,644	$23,147,574	$48,696	$294,334	$86,667	$1,528,363	$3,878,536	$604,907	$350,401	$3,531,283	$760,858	$1,586,916	$3,525,144	$480,199	$157,255	67
$341,625	$18,813,128	$38,106	$197,669	$60,028	$1,034,198	$3,116,632	$445,609	$294,478	$2,480,483	$571,888	$1,366,609	$2,981,275	$369,771	$116,537	68
$19,629	$355,541	$2,575	$8,235	$2,029	$21,458	$87,472	$16,087	$11,052	$57,287	$22,086	$19,616	$69,274	$18,499	$7,678	69
$200	$1,544	...	...	...	...	$504	...	$500	...	$1,718	...	...	...	...	70
$3,677	$145,101	$584	$1,520	$4,782	$25,395	$63,569	$8,131	$6,605	$55,330	$7,037	$16,007	$23,511	$3,667	$1,303	71
$110,224	$3,829,654	$7,331	$86,910	$19,728	$434,723	$607,940	$135,080	$37,501	$938,139	$158,065	$184,524	$421,999	$88,262	$31,737	72
$8,289	$2,606	...	...	...	$12,589	$2,419	...	$265	$44	$64	$160	$29,085	...	...	73

[1] Includes establishments distributed as follows: Alaska, 1; District of Columbia, 2.

TABLE 16.—CARS AND GENERAL SHOP CONSTRUCTION AND REPAIRS BY STEAM

		Montana.	Nebraska.	Nevada.	New Hampshire.	New Jersey.	New Mexico.	New York.	North Carolina.	North Dakota.	Ohio.	Oklahoma.
	Products:											
74	Aggregate value	$754,410	$2,624,461	$295,985	$1,101,301	$5,034,267	$1,069,280	$16,194,850	$1,511,376	$140,894	$12,975,182	$22,691
	Motive power and machinery—											
75	Total value	$524,006	$1,476,402	$111,856	$576,761	$2,551,960	$631,029	$6,864,940	$494,561	$102,101	$4,726,651	$9,400
76	Locomotives built, number							2				
77	Value							$25,114				
78	Locomotives repaired, number.	3,541	54,281	132	812	8,064	16,598	131,290	15,044	194	160,306	1,672
79	Value	$327,637	$1,208,860	$90,834	$449,949	$1,181,002	$591,129	$4,218,942	$430,099	$34,941	$3,175,272	$9,400
80	Work for other corporations, value.	$1,869	$47,931	$12,587	$323	$29,432	$25,400	$324,190	$2,128		$52,023	
81	Other products, value	$194,500	$219,611	$8,435	$126,479	$1,341,526	$14,500	$2,296,694	$62,334	$67,160	$1,499,356	
	Car department—											
82	Total value	$228,796	$1,074,737	$176,748	$490,910	$2,356,015	$426,913	$8,976,656	$993,194	$38,793	$8,032,237	$10,191
83	Passenger cars built, number.				8	12		73	3		9	
84	Value				$25,834	$101,804		$186,191	$15,538		$46,918	
85	Freight cars built, number			12	129	1		786	649		1,304	
86	Value			$6,157	$63,382	$435		$328,719	$276,476		$425,643	
87	Cars repaired, number	36,850	44,901	18,142	20,579	217,801	38,429	1,792,341	27,015	4,430	722,929	2,387
88	Value	$228,271	$631,541	$51,169	$219,801	$1,888,186	$339,636	$6,319,591	$633,263	$36,833	$5,819,411	$9,740
89	Work for other corporations, value.		$377,663	$6,954	$54,603	$107,609	$70,052	$737,088	$26,483		$391,324	
90	Other products, value	$525	$65,633	$112,468	$127,290	$257,981	$17,226	$1,406,067	$41,434	$1,960	$1,348,941	$451
	Bridge and building department—											
91	Total value	$1,608	$73,322	$7,381	$33,640	$126,292	$11,338	$363,264	$23,621		$216,294	$3,000
92	Repairs and renewals, value	$1,608	$73,322	$6,866	$25,846	$125,563	$5,284	$310,266	$12,292		$208,038	$3,000
93	Work for other corporations, value.					$125	$4,478					
94	Other products, value			$515	$7,794	$604	$1,576	$42,989	$11,329		$8,256	
	Comparison of products:											
95	Number of establishments reporting for both years.	7	23	6	9	17	6	82	6	3	87	2
96	Value for census year	$754,410	$2,624,461	$295,985	$1,101,301	$5,027,001	$1,020,770	$16,194,850	$1,310,339	$140,894	$12,913,772	$21,372
97	Value for preceding business year	$688,042	$2,348,276	$237,654	$1,073,301	$4,588,762	$1,012,471	$13,664,930	$1,069,326	$126,762	$11,188,852	$10,101
	Power—											
98	Number of establishments reporting	7	14	6	6	16	6	66	10	2	72	
99	Total horsepower	396	2,037	176	854	2,084	760	6,741	762	223	6,797	
	Owned—											
	Engines—											
100	Steam, number	9	30	6	8	37	8	95	11	3	107	
101	Horsepower	396	1,987	170	684	1,597	610	6,556	757	181	6,762	
102	Gas or gasoline, number					8		2		1		
103	Horsepower					391		35		16		
104	Water wheels, number			1								
105	Horsepower			5								
106	Electric motors, number				10	4		28		3	2	
107	Horsepower				95	16		148		26	30	
108	Other kind, number		1		1	1	1	1				
109	Horsepower		50		75	80	150	2				
	Rented—											
110	Supplied to other establishments, horsepower.										150	
111	From other establishments, horsepower.								5		5	
	Establishments classified by number of employees:											
112	Total number	7	23	6	9	18	7	82	12	3	91	3
113	Under 5		4	1	2	1			4	1	2	1
114	5 to 20		7	3	3	1	1	19	1		20	2
115	21 to 50	2	2	1	1			17	1		20	
116	51 to 100	2	3		1	6	2	11	2	2	13	
117	101 to 250	3	4	1	1	4	2	15	2		20	
118	251 to 500		2		1	2	1	14	2		12	
119	501 to 1,000					2	1	3			3	
120	Over 1,000		1			2		3			1	

RAILROAD COMPANIES, BY STATES AND TERRITORIES, 1900—Continued.

Oregon.	Pennsylvania.	Rhode Island.	South Carolina.	South Dakota.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin.	Wyoming.	Other states.[1]	
$1,026,169	$43,065,171	$203,326	$691,361	$177,631	$3,113,053	$8,314,691	$1,306,591	$824,776	$6,277,279	$1,479,680	$2,943,557	$6,306,823	$1,169,813	$376,990	74
$275,894	$20,409,988	$87,529	$355,726	$91,917	$1,333,763	$4,046,335	$703,752	$343,864	$1,666,179	$742,945	$910,903	$1,942,515	$831,217	$149,571	75
....	166	....	....	....	....	9	....	1	6	....	....	13	....	....	76
....	$2,303,712	....	....	....	....	$59,842	....	$4,718	$61,455	....	....	$77,615	....	....	77
252	223,987	98	1,076	5,740	2,673	7,965	1,996	1,358	75,826	3,274	49,169	12,251	11,470	998	78
$233,750	$8,878,878	$73,555	$288,665	$66,015	$888,751	$2,239,853	$504,169	$208,441	$1,396,735	$339,445	$633,861	$1,125,855	$831,180	$76,733	79
$10,375	$521,698	....	$4,839	$867	$48,770	$270,132	$2,748	$15,632	$1,901	$74,919	$16,747	$30,876	$37	$4,144	80
$31,769	$8,705,700	$13,974	$62,222	$25,035	$396,242	$1,476,508	$196,835	$115,073	$206,088	$328,581	$260,295	$708,169	....	$68,694	81
$721,047	$22,121,173	$112,890	$333,781	$50,378	$1,694,499	$4,159,970	$598,563	$437,468	$4,469,806	$705,243	$1,835,730	$4,072,534	$337,551	$227,419	82
....	153	....	....	....	....	11	....	....	1	....	1	18	....	....	83
....	$643,113	....	....	....	....	$55,564	....	....	$3,800	....	$2,378	$50,268	....	....	84
....	8,420	....	....	....	107	412	14	54	1,407	216	162	3,371	....	101	85
....	$5,805,636	....	....	....	$53,525	$191,945	$15,187	$27,473	$983,971	$108,308	$51,127	$1,792,612	....	$58,200	86
55,716	1,466,305	5,275	16,470	4,413	143,876	207,906	33,876	17,179	154,625	58,695	163,161	117,161	15,881	3,152	87
$460,654	$12,876,887	$91,343	$260,787	$42,048	$1,077,097	$3,033,077	$320,568	$181,151	$1,860,432	$415,609	$1,085,840	$1,540,355	$333,149	$120,098	88
$11,158	$611,351	$3,717	$2,595	$5,730	$116,798	$344,021	$45,649	$100,077	$89,128	$51,141	$124,244	$50,052	$4,402	$3,874	89
$249,235	$2,184,186	$17,830	$70,399	$2,600	$447,079	$535,363	$217,159	$128,767	$1,532,475	$130,185	$572,141	$639,247	....	$45,247	90
$29,228	$534,010	$2,907	$1,854	$35,336	$84,791	$108,386	$4,276	$43,444	$141,294	$31,492	$196,924	$291,774	$1,045	....	91
$22,629	$394,779	$2,557	$1,613	$34,993	$41,776	$73,776	$4,076	$21,600	$126,409	$20,105	$195,020	$260,669	$462	....	92
....	$5,947	....	....	....	....	$23,495	....	....	$50	$2,700	....	$104	$583	....	93
$6,599	$133,284	$350	$241	$343	$43,015	$11,115	$200	$21,844	$14,835	$8,687	$1,904	$31,001	....	....	94
14	138	2	4	7	16	55	9	7	28	16	20	45	7	3	95
$1,026,169	$42,657,032	$198,156	$579,636	$177,631	$3,113,053	$8,304,204	$1,305,471	$824,776	$6,277,279	$1,479,680	$2,906,626	$6,294,223	$1,169,813	$376,990	96
$894,206	$31,426,681	$178,938	$407,914	$147,308	$2,719,703	$6,512,638	$1,179,629	$757,615	$4,712,581	$1,080,998	$2,376,866	$5,679,497	$807,469	$257,788	97
10	111	2	6	3	10	43	5	7	24	9	17	32	7	3	98
721	13,335	120	413	70	1,341	3,189	375	404	1,433	1,187	834	3,071	1,121	177	99
12	260	3	8	3	16	74	9	8	50	13	22	41	13	5	100
701	12,191	120	413	70	1,341	3,133	293	280	1,433	937	834	2,941	1,001	152	101
....	5	....	....	....	....	....	2	1	....	....	....	....	....	....	102
....	104	....	....	....	....	....	22	4	....	....	....	....	....	....	103
....	2	....	....	....	....	....	....	....	....	....	....	1	....	....	104
....	20	....	....	....	....	....	....	....	....	....	....	10	....	....	105
....	51	....	....	....	....	3	2	....	....	6	....	14	8	3	106
....	949	....	....	....	....	31	60	....	....	170	....	117	80	25	107
....	1	....	....	....	....	....	....	1	....	....	....	1	1	....	108
....	30	....	....	....	....	....	....	20	....	....	....	3	40	....	109
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	110
20	41	....	....	....	....	25	....	100	....	80	....	....	....	....	111
14	144	3	6	7	16	56	10	7	28	16	23	46	7	3	112
1	14	....	....	2	1	3	2	1	2	3	3	11	....	....	113
5	36	1	1	4	2	16	2	3	5	7	4	11	1	....	114
6	23	1	1	....	3	10	1	....	5	....	4	7	1	1	115
....	15	....	....	1	2	10	2	....	6	3	3	7	....	1	116
....	28	1	3	....	3	6	2	2	4	1	7	6	4	....	117
2	9	....	1	....	3	8	1	1	2	2	1	3	1	1	118
....	14	....	....	....	2	3	....	....	3	....	1	....	....	....	119
....	5	....	....	....	....	....	....	....	1	....	....	1	....	....	120

[1] Includes establishments distributed as follows: Alaska, 1; District of Columbia, 2.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 215. WASHINGTON, D. C. June 28, 1902.

MANUFACTURES.

COTTON MANUFACTURES.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on cotton manufactures, prepared under my direction by Mr. Edward Stanwood, of Boston, acting in the capacity of an expert special agent of the division of manufactures of the Census Office.

In the presentation of the statistics for the industry at the census of 1900, establishments chiefly engaged in the manufacture of cotton small wares, which at prior censuses were included as part of the industry, have been excluded, and separately treated, both in this report and in the general classification of industries.

Although the industry as a whole shows a fair percentage of increase for the decade ending with 1900, there have been periods of great depression interspersed with those of prosperity. The notable feature of the industry during the last ten years was the wonderful growth and universal prosperity of the industry in the Southern states.

The statistics of the cotton manufactures proper are presented in 24 tables: Table 1 showing the annual imports of manufactures of cotton from 1821 to 1900; Table 2 showing the annual exports of cotton manufactures from 1826 to 1900; Table 3 showing the annual exports of foreign manufactures of cotton from 1821 to 1900; Table 4 being a comparative summary of cotton manufactures for the several censuses from 1840 to 1900; Table 5 showing the chief features of the statistics for 1900 for cotton goods and cotton small wares, separately, and the per cent that each industry is of the total; Table 6 showing the number of spindles in cotton mills within 30 miles of Providence, R. I.; Table 7 being a comparative summary of capital invested, by geographical groups, 1890 and 1900; Table 8 showing, for corporations, the capital as reported at the census of 1900, compared with their capital stock; Table 9 showing the number of wage-earners, men, women, and children, by geographical groups, 1880, 1890, and 1900; Table 10 showing the percentages of men, women, and children of total wage-earners, by geographical groups, for 1880, 1890, and 1900; Table 11 being a comparative summary of miscellaneous expenses, 1890 and 1900; Table 12 showing the quantities of raw cotton produced, imported, exported, and retained for consumption, 1880 to 1900; Table 13 showing, by states, the quantity and cost of domestic cotton, other than sea island, consumed, 1880 to 1900; Table 14 showing the kinds, quantity, and value of products, 1890 and 1900; Table 15 showing the additional value added by finishing processes to products of mills after spinning and weaving, both in cotton mills and in independent establishments; Table 16 showing the amount of yarn spun, coarse, medium, and fine, by states, geographically arranged, 1890 and 1900; Table 17 showing the active cotton spindles in the entire textile industry, by states, geographically arranged, 1890 and 1900; Table 18 showing the spindles in cotton mills, by states, geographically arranged, 1880, 1890, and 1900; Table 19 showing the annual sales of frame spindles from 1890 to 1900; Table 20 showing the number of spindles to each wage-earner and the labor cost per spindle, by states, geographically arranged, 1880, 1890, and 1900; Table 21 showing the classification of looms, by geographical groups, 1890 and 1900; Table 22 presenting, for 1900, the number and capacity of spinning mills, of weaving mills, and of mills which do both spinning and weaving, by states, geographically arranged; Table 23 showing a comparative summary, by states, geographically arranged, 1840 to 1900; and Table 24 showing the detailed statistics of the industry, by states, for 1900. The statistics of the manufactures of cotton small wares are presented in two tables: Table 25 showing a summary of the industry for 1900; and Table 26 presenting the detailed statistics, by states, for 1900.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the general heads of the inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital—that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries—was first called for at the census of 1890; no definite attempt having been made, prior to that census, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages, in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least number of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class overseers, foremen, and superintendents (not general superintendents or managers); while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890. With the exception of several other changes of a minor character in the special features of the schedule, the investigation has been conducted along the lines followed at the census of 1890.

In some instances the number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations. The reports for cotton manufactures proper show a capital of $460,842,772 invested in the 973 establishments reporting for the industry. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the corporations. The value of the products is returned at $332,806,156, to produce which involved an outlay of $7,123,574 for salaries of officials, clerks, etc.; $85,126,310 for wages; $21,650,144 for miscellaneous expenses, including rent, taxes, etc.; and $173,441,390 for materials used, mill supplies, freight, and fuel. For the 82 establishments manufacturing cotton small wares, the principal items were as follows: Capital, $6,397,385; salaries, $226,625; wages, $1,563,442; miscellaneous expenses, $462,534; cost of materials used, $3,110,137; and value of products, $6,394,164. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of the products during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the factory. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures.

COTTON MANUFACTURES.

By Edward Stanwood.

Civilized man finds three things absolutely essential to his life and comfort—food, shelter, and clothing. The labor necessary to procure the indispensable articles which represent these wants diminishes as one approaches the equator, and conversely it increases as one passes from torrid to temperate climates and thence onward toward the poles of the earth. Tillage of the soil, the construction of dwellings, and the conversion of skins and furs or of vegetable or animal fibers into clothing, are arts which establish themselves naturally wherever man fixes his abode. The provision of shelter always remains a local art, from the necessity of the case. An adequate supply of fuel, which is a concomitant of shelter, was frequently the first want for which pioneer communities in early times were compelled to provide from without. Next they supplemented their own provision of clothing with fabrics and garments made elsewhere; and finally as population became dense, and labor was drawn from agriculture and was specialized in commerce and manufactures, they were obliged to import their food.

In the sense indicated, the colonists of America were engaged in all the arts necessary to supply their own wants, and among those arts was the manufacture of cloth and of clothing. They were prohibited by the laws of the mother country from carrying on manufactures for purposes of trade and profit, but the household manufacture always existed. A considerable part of their clothing was made from domestic material, spun and woven in their homes, and made up by members of their own families. When Hamilton wrote his great Report on Manufactures, in 1791, he referred to certain branches of the textile industry as already established, yet at that time there was but one cotton factory where spinning was carried on by means of machinery moved by waterpower, and that factory had been established less than a year and had but 72 spindles. There were no woolen mills in the modern sense of the term, but there were many fulling mills where wool was prepared for household spinning.

Although some progress was made during the next twenty years, it was not until the War of 1812 cut off foreign supplies that the cotton manufacture was truly "established." Since that time it has expanded steadily and marvelously. During every decade, not even excepting that which covered the years of the Civil War, there has been an increase in the number of operatives employed and in the quantity and value of the goods manufactured. The census of 1850 showed a total value of products of $61,869,184. Ten years later, in 1860, the value of products had almost doubled, being $115,681,774. In 1870 the value had increased to $177,489,739, a large part of the increase being due to inflation of the currency. The decline to normal price in the ensuing decade masked the actual growth of the industry, and in 1880 the value of products was only $192,090,110. In 1890 the value was $267,981,724; at the census of 1900 it was $339,200,320—five and a half times as much as in 1850, when it was already the leading manufacturing interest in the United States. It was the first, the largest, and the most typical factory industry in the country, and still holds its ranks, almost undisputed, in all these respects.

The growth of the industry is sufficient proof, were such proof needed, that it has been profitable. Nevertheless it has been subjected to many and sometimes protracted seasons of discouragement and loss. The margin between the price of a pound of raw cotton and that of a pound of goods, whether yarn or cloth, is, in the face of the keen competition which exists, so small that the profits of a mill during a whole year may depend upon the luck or judgment of the treasurer in buying his raw material at the right or the wrong season, which in turn largely depends upon his skill or his fortune in forecasting a large or a small cotton crop. So far as that were the case, what one treasurer might lose another treasurer would gain, and the ultimate effect upon the profits of the industry as a whole would be *nil*. But the fact of a large or a small cotton crop makes an enormous difference in the profits of manufacturers. The general condition of the country determines the demand for goods, and consequently the price; but the cost of production depends greatly upon the price of cotton. Cheap cotton and a quick demand make the manufacture profitable; dear cotton, a sluggish rate of consumption, and labor troubles reduce or extinguish profits. Unfortunately the latter set of conditions is too often presented. Fortunately it is not usually met in so virulent a form as to cause actual loss, and the situation does not ordinarily last long.

Upon the whole, the history of the past ten years was not one of prevailing prosperity. Two influences interfered to reduce profits—an extremely wide fluctuation in the price of cotton, and the great increase of competition caused by the growth of the industry in the Southern states. The first of these influences was general in its application; the other applied to Northern mills only. The new Southern mills, equipped with the most efficient machinery, favored by peculiarly free conditions as to labor, chiefly engaged in the production of goods for which the demand was most steady, and helped not a little by close proximity to the field of supply of their raw material, were able to show constant and large profits; whereas their Northern competitors passed through seasons of no profit or of moderate gains, with only one or two periods when their business was eminently satisfactory.

The condition throughout the census year 1889–90 was highly favorable to manufacturers, and they made extraordinary profits. Barely 1 per cent of the cotton spindles in the country was idle, and most of those were so because they were antiquated and not worth running. But a rise in the price of cotton, from 10 cents a pound in January, 1890, to 11½ cents in April, brought discouragement, because a slackened demand for goods compelled a reduction in the price of cloth at the same time that the cost of producing it was increased. The change to unfavorable conditions was felt first in the great print-cloth center, at Fall River, where a stoppage of the mills and a general curtailment of production became necessary in August. Other branches of the cotton manufacture continued fairly profitable for a few months longer, but before the end of the year all branches were depressed. There was, nevertheless, a somewhat speedy recovery; an improvement set in quite early in the spring for all except print cloths, which continued to be weak. There was an extraordinary fall in the price of cotton, owing to the prospect of a large crop, from 12¾ cents in May, 1891, to 8 cents in June. Notwithstanding this favorable turn of the market, the Northern mills felt the first check to prosperity, owing to Southern competition. Again in September of that year it became necessary both to curtail production by the Fall River mills and to reduce wages. This time the means taken were effectual. Stocks were worked off and the market demand became strong. Accordingly the year 1892 was one of the good years of the industry. No complaints were heard from any part of the country.

In 1893 there was once more a reverse. Cotton manufacturing in England, which had been in an extraordinarily depressed state in 1892, now became prosperous, whereas in the United States it was dull and unsatisfactory. In August there were strikes and closing of mills, and the unfavorable conditions continued throughout the year 1894. No doubt apprehension by manufacturers of tariff legislation less favorable to their interests than the existing import duties went far to create the difficulties with which they contended. The passage of the act of 1894, however, did no injury to the interests of the manufacturers, and the industry revived, and was in a prosperous condition in 1895. Stocks were small, prices were fair, and although cotton was higher, the results of the year were remunerative. This was brought about because mills were well provided with stocks of low-priced cotton of the 1894 crop, and the prospect of a short crop in 1895 gave tone to the market for cloth. Orders were large, prices advanced, machinery was in full operation, and the year 1895 ended with excellent prospects of a continuance of prosperity.

These prospects were not realized. Early in 1896 the market demand began to decline, and as the machinery continued in operation, goods accumulated. The situation became such that in June, efforts were made by means of auction sales of large stocks of goods to reduce the surplus. There was also the suggestion that there be once more an organized curtailment of production, which was not carried out. The attempt to work off the surplus goods was successful, and the prospects of manufacturers brightened to a certain extent, but it was soon discovered that the market had been choked. Cotton advanced in price, narrowing the margin between the cost of raw cotton and the selling value of finished goods, and the demand was not great enough to absorb the output of the largely increased number of mills. The depression that existed in 1896 was due to the agitation and uncertainty that always prevail in a year of Presidential election, which were in this instance more acute than usual. But the peculiar situation of the two markets that determine the financial result of a cotton manufacturer's operations prolonged the depression, and continued it after other branches of business had begun to experience the great prosperity that marked the closing years of the century. Many mills were shut down in May and June, 1897. Renewed sales of goods by auction in the spring broke prices and demoralized the market, as well as reduced to petty proportions the demand for goods of current manufacture. There was another curtailment of production, then a great drop in the price of cotton; but the quick absorption of goods, owing to the generally prosperous condition of the people, rectified the situation altogether, and manufacturers entered upon a somewhat prolonged period of great prosperity. The only interruption was in the print-cloth branch, which was in a very unfavorable condition at Fall River in 1898, and the average return upon capital by the mills of that city for the year was only 2.2 per cent. But prosperity came to Fall River also during the year 1899, beginning about the month of March, and during the whole of the census year, from June, 1899, to June, 1900, all the mills of the country were fully occupied. Goods were produced from cotton costing within a fraction of the lowest on record, and although they were sold at prices which were low as compared with the average for any five years in the past, yet they yielded a profit which, taking the country as a whole, has never been exceeded.

It must always be borne in mind that the foregoing statements apply more particularly to establishments and to the conditions of trade in the manufacturing centers of the North. Prior to the close of the census year there had been scarcely any interruption of the exceeding prosperity of Southern spinners. They did not curtail production when many Northern manufacturers were in a state bordering upon despair; on the contrary, a large number of their mills were running day and night. They did not seek to dispose of their product by auction, but sold all they could make at prices which gave their stockholders handsome dividends.

THE FOREIGN TRADE IN COTTON GOODS.

It is further to be noted in this connection that for the first time in the history of American cotton manufacturing, the domestic market was more than once relieved and steadied by the exportation of goods to foreign markets. This statement does not signify that the export of domestics is a new thing, for it was a feature of the American foreign trade eighty years ago, but that for the first time the existence of an important outlet for such goods saved manufacturers from a disastrous glut, and mitigated the keenness of the competition that became most serious when the South entered the market as a great producer.

The history of the trade of the United States in cotton goods presents some peculiarities which distinguish it from the trade in any other class of articles. In a broad sense the cotton manufacturers have possessed the home market for three-quarters of a century. Nevertheless, in the intervening years there has been a large and important import trade. The seeming paradox disappears when the first of the following tables is critically examined. The imports consist mostly of goods which American manufacturers have never undertaken to produce on a large scale. An overwhelming proportion of the manufactures of cotton consumed in this and other countries consists of plain cloth woven from coarse or medium yarns. Save in a few exceptional years, the American manufacturers have been able to supply fully the demand for such goods. Meanwhile the arrangement of the tariff has been usually such that foreign manufacturers were not permitted to compete successfully in this market.

Table 1 shows the annual imports of manufactures of cotton from 1821 to 1900, inclusive, as compiled from the annual reports on Commerce and Navigation, published by the United States Treasury Department.

TABLE 1.—ANNUAL IMPORTS OF MANUFACTURES OF COTTON, 1821 TO 1900, INCLUSIVE.[1]

YEARS.	Total value.	CLOTHS. Bleached and unbleached.		CLOTHS. Printed, painted, and colored.		Value of clothing, ready-made, and other wearing apparel, not including knit goods.	Value of embroideries, laces, insertings, trimmings, and lace curtains, cords, and gimps.	Value of knit goods made on knitting machines or knit by hand.	THREAD (NOT ON SPOOLS), YARNS, WARPS, OR WARP YARNS.		JEANS, DENIMS, AND DRILLINGS.		All other manufactures.
		Square yards.	Value.	Square yards.	Value.				Pounds.	Value.	Square yards.	Value.	Value.
Total.	$91,972,247		$29,300,792		$52,709,603			$5,422,605		$1,881,685			$2,657,562
1821	7,788,514		2,873,383		4,366,407			397,586		151,138			
1822	10,680,216		3,774,992		5,856,763			866,618		181,843			
1823	8,869,482		3,237,513		4,899,499			629,211		103,259			
1824	7,239,759		1,991,666		4,609,236			523,821		115,036			
1825	12,509,516		3,676,451		7,709,830			545,915		201,549			375,771
1826	8,348,034		2,565,004		5,056,725			404,870		175,143			146,292
1827	9,316,153		2,841,215		5,316,546			439,773		263,772			454,847
1828	10,996,230		2,839,547		6,133,844			640,360		344,040			1,038,439
1829	8,362,017		2,784,984		4,404,078			586,997		173,120			412,838
1830	7,862,326		2,716,037		4,356,675			387,454		172,785			229,375
Total.	116,486,231		21,065,018		75,274,878			10,268,156		4,324,967			5,553,212
1831	16,090,224		4,399,251		10,046,500			887,957		393,414			363,102
1832	10,399,653		2,379,301		6,355,475			1,035,513		316,122			313,242
1833	7,660,449		1,218,513		5,181,647			623,369		343,059			293,861
1834	10,145,181		1,793,819		6,688,823			749,356		379,793			533,390
1835	15,367,585		2,747,514		10,610,722			906,369		544,473			558,507
1836	17,876,087		2,795,135		12,192,980			1,358,608		555,290			974,074
1837	11,150,841		1,647,388		7,087,270			1,267,267		404,603			744,313
1838	6,599,330		1,007,191		4,217,551			767,856		222,114			384,618
1839	14,692,397		2,158,703		9,000,216			1,879,783		779,004			874,691
1840	6,504,484		918,203		3,893,694			792,078		387,095			513,414
Total.	136,804,969		16,674,286		88,005,850		$3,612,457	11,503,447		6,014,843			10,994,086
1841	11,757,036		1,573,722		7,434,727			980,639		863,130			904,818
1842	9,578,515		1,285,947		6,168,544			1,027,621		457,917			638,486
1843	2,958,796		393,105		1,739,318			307,243		26,227			492,903
1844	13,641,478		1,670,769		8,894,219			1,121,460		637,006			1,318,024
1845	13,863,282		1,823,451		8,572,546			1,326,631		565,769			1,574,885
1846	13,530,625		1,597,120		8,755,392			1,308,202		656,571			1,213,340
1847	15,021,550		2,630,979		10,023,418			1,173,824		511,136			682,193
1848	19,138,141		2,487,256		12,490,501		1,387,218	1,383,871		727,422			661,873
1849	16,540,200		1,438,635		10,286,894		1,552,586	1,315,783		770,509			1,175,793
1850	20,775,346		1,773,302		13,640,291		672,653	1,558,173		799,156			2,331,771

nd Navigation, United States Treasury Department.

TABLE 1.—ANNUAL IMPORTS OF MANUFACTURES OF COTTON, 1821 TO 1900, INCLUSIVE[1]—Continued.

YEARS.	Total value.	CLOTHS. Bleached and unbleached.		CLOTHS. Printed, painted, and colored.		Value of clothing, ready-made, and other wearing apparel, not including knit goods.	Value of embroideries, laces, insertings, trimmings, and lace curtains, cords, and gimps.	Value of knit goods made on knitting machines or knit by hand.	THREAD (NOT ON SPOOLS), YARNS, WARPS, OR WARP YARNS.		JEANS, DENIMS, AND DRILLINGS.		All other manufactures.
		Square yards.	Value.	Square yards.	Value.				Pounds.	Value.	Square yards.	Value.	Value.
Total.	$265,744,157	...	$64,692,197	...	$112,936,494	...	$19,794,631	$27,728,527	...	$12,486,172	...	...	$28,106,136
1851	22,921,093	...	1,499,044	...	14,449,421	...	2,715,425	2,117,899	...	980,839	...	...	1,158,465
1852	20,224,552	...	2,477,486	...	11,553,306	...	2,289,863	2,152,340	...	887,840	...	...	863,717
1853	28,573,070	...	2,718,846	...	14,623,268	...	4,056,621	3,002,631	...	1,095,518	...	...	3,076,186
1854	34,803,055	...	2,191,217	...	17,423,249	...	5,088,667	3,013,664	...	1,076,987	...	...	6,009,271
1855	18,524,167	...	12,563,522	...	...	...	895,555	2,055,595	...	997,673	...	...	2,011,822
1856	27,109,018	...	19,110,752	...	...	...	1,385,024	2,516,848	...	1,276,760	...	...	2,819,634
1857	29,815,480	...	21,441,082	...	...	...	1,343,578	3,210,287	...	1,401,153	...	...	2,419,380
1858	18,584,810	...	741,077	...	12,391,713	...	660,649	2,120,868	...	1,080,671	...	...	1,589,832
1859	26,973,381	...	784,964	...	16,561,533	...	646,870	3,228,036	...	1,913,417	...	...	3,838,561
1860	38,215,531	...	1,164,207	...	25,934,004	...	712,379	4,310,359	...	1,775,314	...	...	4,319,268
Total.	186,119,390	160,189,415	29,195,616	152,889,316	42,920,114	$3,349,446	7,337,253	28,688,747	...	10,741,743	28,828,725	$6,996,084	56,890,387
1861	24,985,389	...	705,156	...	14,947,744	...	341,880	3,822,761	...	1,380,119	...	...	3,787,729
1862	8,907,805	13,343,169	1,140,969	15,651,728	1,573,583	...	402,578	...	...	1,116,782	...	...	4,673,393
1863	14,121,589	15,911,460	1,527,455	17,007,719	1,921,835	...	693,672	...	...	1,605,781	...	...	8,372,846
1864	14,341,501	12,039,629	1,424,775	9,689,441	1,737,001	...	741,310	...	...	1,279,424	...	...	9,158,991
1865	7,558,932	7,400,680	1,059,215	10,278,826	1,452,930	...	381,851	2,025,767	...	608,292	2,569,706	466,835	1,564,042
1866	29,519,228	55,127,685	7,808,027	48,762,557	6,944,712	676,101	1,467,392	5,020,167	...	1,459,392	13,473,049	2,146,377	8,997,060
1867	26,164,007	...	5,276,551	...	5,062,505	1,445,459	1,767,243	5,620,776	...	1,617,149	...	1,717,941	3,656,383
1868	16,660,074	...	2,795,079	...	2,315,849	1,227,886	1,541,327	3,457,525	...	1,674,804	...	855,374	2,702,239
1869	20,481,312	26,860,638	3,533,132	21,480,786	2,960,918	...	...	4,007,276	...	...	6,947,359	991,051	8,988,935
1870	23,380,053	29,506,154	3,925,266	30,027,259	4,003,037	...	...	4,734,475	...	...	5,838,611	818,506	9,898,769
Total.	266,905,606	211,443,055	26,001,955	189,363,275	25,851,170	...	...	51,237,968	...	...	29,963,783	4,330,640	159,483,873
1871	29,876,640	36,938,026	4,883,622	28,975,876	3,634,315	...	...	5,085,993	...	...	5,386,146	737,251	15,535,459
1872	35,307,447	41,700,373	5,316,877	36,578,465	4,975,624	...	...	5,451,523	...	...	6,483,461	878,580	18,684,843
1873	35,201,324	31,152,540	3,865,558	33,355,661	5,028,256	...	...	5,449,208	...	...	3,685,477	536,393	20,321,909
1874	28,193,869	26,361,866	3,093,933	23,380,235	3,155,494	...	...	4,621,259	...	...	2,220,653	327,138	16,996,045
1875	27,738,401	23,418,257	2,873,222	18,399,891	2,593,936	...	...	4,948,024	...	...	1,955,825	268,739	17,054,480
1876	22,725,598	15,007,450	1,845,653	15,501,344	2,074,944	...	...	4,682,871	...	...	1,299,627	182,257	13,939,873
1877	18,923,614	11,048,698	1,237,312	10,299,915	1,415,112	...	...	3,804,520	...	...	641,611	86,919	12,879,751
1878	19,081,037	9,676,594	1,076,142	8,335,123	1,086,426	...	...	4,682,246	...	...	825,328	104,633	12,131,590
1879	19,928,310	6,673,088	789,359	5,195,126	707,064	...	...	4,997,335	...	...	1,043,268	141,066	13,293,486
1880	29,929,366	9,466,163	1,020,277	9,341,639	1,179,999	...	...	7,514,989	...	...	6,422,387	1,067,664	19,146,437
Total.	302,987,592	47,307,813	5,015,870	199,782,036	24,741,393	3,134,912	74,346,572	71,435,037	11,184,870	6,303,612	24,895,570	4,384,210	113,625,986
1881	31,219,329	11,236,712	1,253,428	7,128,360	928,043	...	...	8,391,634	...	...	7,608,861	1,332,326	19,813,898
1882	34,351,292	13,798,147	1,503,127	6,687,837	924,602	...	...	7,501,449	...	...	12,797,527	2,257,594	22,164,520
1883	36,853,689	9,368,287	1,039,752	7,163,340	1,120,574	...	...	8,560,063	...	...	4,489,182	794,290	25,339,010
1884	29,074,626	1,687,613	174,323	[1]19,504,784	2,187,044	792,402	10,012,394	6,994,341	1,895,699	1,339,777	...	...	7,574,345
1885	27,197,241	856,213	103,200	[1]24,274,281	2,653,320	408,810	10,123,234	6,307,239	909,480	652,202	...	...	6,949,236
1886	29,709,266	2,176,606	225,103	[1]29,551,543	3,467,485	384,770	11,632,351	6,858,072	1,147,181	669,096	...	...	6,472,389
1887	28,940,353	3,021,696	301,636	[1]24,928,404	3,033,946	436,356	10,467,073	6,910,104	1,894,798	919,994	...	...	6,871,244
1888	28,917,799	1,077,070	82,613	[1]26,483,126	3,356,532	392,307	11,071,907	6,373,780	1,886,672	957,705	...	...	6,682,955
1889	26,805,942	2,577,230	203,100	[1]27,808,959	3,696,194	383,612	9,591,943	6,389,325	1,744,852	860,703	...	...	5,681,065
1890	29,918,055	1,508,239	129,588	[1]26,251,402	3,373,653	336,655	11,447,670	7,149,030	1,706,188	904,135	...	...	6,577,324
Total.	314,624,770	20,444,335	1,831,419	[2]412,063,936	52,536,729	17,190,458	123,266,407	54,733,325	20,891,442	8,426,407	...	...	56,640,025
1891	29,712,624	1,802,397	170,423	[1]31,055,214	[2]4,237,221	1,201,278	10,589,490	6,738,775	1,686,039	857,645	...	...	5,917,792
1892	28,323,841	1,572,224	140,001	[1]32,407,238	[2]4,505,666	1,261,848	11,248,289	5,833,652	1,426,585	664,952	...	...	4,669,433
1893	33,560,293	3,225,767	261,202	[1]42,546,157	[2]5,536,275	1,682,049	12,741,798	6,892,175	1,734,418	762,653	...	...	6,184,141
1894	22,346,547	1,152,798	95,565	[1]27,172,415	[2]3,385,241	1,658,778	8,021,769	4,360,655	747,038	326,224	...	...	4,498,315
1895	33,196,625	1,544,421	125,816	[1]45,342,525	[2]5,428,243	2,766,877	11,686,016	6,535,179	1,784,855	658,702	...	...	5,995,792
1896	32,437,504	2,136,657	179,364	[1]41,161,822	[2]4,921,060	2,683,315	10,878,954	6,190,672	2,431,855	872,067	...	...	6,712,072
1897	34,429,363	3,177,241	273,654	[1]35,937,975	[2]4,404,025	2,627,222	12,573,207	5,596,703	1,664,217	647,388	...	...	8,307,164
1898	27,267,300	1,520,108	120,767	[1]43,258,291	[2]5,313,683	1,050,554	11,768,704	4,034,483	1,817,970	687,999	...	...	4,291,110
1899	32,054,434	1,250,932	107,023	[1]51,196,236	[2]6,649,014	1,027,306	14,550,015	4,335,269	2,325,974	849,819	...	...	4,535,988
1900	41,296,239	3,061,790	357,604	[1]61,986,063	[2]8,156,301	1,231,231	19,208,165	4,715,762	5,272,491	2,098,958	...	...	5,528,218

[1] Includes "bleached."

Table 1 shows that from 1821 to 1855 the value of plain, uncolored cotton cloth imported exceeded $4,000,000 in a single year only, the year 1831; and that the annual average value of such goods imported declined from $2,930,079 in the decade 1821–1830, to $2,106,502 in the decade 1831–1840, and to $1,667,429 in the decade 1841–1850. Except during the three years 1855–1857 the importation was not materially greater during the ensuing decade; and notwithstanding the great advance of the country in population and wealth, the annual average value of the same class of goods in the years 1891–1900 was but $183,142. This class consists of fabrics which are reported by the census as plain cloths for printing and converting, sheetings and shirtings, duck, etc., the value of the domestic production of which is so large that the foreign importation is undoubtedly less than 2 per cent of it.

The same table shows that the average value of the imported cloths per square yard is much above the value of the domestic article. This is because the importation is confined almost exclusively to fine goods, which American manufacturers have only lately begun to produce. Another class of importations which is larger than that already mentioned is colored goods. Some purchasers have so rooted a preference for foreign ginghams and calicoes that they will not buy the American product. The imports of such goods have lately shown a tendency to increase, but the value of colored cloth imported in 1900, when the amount was the largest in recent years, was little more than twice the annual average from 1860 to 1883. The most important importations of cotton are the fancy articles, classed as embroideries, laces, trimmings, cords, gimps, etc., which, with knit goods, constitute more than one-half of the total value of all articles of cotton imported. In short, the trade in foreign manufactures of cotton is almost altogether in special classes of goods which are not made extensively in the United States, or in articles which the customs and habits of buyers lead them to prefer, regardless of considerations of cost or superiority.

Table 2 shows the annual exports of cotton manufactures from 1826 to 1900, inclusive, as compiled from the annual reports on Commerce and Navigation published by the United States Treasury Department.

TABLE 2.—ANNUAL EXPORTS OF MANUFACTURES OF COTTON, 1826 TO 1900, INCLUSIVE.[1]

YEARS.	Total value.	CLOTHS. Uncolored. Square yards.	CLOTHS. Uncolored. Value.	CLOTHS. Colored. Square yards.	CLOTHS. Colored. Value.	Wearing apparel. Value.	All other manufactures. Value.
Total	$5,885,411	....	$4,637,597	....	$396,840	....	$850,974
1826	1,138,125	....	830,532	....	68,884	....	238,709
1827	1,159,414	....	965,751	....	45,120	....	148,543
1828	1,010,232	....	892,777	....	76,012	....	41,443
1829	1,259,457	....	983,248	....	145,024	....	131,185
1830	1,318,183	....	965,289	....	61,800	....	291,094
Total	25,203,681	....	20,626,289	....	3,079,661	....	1,497,731
1831	1,126,313	....	950,329	....	96,931	....	79,053
1832	1,229,574	....	1,053,232	....	104,870	....	71,472
1833	2,532,517	....	1,804,170	....	421,721	....	306,626
1834	2,085,994	....	1,757,197	....	188,619	....	140,178
1835	2,858,681	....	2,355,662	....	397,412	....	105,667
1836	2,255,734	....	1,951,432	....	256,625	....	47,677
1837	2,831,473	....	2,044,930	....	549,801	....	236,742
1838	3,758,756	....	3,256,147	....	252,044	....	250,564
1839	2,975,033	....	2,526,793	....	412,661	....	35,579
1840	3,549,607	....	2,926,457	....	398,977	....	224,173
Total	39,557,256	....	31,797,461	....	4,181,847	....	3,577,948
1841	3,122,546	....	2,324,839	....	450,503	....	347,204
1842	2,970,690	....	2,297,964	....	385,040	....	287,686
1843	3,223,550	....	2,575,049	....	358,415	....	290,086
1844	2,898,780	....	2,298,800	....	385,403	....	214,577
1845	4,327,928	....	3,517,142	....	616,243	....	294,543
1846	3,545,481	....	2,827,320	....	380,549	....	337,612
1847	4,082,523	....	3,354,696	....	281,320	....	446,507
1848	5,718,205	....	4,868,924	....	351,169	....	498,112
1849	4,933,129	....	3,958,320	....	466,574	....	508,235
1850	4,734,424	....	3,774,407	....	606,631	....	353,386
Total	73,059,955	....	37,416,124	....	18,268,343	....	17,375,488
1851	7,241,205	....	5,571,576	....	1,006,561	....	663,068
1852	7,672,151	....	6,139,391	....	926,404	....	606,356
1853	8,768,894	....	6,926,485	....	1,086,167	....	756,242
1854	5,535,516	....	3,927,148	....	1,136,493	....	471,875
1855	5,857,181	....	2,793,910	....	2,613,655	....	449,616
1856	6,967,309	....	4,290,361	....	1,966,845	....	710,103
1857	6,115,177	....	3,463,230	....	1,785,685	....	866,262
1858	5,651,504	....	1,598,136	....	2,069,194	....	1,984,174
1859	8,316,222	....	1,302,381	....	2,320,890	....	4,692,951
1860	10,934,796	....	1,403,506	....	3,356,449	....	6,174,841
Total	39,839,343	28,477,444	6,712,606	12,912,363	6,487,918	....	26,638,819
1861	7,957,038	....	1,076,959	....	2,215,032	....	4,665,047
1862	2,946,464	....	508,004	....	587,500	....	1,850,960
1863	2,906,411	....	254,751	....	630,558	....	2,021,102
1864	1,456,901	177,065	66,639	1,569,235	401,411	....	998,851
1865	3,651,561	122,372	58,469	1,218,724	857,573	....	2,735,519
1866	1,780,175	3,041,715	718,006	405,988	88,742	....	973,427
1867	4,608,235	6,020,731	1,142,451	674,426	139,964	....	3,325,820
1868	4,871,054	10,839,177	1,651,339	2,979,275	581,669	....	2,788,046
1869	5,874,222	....	....	....	....	....	6,874,222
1870	3,787,282	8,276,384	1,345,988	6,064,715	1,035,469	....	1,405,825

[1] Annual Reports on Commerce and Navigation, United States Treasury Department.

TABLE 2.—ANNUAL EXPORTS OF MANUFACTURES OF COTTON, 1826 TO 1900, INCLUSIVE[1]—Continued.

YEARS.	Total value.	CLOTHS. Uncolored. Square yards.	CLOTHS. Uncolored. Value.	CLOTHS. Colored. Square yards.	CLOTHS. Colored. Value.	Wearing apparel. Value.	All other manufactures. Value.
Total	$66,210,965	445,869,911	$39,672,104	190,462,398	$16,454,141	....	$10,084,320
1871	3,558,136	14,832,931	1,776,694	5,083,923	724,841	....	1,056,601
1872	2,304,330	8,859,191	1,317,719	2,844,888	458,998	....	527,613
1873	2,947,928	10,187,145	1,655,116	3,585,629	596,912	....	695,500
1874	3,095,840	13,247,142	1,681,209	4,625,180	668,781	....	745,850
1875	4,071,882	21,224,020	2,313,270	7,593,723	939,061	....	819,551
1876	7,722,978	59,319,267	5,314,738	16,488,214	1,455,462	....	952,778
1877	10,235,843	76,769,147	6,437,223	29,601,304	2,484,131	....	1,314,489
1878	11,438,660	83,528,192	7,053,463	37,765,313	2,959,910	....	1,425,287
1879	10,853,950	84,081,319	6,288,131	45,116,058	3,209,285	....	1,356,534
1880	9,981,418	68,821,557	5,834,541	37,758,166	2,956,760	....	1,190,117
Total	127,491,518	1,062,022,145	77,387,248	456,655,097	31,215,625	$4,265,408	14,623,237
1881	14,105,348	80,399,154	6,624,374	68,184,293	4,983,312	533,961	1,963,701
1882	13,828,377	114,994,402	9,351,713	29,525,672	2,326,319	605,398	1,544,947
1883	13,721,605	103,634,459	8,629,723	34,066,292	2,648,278	770,460	1,673,144
1884	11,885,211	99,750,450	7,503,361	35,441,296	2,579,866	349,270	1,452,714
1885	11,836,591	114,806,595	7,919,670	32,738,123	2,230,567	267,775	1,418,579
1886	13,959,934	142,547,980	9,231,170	51,293,373	3,149,091	435,536	1,144,137
1887	14,929,342	136,809,074	9,256,486	67,793,013	4,003,772	442,757	1,226,327
1888	13,013,189	115,766,679	7,812,947	54,446,936	3,522,612	317,652	1,359,978
1889	10,212,644	77,596,862	5,577,401	40,856,329	2,885,373	301,803	1,448,067
1890	9,999,277	75,716,490	5,480,403	42,309,770	2,886,435	240,796	1,391,643
Total	169,240,332	1,784,369,304	97,111,912	661,332,474	37,566,275	7,558,516	27,003,549
1891	13,604,857	135,529,590	9,277,112	39,016,682	2,590,934	278,169	1,458,642
1892	13,226,277	142,938,871	8,673,663	40,815,450	2,484,360	433,102	1,635,152
1893	11,809,355	100,776,006	6,306,022	43,016,108	2,802,462	452,356	2,248,515
1894	14,340,886	124,349,278	7,639,851	61,538,458	3,854,935	476,617	2,369,483
1895	13,789,810	125,790,318	7,034,678	58,467,743	3,444,539	518,730	2,791,863
1896	16,837,396	166,391,639	9,539,199	58,747,729	3,419,158	708,099	3,170,940
1897	21,037,678	230,123,603	12,511,389	83,409,441	4,770,231	878,804	2,877,254
1898	17,024,092	191,092,442	9,151,936	79,415,376	4,138,887	934,192	2,799,077
1899	23,566,914	303,063,083	13,748,619	108,940,972	5,221,278	1,275,839	3,321,178
1900	24,003,087	264,314,474	13,229,443	87,880,515	4,839,491	1,602,608	4,331,545

[1] Annual Reports on Commerce and Navigation, United States Treasury Department.

Table 2 shows that the exportation of cotton goods has been a feature of the foreign trade for more than seventy-five years. It is impossible to go further back than 1826, because the separate values of articles exported were then reported for the first time. The trade was established soon after the foundation of the modern factory industry, at Waltham, Mass. It became prominent when that first great success was followed up in the development of Lowell. As early as 1851 the annual value of cotton goods exported exceeded $7,000,000; and it is safe to say that this amount represented more than one-half of the total value of American manufactures of all kinds sent to foreign countries in that year. The year 1860 marked the temporary culmination of this trade, when the declared value of cotton manufactures exported was but a trifle less than $11,000,000. The Civil War ensued and not only this branch of the foreign trade, but the cotton trade itself also, was well-nigh annihilated for several years.

When the growth of the cotton crop was resumed, the United States had lost its foreign markets, had given up its shipping formerly engaged in the foreign trade, and had closed most of the mercantile houses in other lands which had previously given its merchants access to the markets of Asia, Africa, and South America. Moreover, the extraordinary increase of population and of wealth at home, and the great demand for cloth to replenish family supplies exhausted during the war period, gave manufacturers ample field for their enterprise in supplying the home consumption. In these circumstances scarcely any attempt was made to recover foreign markets. The exportation declined to a value of less than $1,500,000 in 1864, and from 1866 to 1876, eleven years, the annual average was barely $4,000,000. From 1877 onward there was a moderate revival of the trade. In only five years in the last quarter of a century, 1877 to 1902, has the value fallen below the high mark of 1860, and on the whole there has been steady progress. The following table shows the value of exports of cotton goods in five-year periods:

PERIOD.	Total exports.	Yearly average.
1877–1881	$56,615,219	$11,323,044
1882–1886	65,231,718	13,046,324
1887–1891	61,759,309	12,251,862
1892–1896	70,003,724	14,000,745
1897–1901	105,904,189	21,180,838

The exportation during the census years of the last half century has been as follows: In 1860, $10,934,796; in 1870, $3,787,282; in 1880, $9,981,418; in 1890, $9,999,277; and in 1900, $24,003,087. These figures do not show the actual progress so well as the preceding table, inasmuch as the exportation in 1880 and again in 1890 was less than during the years preceding or following those dates. The exportation in 1900 was the largest on record in declared value, although in the quantity of goods it was not so great as in 1899.

It was not possible, of course, to account for all the exports declared upon the clearing of vessels for foreign ports, since a considerable part of the domestics sold abroad are made for the home market and are purchased for sale in other countries after they have passed wholly out of the control and the knowledge of manufacturers; but so far as the managers of mills are able to trace their products, they furnished goods for export during the year 1899–1900 to the value of $15,357,502, or about five-eighths of the value of cloth exported during the fiscal year. Almost 60 per cent of the total value represents the product of Southern mills, and nearly 37 per cent the goods of New England. It is an interesting fact that South Carolina, which was historically and politically, during the years preceding the Civil War, the most conspicuous champion of a policy favorable to the exportation of raw cotton, upon which the planters most relied, and opposed to the fostering of manufactures of cotton, spun in its own mills in 1900 a quantity of cotton exceeding the half of its own crop, and exported close upon one-half of all the cotton cloth reported to the census as having been dispatched to foreign countries. The exact percentage of South Carolina of the total export reported was 45.5.

Table 3 shows the annual exports of foreign manufactures of cotton goods from 1821 to 1900, inclusive, as compiled from the annual reports on Commerce and Navigation published by the United States Treasury Department. It is presented only for the purpose of furnishing the means of ascertaining—by subtracting the amounts and values from the corresponding statistics in Table 1—the actual consumption of foreign goods.

TABLE 3.—ANNUAL EXPORTS OF FOREIGN MANUFACTURES OF COTTON, 1821 TO 1900, INCLUSIVE.[1]

YEARS.	Total value.	CLOTHS. Bleached and unbleached. Square yards.	CLOTHS. Bleached and unbleached. Value.	CLOTHS. Printed, painted, and colored. Square yards.	CLOTHS. Printed, painted, and colored. Value.	Value of clothing ready-made and other wearing apparel, not including knit goods.	Value of embroideries, laces, insertings, trimmings, and of lace and window curtains.	Value of knit goods made on knitting machines or knit by hand.	THREADS (NOT ON SPOOLS), YARNS, WARPS, OR WARP-YARNS. Pounds.	THREADS (NOT ON SPOOLS), YARNS, WARPS, OR WARP-YARNS. Value.	JEANS, DENIMS, AND DRILLINGS. Square yards.	JEANS, DENIMS, AND DRILLINGS. Value.	All other manufactures. Value.
Total.	$20,747,327	...	$9,740,469	...	$9,954,599	...	...	$447,591	...	$288,994	...	...	$315,674
1821	1,583,473	...	1,194,910	...	379,701	...	...	2,330	...	6,532	...	...	...
1822	1,682,010	...	1,083,253	...	572,626	...	...	17,314	...	8,817	...	...	...
1823	2,654,174	...	1,386,024	...	1,206,502	...	...	36,881	...	24,767	...	...	...
1824	2,561,168	...	929,272	...	1,544,231	...	...	79,191	...	8,474	...	...	...
1825	2,404,455	...	1,148,610	...	1,105,252	...	...	46,311	...	9,412	...	...	94,870
1826	2,226,090	...	1,018,702	...	1,032,381	...	...	74,462	...	34,862	...	...	65,683
1827	1,838,814	...	725,636	...	964,904	...	...	46,788	...	63,413	...	...	38,073
1828	2,242,739	...	730,897	...	1,402,103	...	...	44,988	...	46,736	...	...	18,015
1829	1,564,940	...	699,468	...	751,871	...	...	42,222	...	27,656	...	...	43,723
1830	1,989,464	...	823,697	...	995,028	...	...	57,104	...	58,325	...	...	55,310
Total.	23,581,508	...	6,916,171	...	15,009,337	...	...	342,713	...	664,813	...	...	648,474
1831	3,228,858	...	1,211,104	...	1,746,442	...	...	57,015	...	70,254	...	...	144,043
1832	2,322,087	...	968,301	...	1,094,412	...	...	62,775	...	29,026	...	...	167,573
1833	2,504,618	...	822,911	...	1,352,286	...	...	46,937	...	134,229	...	...	149,155
1834	2,866,854	...	893,508	...	1,818,578	...	...	43,649	...	62,403	...	...	48,716
1835	3,697,837	...	1,248,592	...	2,308,636	...	...	33,994	...	87,089	...	...	19,526
1836	2,765,676	...	683,327	...	1,975,156	...	...	16,689	...	78,176	...	...	12,328
1837	2,683,418	...	377,465	...	2,103,527	...	...	41,360	...	86,756	...	...	74,310
1838	1,153,506	...	271,692	...	826,111	...	...	14,746	...	29,768	...	...	11,189
1839	1,255,265	...	250,173	...	945,636	...	...	12,916	...	34,082	...	...	12,458
1840	1,103,489	...	189,098	...	838,553	...	...	13,632	...	63,030	...	...	9,176
Total.	6,381,153	...	1,583,311	...	3,892,170	...	$59,953	107,048	...	539,911	...	...	198,760
1841	929,056	...	131,632	...	574,603	...	...	16,943	...	198,996	...	...	7,982
1842	836,892	...	110,069	...	502,072	...	...	4,429	...	208,193	...	...	12,129
1843	308,616	...	33,998	...	251,808	...	...	4,881	...	15,028	...	...	2,901
1844	404,648	...	90,381	...	278,434	...	...	4,325	...	24,958	...	...	6,560
1845	502,553	...	162,599	...	281,775	...	...	2,455	...	10,922	...	...	44,802
1846	673,203	...	357,047	...	290,282	...	...	1,780	...	8,482	...	...	15,612
1847	486,135	...	83,716	...	372,877	...	...	19,595	...	3,808	...	...	6,140
1848	1,217,221	...	487,456	...	640,919	...	9,835	20,272	...	40,783	...	...	17,956
1849	583,241	...	81,690	...	424,941	...	19,285	10,425	...	7,718	...	...	39,182
1850	439,588	...	44,724	...	274,559	...	30,833	22,943	...	21,023	...	...	45,506
Total.	10,543,191	...	4,315,219	...	2,939,349	...	284,541	290,033	...	327,205	...	...	2,386,844
1851	691,784	...	132,020	...	440,441	...	31,928	25,923	...	20,546	...	...	40,926
1852	1,018,285	...	401,215	...	457,620	...	30,389	22,287	...	49,155	...	...	57,619
1853	1,259,313	...	362,052	...	622,540	...	11,104	20,396	...	69,607	...	...	173,614
1854	1,515,584	...	502,387	...	684,483	...	54,353	52,420	...	40,795	...	...	181,146
1855	2,083,854	...	1,336,634	...	...	...	104,492	127,191	...	38,460	...	...	477,077
1856	1,607,340	...	1,145,178	...	...	...	32,333	17,531	...	46,813	...	...	365,485
1857	675,063	...	305,392	...	...	...	6,754	11,819	...	22,616	...	...	228,482
1858	396,204	...	40,024	...	126,000	...	5,216	6,813	...	10,012	...	...	208,139
1859	331,072	...	25,668	...	142,673	...	2,131	2,638	...	1,583	...	...	156,379
1860	1,064,692	...	64,649	...	465,592	...	5,841	3,015	...	27,618	...	...	497,977

[1]Annual Reports on Commerce and Navigation, United States Treasury Department.

TABLE 3.—ANNUAL EXPORTS OF FOREIGN MANUFACTURES OF COTTON, 1821 TO 1900, INCLUSIVE[1]—Continued.

YEARS.	Total value.	CLOTHS. Bleached and unbleached.		CLOTHS. Printed, painted, and colored.		Value of clothing ready-made and other wearing apparel, not including knit goods.	Value of embroideries, laces, insertings, trimmings, and of lace and window curtains.	Value of knit goods made on knitting machines or knit by hand.	THREADS (NOT ON SPOOLS), YARNS, WARPS, OR WARP-YARNS.		JEANS, DENIMS, AND DRILLINGS.		All other manufactures.
		Square yards.	Value.	Square yards.	Value.				Pounds.	Value.	Square yards.	Value.	Value.
Total.	$5,710,385	8,640,053	$834,314	10,932,705	$1,428,134	$108,061	$37,202	$58,362	....	$18,267	788,805	$131,762	$3,094,283
1861	323,897	....	32,301	....	67,934	....	3,100	983	....	1,683	....	....	217,896
1862	341,324	....	....	....	....	....	11,410	....	....	....	....	....	329,914
1863	714,358	....	....	....	....	....	....	....	....	....	....	....	714,358
1864	372,428	....	....	....	....	....	....	....	....	....	....	....	372,428
1865	681,916	....	....	....	....	....	....	....	....	....	....	....	681,916
1866	434,672	395,018	60,323	259,011	41,472	60,557	11,872	2,914	....	....	19,977	3,085	254,449
1867	409,304	582,620	67,923	545,725	80,560	19,324	2,126	1,283	....	1,519	158,817	28,124	208,445
1868	949,411	2,428,075	227,165	3,750,009	447,805	28,180	8,694	22,961	....	15,065	374,516	62,419	137,122
1869	541,599	1,790,546	155,668	2,293,584	297,263	....	....	9,854	....	....	88,981	11,102	67,712
1870	941,476	3,443,794	290,934	4,084,376	493,100	....	....	20,367	....	....	146,514	27,032	110,043
Total.	9,991,789	31,068,319	2,417,108	47,472,719	5,012,219	....	....	185,302	....	....	3,369,768	568,225	1,808,935
1871	1,703,029	6,429,725	493,353	8,954,387	996,571	....	....	22,078	....	....	262,965	45,377	145,650
1872	1,380,048	4,200,048	330,543	6,666,891	722,742	....	....	14,163	....	....	542,099	89,658	222,942
1873	1,456,946	4,355,951	351,041	6,549,228	727,919	....	....	20,878	....	....	540,107	99,008	258,100
1874	1,218,092	3,505,641	278,897	4,884,367	549,164	....	....	21,279	....	....	445,571	81,916	286,836
1875	997,187	2,801,844	223,343	4,619,899	501,265	....	....	26,913	....	....	429,931	72,227	173,439
1876	908,612	2,286,609	191,526	4,400,036	456,471	....	....	24,520	....	....	426,552	69,505	166,590
1877	699,450	2,634,940	208,899	3,328,721	325,639	....	....	11,388	....	....	135,874	22,132	131,392
1878	551,923	1,848,025	129,607	2,859,015	260,345	....	....	17,987	....	....	118,209	19,443	124,541
1879	386,870	773,167	57,803	1,617,072	147,449	....	....	9,459	....	....	203,672	28,016	144,143
1880	689,632	2,232,369	152,096	3,593,103	324,654	....	....	16,637	....	....	264,788	40,943	155,302
Total.	2,851,339	4,945,717	339,128	7,922,925	726,036	34,408	108,294	73,664	15,957	5,180	907,444	139,214	1,425,415
1881	679,075	2,451,652	166,594	2,748,863	247,507	....	....	14,707	....	....	341,680	52,468	197,799
1882	498,312	1,833,175	128,107	1,479,381	134,633	....	....	16,628	....	....	261,408	43,979	174,965
1883	270,144	462,887	33,200	388,899	37,125	....	....	5,376	....	....	304,356	42,767	151,676
1884	167,210	27,437	2,602	479,973	35,052	3,430	7,496	6,852	5,014	2,356	....	....	109,422
1885	293,381	2,944	206	237,326	20,718	14,504	28,650	10,103	5,209	1,044	....	....	218,156
1886	435,735	493	26	1,830,765	178,878	1,245	18,341	4,723	2,135	598	....	....	231,924
1887	160,718	29,869	1,564	236,943	24,459	764	27,939	3,956	934	411	....	....	101,625
1888	128,343	65,880	2,787	141,199	13,388	1,981	9,450	1,091	2	1	....	....	99,645
1889	83,779	25,326	1,745	180,620	12,508	4,756	8,013	4,679	352	114	....	....	51,964
1890	134,642	46,054	2,297	198,956	21,768	7,728	8,405	5,549	2,311	656	....	....	88,239
Total.	2,106,172	161,919	9,283	3,980,825	342,166	186,013	297,818	103,062	80,074	24,723	....	....	1,143,107
1891	129,632	7,052	401	196,473	18,800	6,384	6,897	6,022	4,557	1,922	....	....	89,206
1892	141,263	720	40	298,965	29,044	7,708	19,097	9,244	....	....	....	....	76,130
1893	161,429	10,500	478	223,376	21,167	8,504	55,083	3,628	1,700	464	....	....	72,105
1894	212,380	18,395	1,384	324,256	32,892	21,735	25,746	11,516	26,161	5,524	....	....	113,583
1895	177,604	20,955	1,066	242,899	22,188	22,968	40,992	9,279	3,544	954	....	....	80,157
1896	291,162	60,144	2,986	781,861	58,775	41,665	51,608	19,753	6,670	2,875	....	....	113,600
1897	235,212	6,237	292	313,196	28,614	29,992	26,245	17,610	1,509	590	....	....	131,869
1898	290,036	1,525	107	1,012,910	78,125	16,654	28,166	8,330	3,140	1,241	....	....	157,413
1899	179,351	18,901	1,104	215,449	19,649	12,417	14,912	7,324	3,602	1,244	....	....	122,701
1900	288,103	17,490	1,425	371,440	32,912	17,986	29,072	10,356	29,191	9,909	....	....	186,443

[1] Annual Reports on Commerce and Navigation, Uuited States Treasury Department.

THE GENERAL PROGRESS OF THE INDUSTRY.

Table 4 presents the summary of the cotton manufacture from 1840 to 1900, inclusive. The figures for 1900 do not include the manufacture of cotton small wares, which branch of the industry has been separately treated at the Twelfth Census, and is made the subject of a special chapter at the conclusion of the report on cotton manufactures.

TABLE 4.—COMPARATIVE SUMMARY, COTTON GOODS, 1840 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.							PER CENT OF INCREASE.					
	1900	1890	1880	1870	1860	1850	1840	1890 to 1900	1880 to 1890	1870 to 1880	1860 to 1870	1850 to 1860	1840 to 1850
Number of establishments	973	905	756	956	1,091	1,094	1,240	7.5	19.7	[1]20.9	[1]12.4	[1]0.3	[1]11.8
Capital	$460,842,772	$354,020,843	$208,280,346	$140,706,291	$98,585,269	$74,500,931	$51,102,359	30.2	70.0	48.0	42.7	32.3	45.8
Salaried officials, clerks, etc., number	4,713	[2]2,709	(3)	(3)	(3)	(3)	(3)	74.0	......	......	......	......	......
Salaries	$7,123,574	[2]$3,464,734	(3)	(3)	(3)	(3)	(4)	105.6	......	......	......	......	......
Wage-earners, average number	297,929	218,876	174,659	135,369	122,028	92,286	72,119	36.1	25.3	29.0	10.9	32.2	28.0
Total wages	$85,126,310	$66,024,538	$42,040,510	$39,044,132	$23,940,108	(3)	(4)	28.9	57.0	7.7	63.1	......	......
Men, 16 years and over	134,354	88,837	61,760	42,790	46,859	33,150	(3)	51.2	43.8	44.3	[1]8.7	41.4	......
Wages	$46,923,365	$33,797,517	(3)	(3)	(3)	(3)	(4)	38.8	......	......	......	......	......
Women, 16 years and over	123,709	106,607	84,558	69,637	75,169	59,136	(3)	16.0	26.1	21.4	[1]7.4	27.1	......
Wages	$32,917,933	$29,165,086	(3)	(3)	(3)	(3)	(4)	12.9	......	......	......	......	......
Children, under 16 years	39,866	23,432	28,341	22,942	(3)	(3)	(3)	70.1	[1]17.3	23.5	......	......	......
Wages	$5,285,012	$3,061,935	(3)	(3)	(3)	(3)	(4)	72.6	......	......	......	......	......
Miscellaneous expenses	$21,650,144	$16,716,524	(4)	(4)	(4)	(4)	(4)	29.5	......	......	......	......	......
Cost of materials used	$173,441,390	$154,912,979	$102,206,347	$111,736,936	$57,285,534	$34,835,056	(4)	12.0	51.6	[1]8.5	95.1	64.5	......
Value of products	$332,806,156	$267,981,724	$192,090,110	$177,489,739	$115,681,774	$61,869,184	$46,350,453	24.2	39.5	8.2	53.4	87.0	33.5
Active spindles, number	19,008,352	14,188,103	10,653,435	7,132,415	5,235,727	(4)	2,284,631	34.0	33.2	49.4	36.2	......	......
Looms, number	450,682	324,866	225,759	157,310	126,313	(4)	(4)	38.7	43.9	43.5	24.5	......	......
Cotton consumed, bales	3,639,495	2,261,600	1,570,344	(4)	(4)	641,240	(4)	60.9	44.0	......	......	......	......
Cotton consumed, pounds	1,814,002,512	1,117,945,776	750,343,981	398,308,257	422,704,975	(4)	(4)	62.3	49.0	88.4	[1]5.8	......	......

[1] Decrease.
[2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 24.)
[3] Not reported separately.
[4] Not reported.

The classification of cotton goods applies in all the statistics for the Twelfth Census to results in those establishments only in which the chief industry is the spinning of cotton yarn and the weaving of piece goods—one or both. The designation of cotton small wares applies to establishments chiefly engaged in the manufacture of the following classes of articles: Shoe and corset lacings, lamp and stove wicks, tapes, webbings (other than elastic), lace edgings, dress and upholstery trimmings.

In order to preserve the basis for comparison with statistics of former censuses, Table 5 combines the statistics for cotton manufactures and cotton small wares for 1900, and shows the percentage that each is of the total.

Table 5 shows that the totals for capital, wages, cost of materials, and value of products for cotton small wares represented about 2 per cent of the totals for the entire cotton manufactures, and for the number of establishments about 8 per cent.

At the census of 1890 the average capital for the 905 establishments, which included both cotton goods and cotton small wares, was $391,182. In 1900 for the 1,055 establishments of both classes the average capital was $442,882; for the 973 establishments reported as cotton goods only it was $473,631; and for the 82 classified as cotton small wares it was $78,017.

TABLE 5.—COMBINED SUMMARY, COTTON GOODS AND COTTON SMALL WARES: 1900, WITH PERCENTAGE THAT EACH ITEM IS OF TOTAL.

	Total.	Cotton goods.	Cotton small wares.	PER CENT OF TOTAL.	
				Cotton goods.	Cotton small wares.
Number of establishments	1,055	973	82	92.2	7.8
Capital	$467,240,157	$460,842,772	$6,397,385	98.6	1.4
Salaried officials, clerks, etc., number	4,902	4,713	189	96.1	3.9
Salaries	$7,350,199	$7,123,574	$226,625	96.9	3.1
Wage-earners, average number	302,861	297,929	4,932	98.4	1.6
Total wages	$86,689,752	$85,126,310	$1,563,442	98.2	1.8
Men, 16 years and over	135,721	134,354	1,367	99.0	1.0
Wages	$47,594,881	$46,923,365	$671,516	98.6	1.4
Women, 16 years and over	126,882	123,709	3,173	97.5	2.5
Wages	$33,746,665	$32,917,933	$828,732	97.5	2.5
Children, under 16 years	40,258	39,866	392	99.0	1.0
Wages	$5,348,206	$5,285,012	$63,194	98.8	1.2
Miscellaneous expenses	$22,112,678	$21,650,144	$462,534	97.9	2.1
Cost of materials used	$176,551,527	$173,441,390	$3,110,137	98.2	1.8
Value of products	$339,200,320	$332,806,156	$6,394,164	98.1	1.9
Active spindles, number	19,050,952	19,008,352	42,600	99.8	0.2
Looms, number	455,752	450,682	5,070	98.9	1.1
Cotton consumed, bales	3,646,708	3,639,495	7,213	99.8	0.2
Cotton consumed, pounds	1,817,643,390	1,814,002,512	3,640,878	99.8	0.2

With this general explanation of the new system of classification, it will be understood that all the tables hereafter given, except Table 23, make the comparison between cotton goods alone in 1900 and cotton manufactures generally prior to this census. It is believed that the slight difference of 2 per cent will not seriously impair their general usefulness for purposes of comparison or may be allowed for by those who desire more exact figures.

GEOGRAPHICAL DISTRIBUTION OF THE INDUSTRY.

The following tabular statement will bring to light the most interesting and the most important fact relating to the growth of the cotton-manufacturing industry during the decade 1890–1900:

SECTIONAL DISTRIBUTION OF ESTABLISHMENTS.

GEOGRAPHICAL DIVISIONS.	1900	1890	1880
New England states	332	402	439
Middle states	225	239	139
Southern states	400	239	161
Western states	16	25	17
Total	973	905	756

The decrease in the number of establishments in the New England states is more apparent than real. It results partly from the elimination of certain mills from the classification as "cotton manufactures," already mentioned, and partly from the consolidation of establishments under one management. The same reasons account fully for the decline in the number of establishments in the Middle states: New York, New Jersey, Pennsylvania, Delaware, and Maryland. The manufacture has never existed on a considerable scale in the Western states. Comparative distance and inaccessibility with respect to the supply of raw cotton, distance from the commercial cities which are the headquarters of the dry goods trade, and difficulty in procuring the requisite trained labor—these and other causes have hitherto rendered the West an undesirable location for cotton mills, which need for economical operation cheap transportation of raw material, cheap fuel or unfailing waterpower, and nearness to large markets. The cotton manufacture, moreover, is essentially gregarious, and enjoys the greatest prosperity where it is carried on by large establishments or by large groups of small mills.

The growth of the industry in the South is the one great fact in its history during the past ten years. It will be seen that in 1880 there were, in that part of the country, 161 establishments only which made reports to the census; in 1890 there were only 239, an increase of 78, or 48.4 per cent; and in 1900 there were 400 separate establishments, an increase from 1890 of 161, or 67.4 per cent. A scrutiny of the returns by states shows that substantially the whole increase in the South has been in the 4 states of North Carolina, South Carolina, Georgia, and Alabama. The number of establishments in these 4 states was 119 in 1880, 191 in 1890, and 355 in 1900. In the other states of the Southern group the number was 42 in 1880, 48 in 1890, and 45 in 1900.

It would be revealing but a part of the truth to rest the statement of Southern industrial expansion upon the number of establishments; for in the decade 1880–1890 the number of spindles in the four leading Southern states increased almost twofold, from 422,807 to 1,195,256; and the average number of spindles to a mill increased from 3,553 to 6,258. In the decade from 1890 to 1900 the progress has been at an even greater ratio, although the basis of the calculation is larger, for the total number of spindles is 3,791,654, the numerical increase 2,596,398, the percentage of increase 217, and the average number of spindles to a mill has become 10,651. The subsequent tables in this report will give abundant evidence of the expansion of the Southern cotton industry in all directions—in capital, consumption of material, employment of labor, and quantity and value of product.

Speaking broadly, the cotton manufacturing industry did not exist in the South before the Civil War, and it existed only on the most restricted scale before 1880. There are now single establishments in Massachusetts which pay annually a larger sum in wages than the entire cost of labor in Southern cotton mills in 1880. The mills were small, equipped with antiquated machinery, engaged in spinning the coarsest numbers only, and in producing from cotton grown in the neighborhood the stout fabrics used for clothing by the negroes. It is probably not an exaggeration to say that prior to 1880 there was not a mill south of the latitude of Washington that would be classed as an efficient modern cotton factory, even according to the standard of that time. Before the Civil War the people of the South were almost exclusively engaged in agricultural pursuits. The ruling classes looked with disfavor upon manufactures and discouraged the introduction of the industrial arts save as they were necessary to meet local wants.

After the war closed it was some years before the people had recovered sufficiently from the disaster to undertake manufacturing. There had been attempts in the direction of cotton spinning and weaving before 1880, but the cotton exposition in Atlanta, in 1881, gave the industry an impetus which it has never since lost. The possibilities of the region were shown when the governor of Georgia appeared at the fair dressed in a suit of clothes made of cottonade manufactured on the grounds from cotton which had been picked from the stalk on the morning of the same day, in the sight of the visitors to the fair. That the local product of cotton could be worked up into finished cloth without transportation to a distant manufacturing town, together with the fact that the region had abundance of unemployed labor of a class similar to that which in the early days operated the mills of Waltham, Lowell, and

Manchester, brought before the people the vision of a new source of individual and public wealth to which they had previously been blind.

Once the opportunity had been presented to them the chance was eagerly seized, and all who were able to do so contributed to make the new enterprise successful. The press urged it upon those who had capital to invest, hailed joyfully every manufacturing project, and made much of every successful establishment. Municipal aid was given in the shape of exemption from taxation for a term of years. The railroads favored the scheme by arranging their freight schedules so as to encourage Southern manufacturers. The factories first established under the new régime showed large profits, and thus attracted more capital to the new industry. The advantages of the Southern country for cotton manufacturing began to attract attention in the North; and in many cases corporations already established increased their capital and built new mills in the South Atlantic states.

The earliest Southern enterprises were not in all cases begun as first-class establishments. Some of them were equipped with discarded machinery from Northern mills. But the manufacturers quickly learned the lesson that there is no industry in which profits are more directly proportioned to the perfection and speed of the machinery than in the spinning and weaving of cotton; and the old spindles and looms were speedily replaced with others of the newest pattern. A great proportion of the mills built and started within the past decade have been thoroughly up to date in all respects. In fact some improvements in mill construction are to be found in that section, which are not yet introduced in the manufacturing regions of the North. The first factory operated wholly by electricity, without shafting or belts, was located in the South, and until near the time of the writing of this report it was the only factory so equipped. By the use of electrical power it is possible to place the mill on high ground at a suitable distance from mill race and water wheel, and thus to secure accessibility, the health of operatives, and other benefits which could not be enjoyed when it was necessary to put the foundations of the mill below the foot of the waterfall.

The growth of the manufacturing industry in the South has been fairly continuous during the past ten years. How large it has been the figures show. For the most part the product of the region has been coarse or medium goods, as is usually the case in the early stages of the industry. But not a few mills have been constructed to make yarns of the higher medium numbers and cloth which approaches the lower limit of those classed as fine. A considerable part of the product of the region is exported. The industry is now important enough in the 4 states of North Carolina, South Carolina, Georgia, and Alabama to consume nearly one-third of the crop of cotton grown in those states; and both North Carolina and South Carolina spin more than half the cotton grown within their limits.

The growth of the industry in the South has been remarkably steady. As is commonly the case with enterprises of this nature, it has been attended with not a little public excitement; more mills have been projected than have been built; some have been erected which their projectors would not have erected had they studied the matter carefully before entering upon the experiment. But the failures have been few, and upon the whole the return upon investment in Southern cotton mills has greatly exceeded that upon factories in the North. The fact that after a phenomenal growth during more than twenty years the expansion of old mills and the erection of new ones are still going on in the South is ample proof of the success of the enterprise.

The following table, made up from files of the New York Commercial and Financial Chronicle, presents a view of the annual increase in the number of spindles in the states south of the District of Columbia during the past twenty years. The Chronicle is recognized as among the best authorities upon the cotton crop and its distribution. Its statements for the first few years of the period covered were admittedly estimates; but from the year 1888 they are based upon actual returns from the Southern mills made directly to the Chronicle. For the census years, the census figures are substituted.

SPINDLES IN SOUTHERN MILLS, AND THEIR CONSUMPTION OF COTTON.

YEARS.	Number of spindles.	Bales of cotton used.
1880-81	610,000	205,000
1881-82	680,000	238,000
1882-83	860,000	331,000
1883-84	1,100,000	334,000
1884-85	1,150,000	266,000
1885-86	1,200,000	340,000
1886-87	1,225,000	397,929
1887-88	1,177,901	443,373
1888-89	1,344,576	486,603
1889-90	1,554,000	526,856
1890-91	1,756,047	605,916
1891-92	1,938,524	681,471
1892-93	2,082,197	733,701
1893-94	2,167,242	723,329
1894-95	2,379,281	853,352
1895-96	2,770,284	915,810
1896-97	3,197,545	1,024,482
1897-98	3,574,754	1,227,939
1898-99	3,832,201	1,400,026
1899-1900	4,298,188	1,477,775

Although there has been a surprising growth of the industry in the Southern states, yet it still remains true, as it has been true ever since Samuel Slater set in motion the first spindles operated by power in this country at Pawtucket, R. I., in 1791, that the largest and densest concentration of cotton manufacturing in the United States is in southern New England. A list is printed in the American State Papers[1] of the cotton mills within 30 miles of the town of Providence,

[1] Finance, Vol. III.

R. I., in November, 1809. The mills are enumerated in the chronological order of their establishment, beginning with the Pawtucket mill of Almy, Brown & Slater. Twenty-seven mills are mentioned as having in the aggregate 20,406 spindles "now in operation," but as having, including these, 34,900 spindles "which might be employed." There were also 14 other mills, all established in 1809, with 23,600 spindles, which were evidently not yet in operation. One mill, a Titan for those times, contained 10,000 spindles. The average of the 41 factories, counting their greatest capacity, was less than 1,500 spindles, and all combined they did not greatly exceed the average of one Fall River mill of the present time; yet they constituted the greatest concentration of the industry as it existed ninety years before the Twelfth Census was taken. In the year 1900 there were, within the same area, 7,209,235 spindles, as is shown by the following table:

TABLE 6.—NUMBER OF SPINDLES IN COTTON MILLS WITHIN 30 MILES OF PROVIDENCE, R. I.

LOCATION OF ESTABLISHMENTS.	Producing spindles (not including twisting, or doubling spindles).
Total	7,209,235
Brooklyn, Windham county, Conn	59,864
Killingly, Windham county, Conn	85,808
Plainfield, Windham county, Conn	74,736
Putnam, Windham county, Conn	106,800
Thompson, Windham county, Conn	111,688
Woodstock, Windham county, Conn	1,200
Voluntown, New London county, Conn	16,500
Bristol county, Mass	4,561,129
Blackstone, Worcester county, Mass	43,548
Grafton, Worcester county, Mass	62,344
Northbridge, Worcester county, Mass	89,264
Oxford, Worcester county, Mass	5,600
Sutton, Worcester county, Mass	54,496
Uxbridge, Worcester county, Mass	11,172
Webster, Worcester county, Mass	81,000
Bristol county, R. I	102,104
Hopkinton, Washington county, R. I	20,194
Kent county, R. I	472,406
Newport county, R. I	43,008
Providence county, R. I	1,206,374

In round numbers one-third of all the spindles in the United States are in the factories within that small area. It was remarked in the report on the Eleventh Census that 29.61 per cent of all the cotton spindles were operated in the two adjoining counties of Bristol, Mass., and Providence, R. I. The percentage has been maintained. It is now 30.3, and it greatly exceeds that of any other two counties. Indeed, the spindles of Providence county, the smaller of the two, outnumbered those of any Southern state except South Carolina. But the percentage of New England as a whole has suffered a considerable decline. In 1870 these six states had 77 per cent of all the spindles; in 1880 they had 81 per cent; in 1890 there was a decline to 76 per cent; and the percentage in 1900 was but 67.6.

CAPITAL.

Table 7 is a comparative summary, by geographical divisions, of the capital invested in the cotton manufacture in 1900, compared with 1890, with percentages of increase for the decade.

Table 7 shows that the total capital employed has increased 30.2 per cent. Taking the country as a whole, there is a small decrease in the reported value of the land. This is explained by the fact that in a great number of cases the land upon which factories are placed has but a nominal value; indeed, it had scarcely any value before the factories were erected and would be wholly unsalable if the buildings were removed. In these circumstances the officers making returns can only estimate the value, and estimates made at intervals of ten years may be expected to vary. There appears to have been an absolute decrease in the value of land in New England attached to cotton-manufacturing establishments; and the increase in land value in Southern states is 30.8 per cent, although the whole value of the plant has increased 131.4 per cent.

TABLE 7.—COMPARATIVE SUMMARY, COTTON GOODS, CAPITAL, BY GEOGRAPHICAL DIVISIONS, WITH PERCENTAGES OF INCREASE: 1890 AND 1900.

GEOGRAPHICAL DIVISIONS.	Year.	Total.	Land.	Buildings.	Machinery, tools, and implements.	Cash and sundries.
United States	1900	$460,842,772	$22,546,549	$91,621,757	$181,009,280	$165,665,186
	1890	354,020,843	23,225,097	69,742,664	138,025,806	123,027,276
Per cent of increase		30.2	[1]2.9	31.4	31.1	34.7
New England states	1900	272,668,914	14,820,308	55,523,593	99,093,175	103,231,838
	1890	243,153,249	17,074,774	47,871,383	91,666,375	86,540,717
Per cent of increase		12.1	[1]13.2	16.0	8.1	19.3
Middle states	1900	59,078,820	3,277,033	11,327,917	20,779,919	23,693,951
	1890	51,676,249	2,580,935	10,124,364	20,306,550	18,664,400
Per cent of increase		14.3	27.0	11.9	2.3	26.9
Southern states	1900	124,532,864	4,250,540	23,741,094	59,179,798	37,361,432
	1890	53,827,303	3,248,968	10,590,952	24,079,920	15,907,463
Per cent of increase		131.4	30.8	124.2	145.8	134.9
Western states	1900	4,562,174	198,668	1,029,153	1,956,388	1,377,965
	1890	5,364,042	320,420	1,155,965	1,972,961	1,914,696
Per cent of increase		[1]14.9	[1]38.0	[1]11.0	[1]0.8	[1]28.0

[1] Decrease.

In view of the current discussion as to the capitalization of corporations it becomes interesting to note that the objections to the practice of overcapitalization can not justly be urged against cotton-manufacturing establishments. The form of ownership of such establishments is to a remarkable degree the corporate. Of the 973 separate establishments here reported, 708 are classed as corporations, 142 are individual, and 123 are partnerships or firms. Even this does not show the actual situation definitely, since 56 of the individual and 68 of the partnership establishments in Pennsylvania, and most of them in the city of Philadelphia, are weaving factories only, and individually of moderate importance. Outside of Pennsylvania there are 678 corporations, 86 individual, and 55 partnership establishments. With reference to the two latter classes, there can, of course, be no question of overcapitalization. The capital they report is simply that employed in their business. But the incorporated companies have a share capital to an amount specified in their respective charters. Table 8 shows, by geographical groups, the capital for corporations as reported at the census of 1900, compared with the nominal capital of corporations as represented by their capital stock.

TABLE 8.—COMPARISON OF CAPITAL OF CORPORATIONS, AS REPORTED AT CENSUS, WITH CAPITAL STOCK, BY STATES AND GEOGRAPHICAL DIVISIONS: 1900.

STATES.	Capital as reported at census.	Capital stock.
United States	$385,863,827	$204,157,914
New England states	238,502,315	128,703,500
Maine	20,974,669	11,630,000
New Hampshire	28,713,786	17,725,000
Vermont	1,696,331	1,050,000
Massachusetts	135,873,779	71,088,500
Rhode Island	30,466,097	15,367,000
Connecticut	20,777,653	11,843,000
Middle states	33,521,797	15,205,000
New York	12,455,548	5,046,000
New Jersey	12,503,262	5,145,000
Pennsylvania	5,314,968	2,734,000
Maryland	3,248,019	2,280,000
Southern states	109,589,031	57,101,352
Virginia	4,338,206	2,886,700
North Carolina	25,840,465	14,364,500
South Carolina	36,275,727	17,835,200
Georgia	21,826,464	10,874,952
Kentucky	1,867,605	1,325,000
Tennessee	3,105,095	1,634,000
Alabama	10,509,595	5,300,000
Mississippi	2,199,249	1,231,000
Arkansas	249,828	200,000
Louisiana	1,716,688	850,000
Texas	1,660,109	600,000
Western states	4,250,684	3,148,062
Ohio	56,692	25,000
Indiana	1,532,586	800,000
Illinois	831,047	600,000
Wisconsin	455,235	375,000
Missouri	165,500	248,062
Nebraska	190,819	150,000
Colorado	647,805	250,000
California	371,000	800,000

NOTE.—In the foregoing table the nominal capital stock reported of the companies now united in the three industrial combinations is that of the separate companies before the amalgamation. The present capital stock is larger by $15,200,000, and the total capital stock for the whole country is $219,357,914. The addition can not conveniently be shown by states, inasmuch as the plants of two of the three combinations are located in several states. Moreover, the three industrial combinations have issued an aggregate amount of $26,500,000 bonds.

It appears from Table 8 that not only in the United States as a whole, and in each of the geographical divisions, but in every individual state, except Missouri and California, the actual invested capital exceeds the par value of the share capital. Undoubtedly a considerable amount, many millions of dollars in the aggregate, of the capital reported to the census represents borrowed money; but after making the largest reasonable allowance for this item there must remain an excess of at least 25 per cent of assets over the nominal value of the share capital. Very few cotton-manufacturing establishments have a bonded debt.

In this connection it may be remarked that the system of industrial combination, commonly known as the "trust," has not seriously invaded the cotton-manufacturing industry. There were in 1900 only three such combinations: The New England Cotton Yarn Company, which produces but a small fraction of the yarns made for sale; the Mount Vernon-Woodberry Cotton Duck Company, which produces a considerable part of the sail duck made in the country; and the American Thread Company, which has combined several of the large establishments which produce sewing thread. The total value of the plants and miscellaneous items of capital of all the establishments controlled by these three industrial combinations is $31,077,609. Their combined capital stock is $33,000,000, and the total of their bonded debt is $26,500,000.

EMPLOYEES AND WAGES.

In 1900 the average number of employees in the cotton industry (excluding cotton small wares), including officers and clerks, was 302,642, an increase of 81,057, or 36.54 per cent over the total for cotton goods and cotton small wares in 1890. Of this increase more than 60,000, or three-fourths of the whole, were in the Southern states. The figures which show the number and compensation of officers, clerks, and superintendents require no discussion. They are useful merely for the completion of the statistics and to bring out in its true light the magnitude of the industry. The real interest lies in the facts regarding those who are more strictly classified as wage-earners, the operatives in the mills. The importance of the figures relating to them is enhanced by the circumstance that the cotton-manufacturing industry is typical of the factory system in its highest form and on the largest scale. There is scarcely another industry that approaches it in the numbers of hands employed within mills; and the numbers of men and women employed are more nearly equal than is the case with any other industry of a magnitude to be compared with this.

Table 9 shows the number of wage-earners, men, women, and children, by geographical divisions, at the censuses of 1880, 1890, and 1900; and Table 11 shows the percentages of men, women, and children of total wage-earners, by geographical divisions, for 1880, 1890, and 1900.

TABLE 9.—COTTON GOODS, WAGE-EARNERS, AVERAGE NUMBER OF MEN, WOMEN, AND CHILDREN, BY GEOGRAPHICAL DIVISIONS: 1880 TO 1900.

GEOGRAPHICAL DIVISIONS.	TOTAL.			MEN, 16 YEARS AND OVER.			WOMEN, 16 YEARS AND OVER.			CHILDREN, UNDER 16 YEARS.		
	1900[1]	1890	1880	1900	1890	1880	1900	1890	1880	1900	1890	1880
United States	297,929	218,876	172,544	134,354	88,837	59,685	123,709	106,607	84,539	39,866	23,432	28,320
New England states	162,294	147,359	125,779	78,217	63,749	45,521	73,258	73,445	62,554	10,819	10,165	17,704
Middle states	34,843	31,841	28,118	14,473	11,580	8,919	16,056	16,240	13,185	4,314	4,021	6,014
Southern states	97,494	36,415	16,317	40,528	12,517	4,633	32,528	15,083	7,587	24,438	8,815	4,097
Western states	3,298	3,261	2,330	1,136	991	612	1,867	1,839	1,213	295	431	505

[1] Does not include cotton small wares in 1900.

TABLE 10.—COTTON GOODS, WAGE-EARNERS, PERCENTAGE OF MEN, WOMEN, AND CHILDREN, BY GEOGRAPHICAL DIVISIONS: 1880 TO 1900.

GEOGRAPHICAL DIVISIONS.	MEN. Per cent of all wage-earners.			WOMEN. Per cent of all wage-earners.			CHILDREN. Per cent of all wage-earners.		
	1900	1890	1880	1900	1890	1880	1900	1890	1880
United States	45.1	40.6	34.6	41.5	48.7	49.0	13.4	10.7	16.4
New England states	48.2	43.3	36.2	45.1	49.8	49.7	6.7	6.9	14.1
Middle states	41.5	36.4	31.7	46.1	51.0	46.9	12.4	12.6	21.4
Southern states	41.6	34.4	28.4	33.4	41.4	46.5	25.0	24.2	25.1
Western states	34.4	30.4	26.3	56.6	56.4	52.0	9.0	13.2	21.7

Tables 9 and 10 show that of the men, women, and children employed, first, the actual numbers of each class have increased during the past ten years, and, second, the number of men has increased much more rapidly than the number either of women or of children.

In the whole country there has been a numerical increase from 1890 to 1900 of 45,517 men, of 17,102 women, and of 16,434 children. There was an increase in the number of men in every section; a very slight decrease in the number of women in every division except the Southern states, and an increase in the number of children in the South, whereas in the rest of the country the number was nearly stationary. Since, in an expanding industry, the numbers of all classes ought to increase, a better medium for the sociological study of the condition of affairs is afforded by the second table, from which it appears that there is now for the first time a preponderance of the proportion of men employed, over the women. The proportion of men for the whole country increased from 40.6 per cent in 1890 to 45.1 per cent in 1900; the proportion of women declined from 48.7 per cent in 1890 to 41.5 per cent in 1900; the proportion of children advanced from 10.7 per cent to 13.4 per cent.

The returns for the Tenth Census afford the means of discovering that with a slight modification the readjustment of labor conditions has been going on for at least twenty years. Between 1880 and 1890 there was an increase of 6 men in every group of 100 mill operatives. The number of women in the group remained unchanged, owing to the partial discontinuance of the practice of employing children in all parts of the country except the South. In the mills of New England, which then formed a larger fraction of the total than they do now, the number of children in mills was reduced from 14 in every 100 to 7. Between 1890 and 1900 occurred the marvelous expansion of the industry in the South, with the usual result of such an event, a great demand for labor and the employment of whole families. The proportion of children was slightly increased there, by 1 in 100, but the proportion of women diminished by 8, and that of men increased by 7, in each 100. In New England the proportion of men increased 5, that of women decreased 5, in each 100, and the proportion of children remained stationary.

The important fact resulting from an examination of all these proportions is that the tendency is more and more to the employment of men, which, looking at the matter from the social point of view, is highly desirable, in that it diminishes the use of the labor of women in factory service, and doubly desirable in discontinuing the employment of child labor. In this last respect reform has not yet reached the Southern mills, where the supply of labor is not equal to the demand. But the evils of the system of employing children are fully recognized, an agitation for its abandonment is in progress, and no doubt the coming decade will see a substantial diminution of it.

The explanation of the generally increased employment of men is obvious. The chief reasons are two: First, that the operation of some of the modern machines requires the care of men, because it is beyond the physical and nervous capacity of women. For example, the improved high-speed and automatic looms, many of which are put under the charge of one weaver, can be operated most efficiently by men. Moreover, there has undoubtedly been a decrease in the number of women employed as mule spinners. The second cause of the change in the relative proportion of men and women, which, for reasons presently to be stated, is largely influential in the North, is itself a result of a generally improved condition of labor. Whereas formerly it was the custom for an entire family, or, at least, several of its members, to be employed in a mill, the father now earns enough to relieve the mother and some of the children of the necessity of going into the factory; or, perhaps, the mother and the elder daughters find other employment in the shops and offices which manufacturing industry attracts to a community. It is not suggested that the change is one universally to be observed. Possibly the tendency is so slight that the fact of such a change going on can be discovered only when the statistics are studied in a large way. Nevertheless, the cases are sufficiently numerous to justify the assignment of this as one cause of the gradual change that is taking place in the proportion of men and women in the industry as a whole.

The change has not yet perceptibly affected the South. There the labor conditions are different. The industry is growing at a wonderful rate. The help employed is chiefly local. Whole families in that region enter the factories, because in no other way can the demand for labor be satisfied. Consequently the changes in the proportion of men, women, and children employed are largely fortuitous. Roughly speaking, there were three times as many men, twice as many women, and nearly three times as many children employed in Southern mills in 1900 as there were in 1890. The numerical increase was 28,011 men, 17,445 women, and 15,623 children. Manufacturers took whom they could get for operatives in the new mills. The employment of children was not a matter of choice but of necessity, and, economically, is a losing rather than a profitable system; for more than the saving in the dollars and cents of their wages is lost when the quantity and quality of their work are considered.

SKILLED OPERATIVES.

It was intended to make a complete canvass of the spinners and weavers employed in the cotton mills of the country, classified as men, women, and children. Owing to a defect in the form of the inquiry, which was not discovered in season to make a correction, there is reason to believe that some of the numbers were incorrectly returned, and the full table is not presented. Some facts which are trustworthy were, nevertheless, obtained. It was ascertained that during the census year there were between 5,000 and 6,000 persons employed as mule spinners, of whom about 2,250 were employed in Massachusetts mills, 750 in Rhode Island, 600 in New York, and 350 in Connecticut. About nine-tenths of the mule spinners were men. On the other hand, of about 43,000 frame spinners, only about one-sixth were men, and five-sixths were women and children.

The report of the number of weavers is entitled to more confidence than that of spinners, but it is not sufficiently accurate to be presented in detail. The number of weavers returned was 91,515, of whom 41,776 were men, 47,941 were women, and 1,798 were children. There are no earlier returns with which to compare these numbers. But it is well known to those conversant with the industry that only a few years ago the weaving of cotton goods was regarded as peculiarly the work of women. The introduction of improved and fast looms has led more and more to the employment of men as weavers. The tendency is so marked that the next enumeration should show the men in a majority.

WAGES.

It is a matter of general experience that wages in cotton mills were higher in 1900 than they were in 1890. It is almost impossible to obtain a true average by applying the rules of arithmetic to magnitudes of such diverse nature as those which represent the numbers of operatives employed and the gross amount paid to them in wages. Moreover the method of ascertaining the average number of persons employed, which was used at the census of 1900, was quite different from that adopted in 1890, and the figures for 1890 are exclusively those for skilled labor.

MISCELLANEOUS EXPENSES.

Table 11 is a comparative summary of miscellaneous expenses, showing the per cent that each item is of the totals for 1890 and 1900.

Table 11.—COMPARATIVE SUMMARY, COTTON GOODS, MISCELLANEOUS EXPENSES,[1] 1890 AND 1900, WITH PER CENT WHICH EACH ITEM FORMS OF TOTAL.

	1900		1890	
	Amount.	Per cent of total.	Amount.	Per cent of total.
Total	$20,057,190	100.0	$16,716,524	100.0
Rent of works	691,075	3.4	488,735	2.9
Taxes, not including internal revenue	3,521,606	17.6	2,689,632	16.1
Rent of offices, interest, insurance, and all sundry expenses not hitherto included.	15,844,509	79.0	13,538,157	81.0

[1] Exclusive of contract work.

Table 11 shows that the amount paid for rent of works was exceedingly small when the magnitude of the industry is considered. As against the total value of land and buildings owned in 1900, of $114,168,306, and in 1890, of $92,967,761, there was paid for rent of works by manufacturers who did not own all the plant used, in 1900 the sum of $691,075, and in 1890 the sum of $488,735. Estimating the average rent at 6 per cent, the value of the land and buildings rented would have been $11,517,917 in 1900, and $8,145,583 in 1890, or about one-tenth of the real estate owned at the time of each census.

MATERIALS USED.

COTTON.

The consumption of raw cotton of all kinds, domestic and foreign, in all the textile mills of the country during the census year was 3,872,165 bales, having an aggregate weight of 1,923,704,600 pounds. The use of cotton by the several textile industries was as follows:

	Bales.	Pounds.
In cotton mills proper	3,639,495	1,814,002,512
In hosiery and knit goods mills	99,518	49,451,301
In woolen mills	80,725	34,967,959
In worsted mills	12,079	5,276,751
In cotton small wares mills	7,213	3,640,878
In carpet mills	3,813	1,943,942
In cordage and twine mills	26,540	13,022,755
In felt and shoddy mills	2,782	1,398,502
Total	3,872,165	1,923,704,600

At the Twelfth Census no inquiry was made which reveals the variety of cotton used, save in respect to the cotton manufacturing industry proper, cotton small wares, and cordage and twine. It may nevertheless be assumed without risk of serious error that in establishments dealing with the wool fiber all the cotton used was the ordinary domestic staple. A certain amount of the cotton consumed in the few hosiery mills which reported spindles was Egyptian, and a small quantity of sea-island cotton was reported by one establishment, which is classified as "cordage and twine," as having been used in the manufacture of sewing thread. Disregarding these exceptions we may make the following classification of the cotton consumed:

	Bales.	Pounds.
Sea island	47,207	18,442,634
Other domestic	3,748,750	1,849,417,034
Egyptian and other foreign	76,208	55,844,932
Total	3,872,165	1,923,704,600

The figures in the two preceding tables are those which are to be compared with the commercial and official statistics, in which no discrimination is made between the several classes of factories in which the cotton is consumed. Taking first the greatest item, that of ordinary domestic cotton, the report of the New York Commercial and Financial Chronicle—which is generally accepted by manufacturers as the most thorough and accurate—accounts for the taking of 3,792,618 bales, by manufacturers North and South during the crop year 1899–1900. The corresponding census number is 3,748,750 bales. Inasmuch as the commercial returns are for a year beginning September 1, 1899, whereas those of the census are for the year beginning June 1, 1899, and in the case of not a few mills some months earlier, the divergence of the two reports is small and easily to be accepted; and the close approximation of the two, especially when it is remembered that there is a not inconsiderable amount of cotton which is used for purposes other than spinning, is a confirmation of the accuracy of both. Against the census return of 47,207 bales of sea-island cotton used in the mills herein reported, the Chronicle reports 49,543 bales of that variety of cotton left for consumption in the United States after deducting the amount exported from the total crop. This is a still closer correspondence between the two sets of figures. The difference between them is no greater than may easily be explained upon the grounds already mentioned. The imports of foreign cotton during the fiscal year ended June 30, 1900, amounted to 67,398,521 pounds, of which 1,381,463 pounds was reexported. The importation during the calendar year 1899, with which the consumption during the census year corresponded more nearly, was 62,014,809 pounds, and the net importation was 61,296,346 pounds, which exceeded by about 10 per cent the amount reported in the preceding table. It has already been explained that a certain amount—the exact quantity can not be stated—is masked in the returns of cotton-hosiery mills which were not asked to specify the kind of cotton used. Relative to these figures, it should be borne in mind that, whereas, the quantities reported in commercial returns are the gross purchases of material by manufacturers, the census figures are those of cotton which was actually manufactured and which entered into the merchandise reported under the head of products.

In 1900 the consumption of cotton in cotton mills proper was as follows:

	Bales.	Pounds.
Sea island	47,207	18,442,634
Other domestic	3,516,080	1,739,714,946
Egyptian and other foreign	76,208	55,844,932
Total	3,639,495	1,814,002,512

"OTHER DOMESTIC" COTTON.

The consumption of domestic cotton, other than sea island, in the cotton mills of the country during the census year was 3,516,080 bales, as compared with 2,231,385 bales reported at the census of 1890, an increase of 58 per cent. The average weight of bales was 494.8 pounds. By geographical divisions the consumption of cotton by bales and pounds, and the average weight of bales, was as follows:

GEOGRAPHICAL DIVISIONS.	Bales.	Pounds.	Average weight of bales.
New England states	1,719,622	874,011,257	508.3
Middle states	272,947	135,004,971	494.6
Southern states	1,477,775	707,159,521	478.5
Western states	45,736	23,539,197	514.7
Total	3,516,080	1,739,714,946	494.8

The variation shown in the weight of bales between the Northern and the Southern sections of the cotton-spinning industry is in strict accordance with experience. The bales made up from the crop of the Mississippi valley and of Texas are heavier than those of the Atlantic coast states. Spinners in the Carolinas and in Georgia, therefore, relying largely upon the local supply, make use of lighter bales than manufacturers in the Eastern states, who draw largely upon the Southwest for their raw material. The average weight of bales of the entire cotton crop of the United States during the crop year ending August 31, 1900, was, according to the commercial reports, 503.69 pounds; but the average weight of bales in the Carolinas and Georgia, from which states the bulk of the cotton consumed in the South was derived, was but 489.91 pounds; whereas, the bales of Louisiana and Texas averaged a weight of 514.8 pounds.

Table 12 presents the facts relating to the cotton crop of the United States for twenty-one years, 1880 to 1900, inclusive, as reported by the United States Treasury Department.

TABLE 12.—QUANTITIES OF RAW COTTON PRODUCED, IMPORTED, EXPORTED, AND RETAINED FOR CONSUMPTION, 1880 TO 1900.[1]

YEAR ENDING JUNE 30—	PRODUCTION.		Exports of domestic.	Domestic retained for consumption.	Imports.	Exports of foreign.	Foreign retained for consumption.	Total consumption, domestic and foreign.	Per cent of domestic product exported.
	Annual crop.[2]	Crop in pounds, gross weight.							
	Bales.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*
1880	5,761,252	2,771,797,156	1,822,061,114	949,736,042	3,547,792	234,729	3,313,063	953,049,105	65.73
1881	6,605,750	3,199,822,682	2,191,928,772	1,007,893,910	4,449,866	1,240,576	3,209,290	1,011,103,200	68.47
1882	5,456,048	2,588,240,050	1,739,975,961	848,264,089	4,339,952	1,843,490	2,496,462	850,760,551	67.23
1883	6,949,756	3,405,070,410	2,288,075,062	1,116,995,348	4,081,945	3,238,930	843,015	1,117,838,363	67.20
1884	5,713,200	2,757,544,422	1,862,572,530	894,971,892	7,019,492	1,353,936	5,665,556	900,637,448	67.52
1885	5,706,165	2,742,966,011	1,891,659,472	851,306,539	5,115,680	1,609,260	3,506,420	854,812,959	68.96
1886	6,575,691	3,182,305,659	2,058,037,444	1,124,268,215	5,072,334	1,276,961	3,795,373	1,128,063,588	64.68
1887	6,505,087	3,157,378,443	2,169,457,330	987,921,113	3,924,531	716,371	3,208,160	991,129,273	68.70
1888	7,046,833	3,439,172,391	2,264,120,826	1,175,051,565	5,497,592	203,972	5,293,620	1,180,345,185	65.83
1889	6,938,290	3,439,934,799	2,384,816,669	1,055,118,130	7,973,039	187,959	7,785,080	1,062,903,210	69.33
1890	7,311,322	3,627,366,183	2,471,799,853	1,155,566,330	8,606,049	248,104	8,857,945	1,163,924,275	68.15
1891	8,652,597	4,316,043,982	2,907,358,795	1,408,685,187	20,908,817	447,794	20,461,023	1,429,146,210	67.36
1892	9,035,379	4,506,575,984	2,935,219,811	1,571,356,173	28,663,769	132,777	28,530,992	1,599,887,165	65.13
1893	6,700,365	3,352,658,458	2,212,115,126	1,140,543,332	43,367,952	360,832	43,007,120	1,183,550,452	65.99
1894	7,549,817	3,769,381,478	2,683,282,325	1,086,099,153	27,705,949	1,029,936	26,676,013	1,112,775,166	71.19
1895	9,901,251	5,036,964,409	3,517,533,109	1,519,431,300	49,332,022	771,614	48,560,408	1,567,991,708	69.83
1896	7,157,346	3,592,416,851	2,335,226,385	1,257,190,466	55,350,520	1,188,356	54,162,164	1,311,352,630	65.00
1897	8,757,964	4,397,177,704	3,103,754,949	1,293,422,755	51,898,926	1,188,523	50,710,403	1,344,133,158	70.59
1898	11,199,994	5,677,259,827	3,850,264,295	1,826,995,532	52,660,363	499,684	52,160,679	1,879,156,211	67.82
1899	11,274,840	5,794,767,917	3,773,410,293	2,021,357,624	50,158,158	293,988	49,864,170	2,071,221,794	65.12
1900	9,436,416	4,757,062,942	3,100,583,188	1,656,479,754	67,398,521	1,381,463	66,017,058	1,722,496,812	65.18

[1] Statistical abstract of the United States. U. S. Treasury Department, 1900.
[2] The "annual crop" represents the commercial movement for the years ending August 31, and was furnished by the New York Shipping and Commercial List, the New York Commercial and Financial Chronicle, and the New Orleans Cotton Exchange.

Inasmuch as a very large percentage of the cotton supply is of American origin, this statement of the crop by bales and pounds, and of its distribution, furnishes a measure of the annual increase of the cotton manufacturing industry in the United States, as compared with its increase in the rest of the world. It will be seen that the interval of twenty years made hardly any change in the percentage of the domestic products retained and of that which was exported, the difference being merely an increase of six-tenths of 1 per cent in the amount consumed at home. The ratio varies, of course, from year to year, but on the whole the table shows that the rate of increase of domestic production is equal to that of Great Britain and the continent of Europe.

Table 13 exhibits the quantity, cost, and cost per pound of "other domestic" cotton consumed, by states, in 1880, 1890, and 1900. Inasmuch as the purpose of this table is to show the average cost of cotton, and not to compare quantities consumed—which fact is sufficiently brought out in the preceding tables—the returns for 1900 exclude the consumption in "cotton small wares" establishments, and cover those of cotton mills only, whereas for the two preceding decadal periods "cotton small wares" are included.

TABLE 13.—COTTON GOODS, QUANTITY, AND COST OF DOMESTIC COTTON, OTHER THAN SEA ISLAND, CONSUMED, BY STATES GEOGRAPHICALLY ARRANGED: 1880 TO 1900.

STATES.	1900				1890				1880[1]			
	Bales.	Pounds.	Cost.	Cost per pound (cents).	Bales.	Pounds.	Cost.	Cost per pound (cents).	Bales.	Pounds.	Cost.	Cost per pound (cents).
United States	3,516,080	1,739,714,946	$116,108,879	6.67	2,231,385	1,103,492,910	$114,337,802	10.36	1,570,344	750,343,981	$86,945,725	11.59
New England states	1,719,622	874,011,257	58,329,174	6.67	1,405,637	704,792,220	74,683,860	10.60	1,129,498	541,373,880	63,169,434	11.67
Maine	156,674	79,212,256	5,400,379	6.82	132,504	65,717,252	7,053,168	10.73	112,381	54,185,061	6,234,901	11.51
New Hampshire	271,262	136,805,127	9,394,529	6.87	214,034	107,319,124	11,203,742	10.44	157,673	76,386,499	8,629,063	11.30
Vermont	12,493	6,410,674	385,461	6.01	8,954	4,647,889	498,348	10.72	7,404	3,562,088	458,607	12.87
Massachusetts	1,015,305	517,088,846	33,771,414	6.53	765,773	383,539,221	40,206,887	10.48	574,857	273,718,889	31,107,154	11.36
Rhode Island	170,514	86,712,235	6,074,331	7.01	186,558	94,555,788	10,446,155	11.05	167,480	81,137,172	10,457,770	12.89
Connecticut	93,374	47,782,119	3,303,060	6.91	97,814	49,012,946	5,275,560	10.76	109,703	52,384,171	6,281,939	11.99

[1] Includes Sea island, Egyptian, and other foreign.

TABLE 13.—COTTON GOODS, QUANTITY, AND COST OF DOMESTIC COTTON, OTHER THAN SEA ISLAND, CONSUMED, BY STATES GEOGRAPHICALLY ARRANGED: 1880 TO 1900—Continued.

STATES.	1900				1890				1880[1]			
	Bales.	Pounds.	Cost.	Cost per pound (cents).	Bales.	Pounds.	Cost.	Cost per pound (cents).	Bales.	Pounds.	Cost.	Cost per pound (cents).
Middle states	272,947	135,004,971	$9,327,774	$6.91	251,260	123,630,916	$12,917,244	$10.45	228,729	109,321,428	$13,258,526	$12.13
New York	99,064	50,464,770	3,513,661	6.96	78,171	39,038,689	4,192,105	10.74	64,614	31,656,594	3,981,106	12.58
New Jersey	15,872	8,183,469	541,858	6.62	16,482	8,231,147	905,524	11.00	21,069	9,950,609	1,319,422	13.26
Pennsylvania	74,382	35,083,214	2,521,768	7.19	92,705	44,629,588	4,371,693	9.80	83,997	40,311,809	4,749,428	11.78
Delaware	2,675	1,371,563	106,358	7.75	8,876	4,465,825	475,490	10.65	7,512	3,236,184	427,855	13.22
Maryland	80,954	39,901,955	2,644,129	6.63	55,026	27,265,667	2,972,432	10.90	51,537	24,166,232	2,780,715	11.51
Southern states	1,477,775	707,159,521	46,988,926	6.64	526,856	250,837,646	24,508,776	9.77	182,349	84,528,757	8,890,408	10.52
Virginia	38,118	17,832,465	1,154,215	6.47	22,731	10,616,206	1,080,773	10.18	11,461	5,087,519	601,796	11.83
North Carolina	404,148	189,984,759	13,604,720	7.16	114,371	53,546,289	5,396,974	10.08	27,642	11,832,641	1,125,984	9.52
South Carolina	485,024	229,899,760	14,909,520	6.49	133,342	64,000,600	6,242,598	9.75	33,624	15,601,005	1,723,187	11.05
Georgia	303,836	145,470,324	9,665,464	6.64	145,859	69,139,410	6,663,560	9.64	71,389	33,757,199	3,591,554	10.64
Kentucky	23,982	11,971,815	770,363	6.43	11,980	5,751,305	554,206	9.64	4,050	1,882,234	188,856	10.03
Tennessee	30,234	15,028,584	982,146	6.54	33,114	15,779,360	1,554,851	9.85	10,436	4,944,279	508,305	10.28
Alabama	134,371	67,987,299	4,206,721	6.19	29,962	14,726,454	1,372,058	9.32	14,702	7,271,791	729,202	10.03
Mississippi	20,962	10,363,458	623,576	6.02	17,366	8,449,834	793,600	9.39	6,411	2,881,853	301,226	10.45
Texas	18,045	9,304,434	566,517	6.09					246	119,986	11,280	9.40
All other Southern states[2]	19,055	9,316,623	505,684	5.43	18,131	8,828,188	850,156	9.63	2,388	1,150,250	109,018	9.48
Western states	45,736	23,539,197	1,463,005	6.21	47,632	24,232,128	2,227,922	9.19	29,768	15,119,916	1,627,357	10.76
Ohio					11,023	5,840,078	383,556	6.57	5,323	2,506,182	258,198	10.30
Indiana	19,884	10,283,614	608,822	5.92	16,306	8,240,434	798,178	9.69	11,558	6,364,887	679,911	10.68
Illinois					6,405	3,267,188	312,621	9.57	2,261	1,099,130	110,969	10.10
Wisconsin	4,565	2,316,727	145,773	6.29	6,924	3,470,388	359,117	10.35	3,173	1,541,797	180,072	11.68
All other Western states[3]	21,287	10,938,856	708,410	6.48	6,974	3,414,040	374,450	10.97	7,453	3,607,920	398,207	11.04

[1] Includes Sea island, Egyptian, and other foreign.
[2] Includes establishments distributed as follows: 1900—Arkansas, 2; Louisiana, 2; West Virginia, 1. 1890—Arkansas, 2; Louisiana, 2; Texas, 1. 1880—Florida, 1; Arkansas, 2; Louisiana, 2; Texas, 2.
[3] Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1. 1890—California, 1; Iowa, 2; Missouri, 1. 1880—Illinois, 2; Michigan, 1; Minnesota, 1; Utah, 1; Wisconsin, 1.

It will be seen from an examination of Table 13 that the average price of cotton in 1899–1900 was much below that in 1890, and that the decline was still greater when compared with 1880. Another fact which has a certain bearing upon the future of cotton manufacturing is that the average price in all parts of the country was fairly uniform. In 1880 the average price in states using a considerable amount of cotton varied between 9.52 cents per pound in North Carolina and 13.26 cents in New Jersey. In 1890 the variation was between 9.32 cents per pound in Alabama and 11.05 cents in Rhode Island. In 1900 the variation in states using as many as 75,000 bales each was from 6.19 cents in Alabama to 7.16 cents in North Carolina. Of course no general inferences of great value can be drawn from such facts further than that the price of cotton tends, under the influence of a local demand for the local crop and the steady cheapening of transportation charges, to equalize itself over the whole country. Differences in the quality of cotton used in the industry in the several sections of the country, and the season at which cotton is bought—often a mere matter of lucky or unlucky prognostication on the part of manufacturers—these things have too much influence in establishing average prices to allow definite conclusions to be drawn from the figures. It will be interesting to note how far consumption is overtaking production in some of the cotton states.

CROP, 1899-1900.	PRODUCTION (NEW YORK CHRONICLE).		CONSUMPTION (CENSUS).	
	Bales.	Pounds.	Bales.	Pounds.
Virginia	413,170	206,312,308	38,118	17,832,465
North Carolina	317,530	155,589,700	404,148	189,984,759
South Carolina	266,810	130,285,991	485,024	229,899,760
Georgia	1,358,586	665,978,857	303,836	145,470,324
Alabama	202,945	102,006,245	134,371	67,987,299

It appears that the crop of South Carolina needed to be supplemented by almost exactly 100,000,000 pounds, drawn from other states, to supply its spinners; that the North Carolina crop was deficient more than 34,000,000 pounds; that Alabama made use at home of two-thirds of its crop; that the great cotton-growing state of Georgia consumed more than one-fifth of its crop; and that even Virginia, which had made less progress in the industry than the states farther South, consumed more than one-twelfth of its crop. At the present rate of progress it will not be long before the entire cotton supply of the states on the Atlantic seaboard will be taken at home. More than half of it was taken during the census year here reported; for of the 1,260,000,000 pounds raised by the 5 states mentioned, their own mills took 651,000,000 pounds.

SEA-ISLAND COTTON.

The amount of sea-island cotton here reported as consumed in the United States is not only larger than the amount reported at any previous census, but it is also larger than the commercial report for any previous year. The nearest approach to the current figures are those for the crop year 1896–97 when the American consumption is fixed at 40,670 bales. The New York Chronicle reports are taken for the years intervening between 1890 and 1900.

AMERICAN CONSUMPTION OF SEA-ISLAND COTTON.

YEARS.	Bales.	YEARS.	Bales.
1890	21,283	1896	40,530
1891	26,651	1897	40,670
1892	32,093	1898	34,140
1893	22,911	1899	38,654
1894	24,345	1900	47,207
1895	34,981		

Notwithstanding an extending use of sea-island cotton, an increase in the crop has caused a decline in the price, which at this census is but 14.8 cents per pound, as compared with 25.1 cents in 1890. The use of this material is restricted to 5 states—Massachusetts, Rhode Island, Connecticut, New York, and New Jersey—although a small quantity is returned by one establishment in North Carolina.

EGYPTIAN COTTON.

The use of Egyptian cotton for the manufacture of fine fabrics, but more particularly as the material for knit underwear, has grown greatly during the last decade. The amount imported into the country nearly doubled during the ten years 1881–1890, rising from 4,440,996 pounds, valued at $757,352, to 8,407,160, valued at $1,393,071. But in the ensuing ten years the importations have still further multiplied eightfold. The following statement shows by fiscal years the imports of foreign cotton, which was nearly all Egyptian:

YEARS.	Pounds.	Value.
1890–91	20,908,817	$2,825,004
1891–92	28,663,769	3,217,521
1892–93	43,367,952	4,688,799
1893–94	27,705,949	3,003,888
1894–95	49,332,022	4,714,375
1895–96	55,350,520	6,578,212
1896–97	51,898,926	5,884,262
1897–98	52,660,363	5,019,503
1898–99	50,158,158	5,013,146
1899–1900	67,398,521	7,960,945
Total for 10 years	447,444,997	48,905,655
Annual average	44,744,500	4,890,565

During the census year 1889–90 there was reported a use of 6,560,951 pounds of Egyptian cotton. The present returns account for a consumption of 55,844,932 pounds, which should properly be increased by an unknown amount consumed in a few hosiery establishments which spin a part, at least, of their own yarn. Egyptian cotton possesses some peculiarities which adapt it especially to the uses to which it is put. It is especially desirable, on account of its natural silkiness, for the process of mercerization.

YARN PURCHASED.

Although there has been no perceptible movement during the last ten years in the direction of the English system of treating spinning and weaving as distinct industries—in the sense that both processes are not usually carried on in one factory—yet there has been a large proportionate increase in the number and importance of yarn mills. At the census of 1890 a little less than one-eighth of the value of products reported consisted of "yarns for sale;" at this census almost exactly one-sixth of the product is so classed. Although this increase, as will presently be noted, was demanded largely for consumption in collateral industries, there was an augmented use of cotton yarn in weaving establishments. The return of cotton yarn purchased for use in cotton mills proper, in the census year 1899–1900, was 83,832,216 pounds, valued at $15,749,536, as compared with 48,779,715 pounds, valued at $10,853,536, in 1890, an increase in value of about 50 per cent. Nevertheless, the situation has not changed substantially since it was noted in the report on the Eleventh Census that the establishments classed as "cotton goods," which make use of yarn not spun by themselves, are of three classes: (1) Those which both spin and weave, but do not produce enough yarn to supply their looms; (2) those which purchase fine yarn to be converted into sewing thread; and (3) those which weave only. It is noted elsewhere that the number of spindles in Pennsylvania has diminished during the last ten years. But there are in that state, chiefly in Philadelphia and its suburbs, a great many establishments which operate looms only in the production of the highest class of fancy-woven fabrics. They are by far the largest users of the yarn here reported among materials consumed. During the census year the factories in Pennsylvania took 36,304,919 pounds of this yarn, valued at $6,741,518, about 43.3 per cent of all the yarn so taken by the mills of the United States. Pennsylvania, with but 1.6 per cent of the spindles operated in the United States, has 3.5 per cent of the looms.

YARNS OTHER THAN COTTON.

The consumption of raw fibers, other than cotton, in the cotton mills of the country is quite unimportant; but in special mills there is a large use of yarn made of such fibers. The facts relating thereto were, at the census of 1900, obtained in much greater detail than heretofore. The following statement makes such comparisons as are possible with the statistics published in 1890:

MATERIALS.	1900		1890	
	Pounds.	Value.	Pounds.	Value.
Silk	298, 716	$1, 158, 321	32, 851	$154, 336
Spun silk	208, 403	625, 658	18, 683	83, 064
Linen	1, 575, 403	350, 962	17, 722	9, 823
Worsted	687, 019	415, 904	87, 257	62, 514
Woolens	435, 361	176, 467	196, 874	131, 657
Merino	87, 064	21, 946	....	....
Mohair	21, 398	21, 435	....	....
Camel's hair	134, 595	62, 838	....	....
Jute	220, 507	17, 967	99, 938	8, 976
Mercerized cotton	16, 233	15, 752	....	....
Tussur	15, 918	19, 102	....	....
Other yarn	103, 157	10, 221	224, 729	59, 312
Total	3, 803, 774	2, 896, 573	677, 954	509, 682

It appears from the foregoing tabular statement that the use of yarn made from fibers other than cotton has increased more than fivefold in the last ten years. Such yarns are, of course, employed for mixing with cotton. With the exception of jute, and the inconsiderable amount reported indefinitely as "other yarn," they are all of higher cost than ordinary cotton yarn; and their use implies not an adulteration, but an improvement of the fabrics into which they enter.

OTHER MATERIALS.

Raw cotton and yarn account for 80 per cent of the total value of the materials used. The rest is made up of oil and starch, mill supplies, fuel, and freight. The purity of the goods manufactured in American mills is attested by the fact that no place needs to be reserved in this branch of the statistics for any articles used elsewhere for "loading" fabrics. A careful return was required of the quantity of starch consumed—a necessity in dressing warps—and it appears that it constitutes only 3.7 per cent of the weight of piece goods and yarn produced.

PRODUCTS.

Table 14 exhibits the kinds, quantity, and value of products of cotton mills in 1900, together with such comparison with the corresponding figures for 1890 as the inquiries at the Eleventh Census render possible.

TABLE 14.—PRODUCTS OF COTTON MILLS IN DETAIL: 1890 and 1900.

KINDS.	1900		1890	
	Square yards.	Value.	Square yards.	Value.
Aggregate value	....	$332, 806, 156	....	$267, 981, 724
Woven goods:				
Total	4, 509, 750, 616	243, 218, 155	3, 004, 320, 473	193, 874, 275
Plain cloths for printing or converting—				
Total	1, 581, 613, 827	57, 780, 940	955, 294, 320	43, 550, 174
Not finer than No. 28 warp	1, 056, 278, 952	35, 616, 575	(1)	(1)
Finer than No. 28 warp	525, 334, 875	22, 164, 365	(1)	(1)
Brown or bleached sheetings and shirtings	1, 212, 403, 048	55, 513, 032	962, 238, 062	55, 193, 439
Ginghams	278, 392, 708	16, 179, 200	268, 996, 715	20, 686, 390
Ticks, denims, and stripes	171, 800, 853	16, 446, 633	167, 121, 426	16, 987, 546
Drills	237, 206, 549	11, 862, 794	[2] 334, 020, 091	[2] 23, 601, 239
Twills and sateens	235, 860, 518	14, 301, 302	....	....
Cottonades	26, 323, 947	2, 791, 431	(3)	(3)
Napped fabrics	268, 852, 716	18, 231, 044	[4] 132, 524, 706	[4] 10, 574, 924
Fancy woven fabrics	237, 841, 603	21, 066, 310	127, 373, 179	12, 645, 929
Corduroy, cotton velvet, and plush	7, 961, 523	2, 682, 017	(3)	(3)
Duck—				
Total	129, 234, 076	14, 263, 008	55, 192, 538	8, 664, 395
Sail	11, 750, 151	2, 216, 371	(3)	(3)
Other	117, 483, 925	12, 046, 637	(3)	(3)
Bags and bagging	30, 039, 616	2, 554, 192	(3)	(3)
Mosquito and other netting	41, 885, 023	875, 868	(3)	(3)
Upholstery goods—				
Total	50, 334, 609	8, 670, 384	1, 559, 436	2, 070, 239
Tapestries (piece goods and curtains)	10, 131, 538	4, 123, 600	642, 061	354, 987
Lace and lace curtains	36, 880, 198	3, 585, 138	(3)	1, 225, 364
Chenille curtains	805, 414	257, 840	666, 405	360, 706
Other, including covers	2, 517, 459	708, 806	250, 970	129, 182
	Pounds.	Value.	Pounds.	Value.
Yarns for sale	332, 186, 012	$55, 188, 663	166, 397, 003	$33, 247, 596
Sewing cotton	15, 741, 062	11, 825, 218	13, 868, 309	11, 637, 600
Twine	11, 132, 250	1, 475, 146	8, 533, 780	1, 364, 300
Tape and webbing	(3)	328, 801	(3)	(3)
Batting and wadding	10, 567, 700	864, 016	20, 470, 556	2, 094, 232
Waste for sale	270, 100, 756	5, 552, 234	141, 109, 597	5, 679, 701
Other products of cotton	(3)	5, 154, 170	(3)	(3)
All other products	....	9, 199, 758	....	20, 084, 120

[1] No separation of print cloths was made in 1890.
[2] Drills, twills, and sateens.
[3] Not separately reported.
[4] Cotton flannels.

The total value of the products of all the mills here reported was $332,806,156, of which $243,218,155, or 73.1 per cent, represented the value of woven goods; $55,188,663, or 16.6 per cent, the value of yarn spun to be used in other mills; $11,825,218, or 3.6 per cent, the value of sewing cotton; and $22,574,120, or 6.8 per cent, the value of miscellaneous and by-products. The proportion of these several classes of goods varies but slightly from that indicated in the census returns of 1890. There was a decline of about 1 per cent in the relative value of woven goods, an increase of about 4 per cent in the relative value of yarn for sale, and a decrease in miscellaneous products. It should, nevertheless, be remarked that the more thorough classification of products at this census is responsible for an apparent decline in miscellaneous products which is not real. A large part of the "all other products" reported in 1890 should undoubtedly fall into some of the newly specified classes of woven goods. In respect to the corresponding item in the returns of the present census, a still more detailed classification would have removed from "all other products" a large quantity and value of toweling and other woven products which are not properly classified as piece goods.

An inspection of the table brings out the fact which is known to all persons acquainted with the trade in cotton goods, namely, that the demand for coarse and medium goods is many times that for fine fabrics. The largest single item is that of sheetings and shirtings, 1,212,403,048 square yards, the whole of which is made from coarse or medium yarns; and the next in point of magnitude is the 1,056,278,952 square yards of print cloths, not finer than No. 28 warp. Most of the other classes of goods are wholly or mostly woven from medium or coarse yarns. The exceptions are the finer-print cloths, 525,334,875 yards (which is only one-ninth of the gross yardage of woven goods), a certain portion of the fancy woven fabrics, a part of the twills and sateens, and a small part of the ginghams. The fact that there is a great demand for coarse and medium goods and a limited market for fine goods is pertinent to the suggestion that manufacturers who are unable to compete successfully in the production of standard plain cloths can find their salvation in turning to the spinning of fine yarns and the weaving of fine fabrics.

In comparing the quantities and values of goods in 1890 and in 1900 it will be seen that, taking both classes of print cloths, there was an increase in quantity of more than one-half, and an increase in value of little more than one-third. There was an increase in the quantity of standard sheetings and shirtings of rather more than one-fourth, but the aggregate value was almost the same in 1890 and 1900. A small increase in the quantity of ginghams is accompanied by a reduction of more than one-fifth in the gross value. The same discrepancy is to be noted throughout the list. The explanation—the greatly diminished cost of cotton during the census year 1899–1900—is an interesting illustration of the untrustworthiness of statistics showing the value of products as a test of the condition of an industry, or for the purpose of comparing one industry with another.

An interesting feature of the details respecting woven goods is the great increase in the quantity of articles classed as upholstery goods. In 1890 they were reported as of a total value of $2,070,239; in 1900 they were returned at $8,670,384, consequently, the industry has become more than four times as important as it was ten years ago. Practically the whole of this industry is located in the city of Philadelphia.

An important increase is also to be noted in the production of yarns for sale. The amount, in fact, has almost exactly doubled, and the value is two-thirds greater than in 1890. There is a large and growing demand for yarn in knitting mills and in weaving establishments which do no spinning, as well as in mills which spin too little for their own consumption. Prior to 1890 there were few yarn mills in the South, but during the last decade there have been many factories of that class put in operation. A large part of the yarn here reported can be traced to its ultimate use. Thus, we find that 83,832,216 pounds were used in other mills, classed as "cotton goods;" 55,217,994 pounds in the wool manufactures; 131,820,068 in the hosiery and knit goods manufactures; 10,860,648 pounds in cotton small wares establishments; 6,444,208 pounds in silk manufactures; 3,860,235 in cordage and twine; 810,957 pounds in linen manufactures; and 301,888 pounds in jute manufactures. This leaves but 39,037,798 pounds not accounted for, but the consumption of yarn for other purposes is large—for example, in winding wire to insulate it for electrical conduction. The production of sewing cotton has not kept pace, in expansion, with most other branches of the industry. It may be that the consolidation of the producing companies has led to a more close approximation of demand and supply. It will be noted that, in common with other branches of the cotton manufacture, the average price of sewing cotton has declined.

MATERIALS AND PRODUCTS TWICE REPORTED.

The gross value at the factory of all the products of cotton mills is reported as $332,806,156. This sum is no doubt in excess of the net product, inasmuch as in many cases the finished product of one mill is the material of another. The excess is, nevertheless, far less proportionately than is the case with many other industries, for the reason that, as is elsewhere explained, the great majority of establishments in this branch of textile manufacturing carry through their raw material, cotton, from the baled lint to the woven cloth. In the aggregate, however, there is a large consumption of partially manufactured material consumed by weaving establishments, of which some spin a quantity of yarn insufficient to supply their looms, and others do not spin at all. Following is a statement, as complete as can be made, of the partially manufactured materials consumed which must be eliminated from the total of both materials and products to show the facts regarding this industry:

ARTICLES.	Value.
Yarn:	
Cotton	$15,749,536
Silk	1,158,321
Spun silk	625,658
Worsted	415,904
Woolen	176,467
Other	520,223
Total of yarn	18,646,109
Waste of other mills	1,513,281
Oil	494,179
Starch	1,223,102
Chemicals and dyestuffs	5,671,768
Mill supplies	7,664,490
Other materials	4,614,468
Total	39,827,397

Probably a considerable amount of the chemicals and dyestuffs reported consisted either of crude materials of domestic origin, which do not appear anywhere as a product of manufacture, or of articles imported in a condition for immediate use; but it is impossible to separate the amounts from the total, or even to make a reasonable estimate of their value. The whole is therefore counted as a duplication.

Deducting the total above shown from the total value of materials used, the remainder is $133,613,993. Deducting it also from the total value of products, the remainder is $292,978,759.

DYEING AND FINISHING.

The dyeing and finishing of cotton yarn and cloth is carried on partly in cotton mills and partly in independent establishments. The statistics of this industry are presented in the reports on combined textiles, and on the dyeing and finishing of textiles. Table 15 shows the additional work done upon the products of mills after spinning or weaving in both classes of establishments, and the additional value reported to have been given to those products by the several processes.

TABLE 15.—DYEING AND FINISHING IN COTTON MILLS AND IN INDEPENDENT ESTABLISHMENTS: 1900.

PROCESS.	TOTAL.		IN COTTON MILLS.		IN INDEPENDENT ESTABLISHMENTS.	
	Quantity, pounds.	Value added.	Quantity, pounds.	Value added.	Quantity, pounds.	Value added.
Yarn:						
Bleached	12,780,518	$252,635			12,780,518	$252,635
Dyed	205,713,712	7,691,268	151,610,157	$5,464,356	54,103,555	2,226,912
Mercerized	3,018,573	487,946	2,149,722	328,330	868,851	159,616
Total yarn treated	221,512,803	8,431,849	153,759,879	5,792,686	67,752,924	2,639,163
	Square yards.	Value added.	Square yards.	Value added.	Square yards.	Value added.
Cloth:						
Bleached	1,162,593,900	$7,623,875	197,691,533	$932,452	964,902,367	$6,691,423
Dyed	685,374,965	8,923,925	125,894,626	1,338,721	559,480,339	7,585,204
Printed	1,233,191,438	21,239,782	292,741,100	5,242,695	940,450,338	15,997,087
Mercerized	7,973,506	400,118			7,973,506	400,118
Total cloth treated	3,089,133,809	38,187,700	616,327,259	7,513,868	2,472,806,550	30,673,832
Total value added		46,619,549		13,306,554		33,312,995

From Table 15 it appears that $46,619,549 was added to the value of goods produced in the cotton mills of the country, by the various processes of dyeing and finishing. Manufacturers were not asked to return the amount of yarn bleached, and the full added value was therefore not ascertained. Even without this amount the returns show that of the yarn treated 69.4 per cent was treated in the cotton mills, and only 30.6 per cent in independent establishments. On the other hand four-fifths of the cloth treated was operated upon in independent establishments. Of the 4,509,750,616 square yards of woven goods reported in Table 14, 1,233,191,438 square yards were printed; 685,374,965 square yards were dyed; 278,392,708 square yards were ginghams, and 171,800,853 square yards ticks, denims, and stripes, containing dyed yarns—a total of 2,368,759,964 square yards. This indicates that something more than one-half of the woven goods produced in cotton mills is colored by printing or dyeing before entering into consumption. The figures relating to bleaching are to be considered with full allowance for the fact that bleaching is a necessary preliminary to printing and other processes, so that the same material is twice reported. Many manufacturers in making returns of dyeing or printing did not report separately the amounts bleached, but treated the whole process as one.

FINENESS OF GOODS—AVERAGE NUMBER OF YARN.

The method adopted for ascertaining the average number of yarn spun is the same as that first introduced at the Eleventh Census. The method in use prior to that time was based upon the number of spindles producing yarn of a particular fineness. For example, the average number of yarn produced by two mills, each having 10,000 spindles, the one spinning No. 20's and the other spinning No. 30's would be No. 25. This method was faulty, inasmuch as it assumed the equal speed and efficiency of all spindles, and also because it took no account of the fact that spindles of equal efficiency making coarse yarns spin a greater weight of yarn than those making fine yarn. The new mode of calculating it is based upon the quantity of yarn produced. The average of 5,000 pounds of No. 20 and 7,000 pounds of No. 36 would be No. 29.333. There would be 100,000 hanks (of 840 yards) of No. 20 and 352,000 hanks of No. 36, and the average is ascertained by dividing the number of hanks by the number of pounds. Of course, this method does not give an absolutely accurate result, inasmuch as manufacturers can not in all cases estimate exactly what is the average number of their own production, particularly if they make yarn of many degrees of fineness; but it is more nearly correct than the former system and is the most satisfactory method yet devised. To illustrate the inaccuracy that arises in the use of the present method, there is a mill in the state of New York which has a majority of its spindles producing yarn finer than No. 40; but as it operates also a comparatively small number of mules making coarse hosiery yarn, it reports its average number as 18.

It is, and probably it always will be, true that an overwhelmingly great proportion of the cotton goods demanded for use even in wealthy communities is made of medium or coarse yarns. It will be seen from the table showing the gross spinning of fine, medium, and coarse yarns, that not much more than one-twentieth of the yarn spun is classed as fine. Nevertheless there is a constant tendency toward finer spinning. The demand for cloth classed strictly as fine increases steadily, and, among the users of the heavy goods which represent the spinning and weaving industries in pioneer times, the desire grows for the standard sheetings and shirtings made of yarn ranging from No. 25 to No. 40. Yet the perversity of averages conceals these tendencies to a great extent, as will become evident upon an examination of the following statement, showing by states and geographical divisions the average number of yarn spun in 1900 and 1890:

No. 215——4

	AVERAGE NUMBER OF YARN.	
	1900	1890
United States	21.573	22.93
New England states	25.560	26.20
Maine	22.937	22.66
New Hampshire	19.174	21.14
Vermont	27.894	25.95
Massachusetts	25.097	26.75
Rhode Island	36.541	34.73
Connecticut	30.373	29.91
Middle states	19.176	20.45
New York	23.457	27.69
New Jersey	35.370	37.14
Pennsylvania	16.489	16.65
Delaware	23.522	22.33
Maryland	9.357	9.35
Southern states	17.046	14.76
Virginia	15.287	17.04
North Carolina	18.830	15.30
South Carolina	19.040	15.13
Georgia	14.371	14.35
Kentucky	13.722	15.75
Tennessee	12.722	12.22
Alabama	14.437	12.67
Mississippi	14.344	14.58
Arkansas	5.878	....
Louisiana	15.876	....
Texas	9.580	....
Western states	19.418	15.32
Indiana	18.262	14.66
Illinois	22.000	17.20
Wisconsin	20.879	20.37
Nebraska	27.000	....
Missouri	15.426	....
Colorado	20.000	....
California	9.000	....

From the foregoing figures it would be natural to conclude that the tendency has been toward coarser spinning. But it will be seen that the average number of yarn in the Southern states, where the largest increase has taken place, has advanced two and a quarter numbers. Yet because the average in that section is still eight and a half numbers below the average in New England, the general average of the whole country is reduced. In New England there was a large increase in the spinning of coarse, medium, and fine yarns. The proportional increase of fine spinning was 59.3 per cent more than the increase of coarse, and 94.7 per cent more than the increase of medium goods; but since the actual increase in pounds of fine yarn spun was less than the increase in the two other classes, the general average is slightly reduced. Table 16, showing the aggregate amount of yarn spun, by states, geographically arranged, divided into coarse, medium, and fine, in 1900 and 1890, gives a much better idea of the situation than can be obtained from any calculation of the average number.

TABLE 16.—YARNS SPUN, CLASSIFIED BY GRADE, BY STATES, GEOGRAPHICALLY ARRANGED: 1890 AND 1900.

STATES.	1900					1890			
	Number of hanks of yarn spun.	Total.	No. 20 and under.	No. 21 to No. 40.	No. 41 and over.	Total.	No. 20 and under.	No. 21 to No. 40.	No. 41 and over.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	31,660,042,486	1,467,565,971	850,203,953	540,166,147	77,195,871	901,842,238	480,273,239	386,723,173	34,845,826
New England states	19,067,774,000	745,990,534	304,842,149	369,423,518	71,724,867	574,084,144	207,672,353	331,611,339	34,800,452
Maine	1,536,861,865	67,003,387	40,530,149	23,608,965	2,864,273	54,963,253	26,577,650	28,385,603	...
New Hampshire	2,089,377,338	108,968,243	79,300,869	29,667,374	...	91,167,408	54,984,891	36,182,517	...
Vermont	151,549,744	5,432,983	1,525,033	3,907,950	...	3,752,391	1,243,508	2,508,883	...
Massachusetts	11,106,615,977	442,538,758	164,190,352	235,617,217	42,731,189	308,797,274	103,234,514	186,750,241	18,812,519
Rhode Island	2,822,384,752	77,238,360	3,661,667	57,341,561	16,235,132	75,037,935	8,280,776	55,640,821	11,116,338
Connecticut	1,360,984,324	44,808,803	15,634,079	19,280,451	9,894,273	40,365,883	13,351,014	22,143,274	4,871,595
Middle states	2,260,033,536	117,856,490	86,166,567	27,105,119	4,584,804	103,035,788	62,850,759	40,139,655	45,374
New York	985,573,613	42,014,730	25,241,091	16,443,639	330,000	32,083,114	6,553,540	25,529,574	...
New Jersey	432,593,550	12,230,347	5,366,044	2,979,499	3,884,804	6,133,639	1,456,672	4,631,593	45,374
Pennsylvania	555,394,994	32,468,390	25,344,251	6,754,139	370,000	40,238,918	32,215,744	8,023,174	...
Delaware	24,968,690	1,061,474	133,632	927,842	...	3,828,238	2,325,960	1,502,278	...
Maryland	281,502,689	30,081,549	30,081,549	...	...	20,751,879	20,298,843	453,036	...
Southern states	9,998,763,591	586,546,002	445,967,812	139,691,990	886,200	209,987,348	197,443,432	12,543,916	...
Virginia	230,991,103	15,110,233	13,457,870	1,652,363	...	7,719,379	7,719,379	...	...
North Carolina	2 945,812,639	156 435,539	99,021,341	56,527,998	886,200	45,048,638	41,972,080	3,076,558	...
South Carolina	3,730,694,191	195,930,440	132,903,687	63,026,753	...	54,520,363	53,275,593	1,244,770	...
Georgia	1,680,985,417	116,967,671	108,276,364	8,691,307	...	58,832,378	52,611,129	6,221,249	...
Kentucky	124,480,316	9,071,044	5,818,514	3,252,530	...	4,248,115	2,246,776	2,001,339	...
Tennessee	141,889,665	11,152,567	11,152,567	...	...	12,310,343	12,310,343	...	...
Alabama	835,446,399	57,866,762	51,325,723	6,541,039	...	11,699,255	11,699,255	...	...
Mississippi	113,456,683	7,909,625	7,909,625	...	...	6,966,959	6,966,959	...	...
Arkansas	5,251,558	893,279	893,279	...	...	...	...	...	...
Louisiana	111,105,000	6,998,216	6,998,216	...	...	...	...	...	...
Texas	78,650,620	8,210,626	8,210,626	...	...	...	...	...	...
All other Southern states	...	...	...	...	...	8,641,918	8,641,918	...	...
Western states	333,471,359	17,172,945	13,227,425	3,945,520	...	14,734,958	12,306,695	2,428,263	...
Indiana	158,265,234	8,666,072	8,666,072	...	...	6,649,187	6,649,187	...	...
Illinois	48,345,506	2,197.523	...	2,197,523	...	2,374,131	950,000	1,424,131	...
Wisconsin	36,855,304	1,765,128	988,756	776,372	...	2,682,606	1,678,474	1,004,132	...
Missouri	20,339,500	1,318,500	1,318,500	...	...	...	...	...	...
Nebraska	26,233,875	971,625	...	971,625	...	...	...	...	...
Colorado	42,081,940	2,104,097	2,104,097	...	...	...	...	...	...
California	1,350,000	150,000	150,000	...	...	...	...	...	...
All other Western states	...	...	...	...	...	3,029,034	3,029,034	...	...

POWER.

The returns of power used in the cotton-manufacturing industry present the extraordinary fact, that of the 806,121 horsepower employed in all the establishments in the United States, only 12,602 horsepower, less than 1.6 per cent, was hired. It should be explained that a large number of corporations whose factories are operated by waterpower do not own the water privileges. That is to say, they pay in one form or another for the water which turns their wheels. This expense is not classed as rent, but as a part of the materials used. It is evidently an expense of the same sort as the fuel which is consumed in supplying steam power.

Although the statistics are lacking for a comparison of the kinds of power in use during the year 1900 with those employed in previous census years, yet it may be surmised with a degree of confidence that the present returns signalize a culmination of the use of steam as compared with waterpower. In the early days of the industry cotton factories were usually, one might almost say invariably, located upon waterpower. So universally was this the practice that cotton mills which were erected in coast towns, where coal could be procured at a low transportation cost for steam making, were distinguished in the titles of the corporations as "steam" mills. But the inadequacy of waterpower as the motive force for great groups of factories, and the failures and stoppages caused by drought, flood and ice, led to the addition of steam engines for a supplementary power, and to the erection of mills without reference to waterpower. This change has gone to such an extent that steam power used in the factories is more than double the waterpower employed. The numbers representing the two kinds of power are 527,186 horsepower for steam, and 250,790 horsepower for water. There are, nevertheless, some reasons for believing that there may be a reaction, the importance of which can not be predicted. The development of the use of electricity carries with it the possibility of a cheap transmission of power to a distance without serious loss. In this way it becomes feasible to make available certain waterpowers which, on account of their location or the physical characteristics of the country, have heretofore been useless. The growing importance of electricity as a motor appears in the current returns which show a total of over 18,000 electric horsepower, owned and rented. The application of electricity direct to the machinery, without the use of shafting and belting, is comparatively new, but it is certain that it has a great future, and that hereafter manufacturers will find in the system great benefits, of which a saving in expense will not be the least.

MACHINERY.

Ever since the first application of mechanical power to the movement of the spindle there has been a constant improvement in the machinery employed in the spinning and weaving of cotton. The foundation of the cotton manufacture was laid in the almost simultaneous invention of the steam engine and the earliest form of spinning machinery. Hargreaves's spinning jenny, invented in 1764 and patented in 1770; Arkwright's water frame, the invention of drawing by rollers, brought out in 1769 and improved in 1775; Crompton's mule—so called because it combined the principles of Hargreaves's and Arkwright's inventions—patented in 1779; these antedated but a short time the introduction of Watts's steam engine, which was invented in 1769, became a practicable power agent by improvements made in 1781, and was first applied to the production of cotton yarn in 1785. All of Arkwright's patents, which included improvements in carding, drawing, roving, and spinning, were thrown open in 1785. In the same year Dr. Cartwright invented the power loom, and thus completed the group of fundamental inventions of which all modern spinning and weaving machinery is but an adaptation and a series of improvements.

But there has been another series of inventions directed to the economical, rapid, and thorough preparation of the cotton for spinning, as well as a constant succession of improvements in the final processes of the manufacture, which have multiplied a hundred if not a thousand fold the efficiency of the industry. In the year 1800 the scutching machine was introduced, the invention of Snodgrass, of Glasgow. The lap machine was introduced in nearly the form it has to-day by Mr. John Crighton, of Manchester, in 1814. Mr. Crighton also effected an important reform in the processes of opening and scutching. The invention of the carding machine and its gradual evolution into the almost perfect mechanism of to-day, cover nearly the whole of the Nineteenth century. The first important improvement was made in 1823. The principle of the revolving flat was devised in 1834. After being neglected for more than twenty years it was taken up and improved in 1857, and about 1880 became, in the hands of the Messrs. Ashworth, substantially the carding machine of the present day. The combing machine was first exhibited by its inventor, Mr. Josué Heilmann, of Mulhouse, at the Paris Exposition, in 1851.

The mule, as invented by Crompton, was a semi-manual machine. Richard Roberts, in 1835, transformed it into the purely automatic machine which we see at this time, so exact and precise in its several successive motions that it seems endowed with almost human intelligence. Since Roberts's time the history of the mule has been one of development in detail and of better construction, but the changes of this sort have made it vastly more useful in speed, in precision of action, and in the quality of the yarn which it makes. The improvement in frame spinning has been much greater than in the mule. The invention of the ring and the traveler in the third decade of the last century opened a wide field to the genius of mechanicians. Improvement followed improvement in rapid succession until the Rabbeth spindle reached what seems to be the practical limit of speed, and, therefore, of the production of yarn, at about 10,000 turns a minute. The final improvements, which made ring spinning more economical and profitable than mule spinning, for all except certain special purposes, in mills wherein both spinning and weaving are carried on, were accomplished in the closing decades of the century.

The most important advance in machinery during the past decade has been in the loom. Glancing backward we find that Cartwright invented the power loom in 1785, as has been already noted. The policy of the British Government at that time and for many years afterwards forbade the exportation of machinery and of patterns for making it. Accordingly, it was necessary to reinvent the power loom for use in the manufacture of cotton in this country. The feat was successfully accomplished by Francis Cabot Lowell, in 1814. Numerous improvements were made during the ensuing three-quarters of a century. The efforts of inventors are always directed toward the discovery of devices by which the speed of machinery may be increased, of automatic motions which will diminish the amount of care and attention to be bestowed by operatives upon the machines, and to a reduction of the time during which the machines must be stopped, either after a breakage of the yarn or to replace exhausted shuttles. Stop-motions have been devised for many of the machines used in cotton mills, arrangements by which the breaking of a single thread at any point causes the whole machine to stop instantly.

The problem of the loom, so far as necessary stoppages are concerned, has been most difficult. For spinning, the process, whether on the mule or on the frame, may be said to be almost continuous, the time required for doffing forming but an inappreciable part of the whole. But the capacity of the shuttle is limited. At the speed at which modern looms are run the yarn in the shuttle box is exhausted in about eight minutes, in the manufacture of medium shirtings or print cloths. If the yarn is coarser and the speed the same, the shuttle needs to be changed still oftener. Inasmuch as the cost of labor in weaving is fully one-half the labor cost of converting a pound of raw cotton into cloth, the importance of reducing or of doing away altogether with the time occupied in changing shuttles is too evident to be more than stated. Attention was long ago turned in this direction. In 1840 an English patent was taken out for a shuttle-changing device when the weft was broken or exhausted; but it seems not to have been successful, otherwise it would have been adopted by manufacturers throughout the world. Many inventors have exercised their ingenuity to overcome the mechanical difficulty. Within the last decade the principle so long sought after has been found, but it consists not in a changing of the shuttle while the loom is in motion, but in giving the shuttle a fresh supply of weft without removing it from the loom. The success of the Northrop loom has stimulated inventors to accomplish equally brilliant results by new devices of the shuttle-changing variety. Although there are some machines which effect the change with promising efficiency, they are yet in the experimental stage.

On the other hand, the Northrop loom, which was first brought to the attention of manufacturers in April, 1895, has such self-evident advantages for the weaving of plain cloth that in less than five years, at the end of the year 1899, the output was more than 42,500 looms. This loom has two fundamental improvements—the filling-changing mechanisms and the warp-stopping devices. By the first, the time of stoppage on account of exhausted shuttles is wholly saved. By the second, the machine is stopped instantly upon the breaking of a single warp thread. In combination they add greatly to the productive capacity of the weaver. A good weaver, operating plain narrow looms, has a capacity of 8 looms. His time is chiefly occupied by replacing empty shuttles and in mending broken warp threads. The first is the more important, inasmuch as the failure to repair warp breaks merely causes an imperfection in the weaving, which is tolerated in many classes of goods; whereas an empty shuttle means a stoppage of the loom. The filling-changing mechanism reduces to a small fraction the time needed to supply looms with weft, and thus leaves most of the weaver's time free to repair warp breaks. His capacity is therefore increased to the number of looms for which he can perform this service, practically, to double or more than double the number of plain looms which he can tend. The saving which is effected is illustrated by the fact that in some cases the weaver, on leaving his work for dinner, has left all his looms running, the filling magazines all full, and on returning at the expiration of the dinner interval has found some of them still running. All those in which there had been a breakage of the warp had of course stopped, and therefore no imperfect cloth had been woven.

The stimulation to the production of a rival to this invention has already been mentioned. But the introduction of the Northrop loom has had an important reflex influence upon other parts of the cotton-manufacturing machinery. For example, an appreciable gain of time can be made if the frequency of stoppages for changing the shuttle can be diminished. Heretofore mule filling has not been adapted to the Northrop loom, where a large ring bobbin can be more readily handled than a mule cop on the spindle. Moreover, there has been in the past difficulty in making mule cops of large size that would be proof against breaking in the shuttle, or in being handled about the mill. The waste from mule filling was in many cases so great as to be prohibitive. Weavers preferred to use small cops rather than take the risks of large cops falling apart in weaving. But the problem of spinning large, well-wound mule cops of filling yarn has now been solved, and the necessary devices can be applied to old mules. A weaver tending 8 looms, and changing shuttles that contain yarn enough to supply the loom eight minutes, has to make an average change of one a minute. The larger mule cops contain enough No. 36 yarn to run twelve minutes, and of course his loom capacity is considerably increased. Many manufacturers prefer mule filling for certain fabrics on account of the soft appearance and "feel" of the cloth, as compared with ring-filling cloth, and the new mills which have been built to make the higher grades of fine cloths are still fully equipped with mules to make filling.

If the mule is being adapted to produce yarns usable where frame-spun yarn has heretofore had full sway, there has been a promising effort to adapt the ring-traveler principle to the production of a slack-twisted yarn, which could formerly be made only on the mule, at the same time winding it on the bare spindle, in cop form. This improvement is as yet only in the experimental stage. At present there seems to be a difficulty in the way of making use of the device for the production of knitting yarns, which constitutes the largest demand for yarns not immediately used by the spinner. Soft-twisted yarns for knitting purposes should be in large cops to avoid frequent piecings in the knitting machine. This does not now seem practicable, for the greater diameter of ring necessary would bring too great a strain upon the yarn. No doubt in time this difficulty can be overcome, as many difficulties greater than this have been surmounted. The attempt to solve the problem is cited as evidence that the age of invention in the marvelously developed cotton-manufacturing industry has not yet closed.

THE PROGRESS OF THE INDUSTRY AS INDICATED BY THE NUMBER OF SPINDLES.

Table 17 shows the number of cotton spindles used in textile manufactures, by states, 1890 and 1900.

TABLE 17.—NUMBER OF ACTIVE COTTON SPINDLES IN THE TEXTILE INDUSTRY, BY STATES, GEOGRAPHICALLY ARRANGED: 1890 AND 1900.

STATES.	1900						1890
	Total.	In cotton mills.	In hosiery and knit-goods mills.	In worsted mills.	In woolen and carpet mills.	In cotton small wares, and cordage and twine factories.	Total.
United States	19,472,232	19,008,352	206,698	95,356	59,460	102,366	14,384,180
New England states	13,171,377	12,850,987	137,376	95,356	27,344	60,314	10,934,297
Maine	848,377	841,521			3,584	3,272	892,762
New Hampshire	1,249,875	1,243,555	6,320				1,198,643
Vermont	100,028	100,028					71,591
Massachusetts	7,932,883	7,784,687	91,356	50,080	3,760	3,000	5,872,852
Rhode Island	1,976,198	1,880,622		45,276	10,000	40,300	1,959,294
Connecticut	1,064,016	1,000,574	39,700		10,000	13,742	939,155
Middle states	1,721,347	1,647,251	52,712		20,184	1,200	1,716,019
New York	764,492	720,268	38,404		5,820		629,324
New Jersey	431,730	431,730					374,442
Pennsylvania	336,509	306,637	14,308		14,364	1,200	496,551
Delaware	34,552	34,552					53,916
Maryland	154,064	154,064					161,786
Southern states	4,354,034	4,298,188	16,610		5,000	34,236	1,563,598
Virginia	132,707	126,827	5,880				94,294
North Carolina	1,137,328	1,133,432	2,860			1,036	344,606
South Carolina	1,436,969	1,431,349	5,620				332,784
Georgia	832,321	815,545				16,776	445,452
Kentucky	66,633	66,633					42,942
Tennessee	130,296	123,896			5,000	1,400	98,324
Alabama	419,968	411,328				8,640	79,362
Mississippi	78,146	75,122				3,024	57,004
Arkansas	13,060	9,700				3,360	5,780
Louisiana	57,850	55,600	2,250				48,050
Texas	48,756	48,756					16,000
Western states	225,474	211,926			6,932	6,616	170,266
Ohio	4,600					4,600	16,580
Indiana	108,988	102,488			6,500		80,604
Illinois	31,488	31,488					21,800
Wisconsin	21,496	21,496					32,592
Iowa							6,000
Missouri	13,654	13,654					6,690
Nebraska	15,488	15,488					
Utah	432				432		
Colorado	17,312	17,312					
Kansas	2,016					2,016	
California	10,000	10,000					6,000

The number of working spindles is the universally accepted measure of the capacity of cotton mills, and of the growth of the industry in any particular state or region. It is admittedly an imperfect measure; but it is not only more accurate than would be any expression in terms of capital employed, number of hands or their wages, quantity or value of materials consumed, or weight or value of product, but it is also a better gauge than is available for most industries. The present mill of 50,000 spindles is a vastly larger factory in all respects than was the mill of 50,000 spindles in 1850, and the 19,000,000 spindles of the year 1900 undoubtedly produce five times as great an amount of goods as the 7,000,000 spindles of 1870. Nevertheless, the necessity manufacturers are under to adopt improvements in machinery produces such an equalizing effect upon the several establishments at any one time that the percentage of correction needed is not great; and the rate of progress in the efficiency of machinery is so well known that it is easy to make allowance for it in comparisons of one time with another.

The grand total of active producing cotton spindles in all the textile mills of the United States during the census year 1899–1900 was 19,472,232, as compared with 14,384,180[1] at the Eleventh Census, a numerical increase of 5,088,052 spindles, or 35.4 per cent. These spindles were located as follows:

	1900	1890
In cotton mills	19,008,352	14,188,103
In hosiery and knit-goods mills	206,698	69,830
In worsted mills	95,356	68,225
In woolen mills[1]	59,460	58,022
In cotton small wares establishments	42,600	(2)
In cordage and twine factories	59,766	(3)
Total	19,472,232	14,384,180

[1] Including carpets. [2] Included in cotton mills. [3] Not reported.

The indicated increase in the number of spindles in mills other than cotton factories is apparent rather than real. A company in New England having 75,000 spindles, which in 1890 made both woven goods and knit goods, and was then classed as operating a cotton factory, now makes hosiery and knit goods exclusively,

[1] The total number of spindles in the United States as reported at the Eleventh Census was 14,550,323, of which 166,143 were idle spindles in cotton mills. At this census no idle spindles which are likely to be put in operation again were reported from any state.

and being classed with that industry swells the total unduly. In many cases, both in 1890 and in 1900, companies that produce both cotton and woolen or worsted goods, or mixed goods, made divided returns of their operations; some such companies made but one return, being classified according to the relative importance of their cotton or their woolen business. The fact of their making one return or divided returns at one census and not at the other explains partially the apparent increase in 1900. No doubt a certain part of the increase is real.

Although the gross number of operating spindles in mills of all kinds, 19,472,232, is to be taken as the true measure of the magnitude of the cotton industry in the United States, the present report deals exclusively with the spindles in cotton mills proper. The percentage of increase in them in the whole country is almost exactly 34 per cent. If we estimate that the average efficiency of spindles has increased 5 per cent during the same period, the ability of American mills to supply a demand for goods has increased about 40 per cent. Numerically there has been an addition of 2,014,832 spindles, or 18.6 per cent, in New England; of 13,529 spindles in number, or 0.8 per cent, in the Middle states; of 2,744,188 spindles in number, or 176.6 per cent, in the Southern states; and of 47,700 spindles in number, or 29 per cent, in the Western states. Taking account of the spinning capacity of spindles, the growth of the industry in the New England states is probably not greatly above that which is indicated by the actual number of spindles, since the mills in that part of the country were in advance of the South in installing improved spindles. On the other hand, not only has the number of spindles in the Southern states become nearly threefold that reported in 1890, but the spindles themselves are for the most part of the latest and most efficient types. With respect to one state the test of capacity by the number of spindles wholly fails. The industry in Pennsylvania is largely one of weaving yarn made elsewhere. Although the state ranks fifth in the value of the products of its cotton mills, and fourth among the states in the amount of wages paid to employees, it is only the twelfth according to the number of spindles. It shows a considerable increase of looms, and the industry has in fact expanded during the decade, but the number of spindles has declined.

Table 18 shows the mule and frame spindles in cotton mills, by states, geographically arranged: 1880, 1890, and 1900.

TABLE 18.—NUMBER OF SPINDLES IN COTTON MILLS, BY STATES, GEOGRAPHICALLY ARRANGED: 1880, 1890, AND 1900.

STATES.	1900			1890			1880
	Total.	Mule.	Frame.	Total.	Mule.	Frame.	Total.
United States	19,008,352	5,563,480	13,444,872	14,188,103	5,363,486	8,824,617	10,653,435
New England states	12,850,987	4,477,199	8,373,788	10,836,155	4,391,895	6,444,260	8,632,087
Maine	841,521	256,948	584,573	885,762	344,697	541,065	695,924
New Hampshire	1,243,555	287,165	956,390	1,195,643	364,234	831,409	944,053
Vermont	100,028	43,316	56,712	71,591	42,735	28,856	55,081
Massachusetts	7,784,687	2,556,316	5,228,371	5,824,518	2,430,719	3,393,799	4,236,084
Rhode Island	1,880,622	940,328	940,294	1,924,486	811,869	1,112,617	1,764,569
Connecticut	1,000,574	393,126	607,448	934,155	397,641	536,514	936,376
Middle states	1,647,251	858,675	788,576	1,633,722	822,613	811,109	1,391,164
New York	720,268	367,136	353,132	606,796	334,210	272,586	561,658
New Jersey	431,730	367,092	64,638	374,442	304,480	69,962	232,221
Pennsylvania	306,637	124,447	182,190	439,638	175,687	263,951	425,391
Delaware	34,552	...	34,552	53,916	2,880	51,036	46,188
Maryland	154,064	...	154,064	158,930	5,356	153,574	125,706
Southern states[1]	4,298,188	180,534	4,117,654	1,554,000	108,474	1,445,526	[1]542,048
Virginia	126,827	2,325	124,502	94,294	13,198	81,096	44,340
North Carolina	1,133,432	35,352	1,098,080	337,786	30,920	306,866	92,385
South Carolina	1,431,349	10,752	1,420,597	332,784	4,000	328,784	82,334
Georgia	815,545	84,926	730,619	445,452	20,524	424,928	198,656
Kentucky	66,633	18,399	48,234	42,942	8,784	34,158	9,022
Tennessee	123,896	20,780	103,116	97,524	21,588	75,936	35,736
Alabama	411,328	8,000	403,328	79,234	9,460	69,774	49,432
Mississippi	75,122	...	75,122	57,004	...	57,004	18,568
Arkansas	9,700	...	9,700	5,780	...	5,780	...
Louisiana	55,600	...	55,600	46,200	...	46,200	...
Texas	48,756	...	48,756	15,000	...	15,000	...
Western states[2]	211,926	47,072	164,854	164,226	40,504	123,722	[2]88,136
Ohio	...	...	...	16,560	8,152	8,408	13,328
Indiana	102,488	16,320	86,168	74,604	16,320	58,284	33,396
Illinois	31,488	16,000	15,488	21,800	8,000	13,800	...
Wisconsin	21,496	2,816	18,680	32,592	5,632	26,960	...
Iowa	...	...	...	6,000	...	6,000	...
Missouri	13,654	...	13,654	6,670	2,400	4,270	19,312
Nebraska	15,488	6,272	9,216	...	...	...	...
Colorado	17,312	5,664	11,648	...	...	...	...
California	10,000	...	10,000	6,000	...	6,000	...

[1] Includes in 1880, 11,575 spindles reported by states other than those named.

[2] Includes in 1880, 22,100 spindles reported by states other than those named.

Attention was called in the report upon the Eleventh Census to the steady substitution of frame spindles for mules. The change has been going on to a marked degree during the past ten years. It would, perhaps, not be accurate to assert that mules have been to any great extent removed from old mills and ring spindles placed in them. The more correct view is that substantially all the new spinning is frame spinning. In New England the increase in mule spindles is less than 100,000; of frame spindles, nearly 2,000,000. In the South ten years ago there were only 108,474 mule spindles; there are now reported 180,534; but as contrasted with this very moderate increase we have an addition of almost 2,700,000 frame spindles. In the Middle states the mule has more than held its own. Ten years ago there was an excess of about 11,000 mule spindles over ring spindles. By the present count the excess is about 70,000. It is well known that although for most purposes in cotton manufacturing the yarn made upon ring spindles is altogether satisfactory, there is a demand for slack-twisted yarn chiefly for knit underwear, which has heretofore been produced by the mule only. Moreover, a mechanical difficulty which has not been overcome has been experienced in employing ring spindles for spinning upon cops, where the yarn made in one mill must be transported to another part of the country for consumption in hosiery mills. It is, therefore, not probable that there will be a reduction in the number of mules in use, and there may even be an increase; but the economy in the production of yarn by ring spindles, and the fact that the machinery can be operated by labor not so highly skilled as is required for mule spinning, will doubtless cause the tendency to install frame spindles in new spinning and weaving mills to continue. It will be observed that in Rhode Island there has been an actual decrease of ring spindles and an increase of mules. The mills of that state produce a large amount of fine yarn, and many of them are engaged extensively in spinning yarn for knitting mills. The ascendency of the mule in New Jersey is explained by the fact that the industry in that state is for the most part devoted to the production of fine sewing thread, to which the mule is by far the better adapted.

No radical improvement has been made during the past decade in spinning machinery of either kind, nor do the makers of such machinery anticipate great changes in the future. The mule is already a perfect machine, in the sense that it is automatic in every part and that in none of the various operations which it performs without human guidance does any part act as a drag upon others. Inasmuch as the spindles are now operated at as high a speed as is compatible with the spinning of good yarn, it follows that in order to increase the production sensibly it would be necessary to improve the machine not in one part only but in many parts. With respect to the ring spindle the quantity of yarn it can make of any particular count is directly proportioned to the speed of the spindle itself. Ten thousand turns a minute comes near to being the limit of the ring spindle under present conditions, because at a speed above that the travelers are apt to fly off badly. It it estimated that the average speed of the spindle on No. 28 warp yarn is about 9,000 turns. The production of yarn per spindle varies greatly with the number of yarn spun, and the speed varies in almost like proportion—that is, on coarse yarns a spindle running 7,000 turns a minute is running relatively as fast as when it is going 10,000 turns a minute on fine yarns.

During the ten years 1880–1890 the number of frame spindles sold by all manufacturers and placed in the old and new mills was 6,000,193. The corresponding number for the period 1890–1900 was 8,901,408. The total for the period of twenty years exceeds the whole number of ring spindles in the United States, a fact which suggests that substantially all the spindles of older types have been replaced. There were in 1880 in all the Northern states 10,111,387 spindles. No count was taken of the number of mule and frame spindles; but during the ensuing decade 1,569,589 new ring spindles were placed in old frames, and 3,561,896 spindles in new frames were installed, replacing either mules or old-fashioned ring spindles thrown out. At the close of the decade, at the census of 1890, there were in Northern mills 7,255,369 ring spindles. In the last ten years 3,520,640 spindles in new frames have been placed in mills which were built prior to 1890, in addition to 1,742,120 spindles in old frames. Thus more than one-half of the spindles in use ten years ago in Northern mills have since been replaced. The absolute increase of spindles in the South between 1880 and 1890 was 1,011,952. The number of new spindles installed in that part of the country during the same period was 868,708, which, it will be noticed, was 143,244 less than the total increase. During the early years of the Southern development it was not unusual to equip mills with machinery discarded by Northern mills. But in the last decade the numerical increase of frame spindles in the South has been 2,672,128, and the number of new spindles has been 3,283,884, showing that not only were all, or substantially all, the spindles in the new mills of the most modern type, but that about 600,000 old spindles in old mills were replaced by new. Combining the twenty years we find that there is a present total of 4,117,654 frame spindles in the South, and that 4,152,592 new spindles have been supplied to them in that time. The installation of new spindles, by years, and by a geographical division into North and South, is shown by the following table:

TABLE 19.—NUMBER OF FRAME SPINDLES SOLD, SUMMARY: JANUARY 1, 1890, TO JANUARY 1, 1900.

YEARS.	Aggregate.	NORTHERN STATES.				SOUTHERN STATES.			
		Total.	New frames.		Old frames.	Total.	New frames.		Old frames.
			To new mills.	To old mills.			To new mills.	To old mills.	
Total	8,901,408	5,617,524	354,764	3,520,640	1,742,120	3,283,884	1,467,624	1,485,459	330,801
1890	784,809	602,890	38,600	356,225	208,065	181,919	57,909	108,260	15,750
1891	656,306	499,999	14,656	298,288	187,055	156,307	18,697	116,425	21,185
1892	866,616	691,510	36,440	415,483	239,587	175,106	60,552	97,282	17,272
1893	1,042,268	823,008	54,656	493,435	274,917	219,260	48,080	135,524	35,656
1894	552,767	377,423	18,812	241,397	117,214	175,344	73,048	84,040	18,256
1895	958,426	669,075	45,120	464,056	159,899	289,351	113,560	145,691	30,100
1896	1,518,099	832,027	128,192	512,089	191,746	686,072	309,060	315,976	61,036
1897	651,427	278,439	11,424	154,160	112,855	372,988	206,468	121,252	45,268
1898	730,312	339,226	4,480	231,063	103,683	391,086	205,491	150,117	35,478
1899	1,140,378	503,927	2,384	354,444	147,099	636,451	374,759	210,892	50,800

CONSUMPTION OF COTTON PER SPINDLE.

The length of yarn spun is, in general, directly proportioned to the speed of spindles. The weight of yarn spun upon spindles of equal efficiency is proportioned to the coarseness or fineness of the yarn. Thus it might happen that spindles of an ancient pattern, producing No. 10 yarn, would consume several times as much raw cotton as an equal number of the high-speed modern spindles would convert into No. 50 yarn. Consequently, in studying the table which shows the average consumption of cotton per spindle in the several divisions of the country, it must be borne in mind that the indication is a resultant of two forces acting in opposite directions.

It will be seen that the tendency is, as it was during the preceding decade, to an enlarged average consumption. In the whole country it has gone up from 70.43 pounds in 1880, to 78.79 pounds in 1890, and 95.43 pounds in 1900. The increase is due chiefly to the greatly enlarged extent of the industry in the South. For although the average increase per spindle in that section is but little more than 3 pounds, yet the number of spindles which consume more than twice the average of New England spindles is three times as great as in 1890, and the proportion of the whole is much larger. Although the circumstance of the excessive increase of spinning in the South as compared with the rest of the country masks the actual facts of the case, yet an analysis of the figures by sections gives some useful indications. Thus in New England there has been an increased relative production of fine yarn, and yet the average annual consumption of cotton has increased by 7 pounds, or rather more than 10 per cent. We may, perhaps, infer that the average efficiency of spindles increased somewhere between one-eighth and one-seventh. On the other hand, the average consumption per spindle in the Southern states increased but a little more than 3 pounds a year, or about 2 per cent. But there was a notable increase in the number of yarn spun in those states. For example, in North Carolina from No. 15.30 to No. 18.90, and in South Carolina from No. 15.13 to No. 19.04. It would require spindles averaging from 20 to 25 per cent greater efficiency to accomplish the conversion of an equal weight of cotton into the finer yarn; and since the actual consumption has also increased, we may fairly conclude that the average efficiency of spindles operated in Southern mills has increased by from 25 to 30 per cent, and that they are on the whole quite up to the average of the whole country. The industry, being stationary, or declining, in the Middle and Western states, except as regards the weaving business in Philadelphia, the facts regarding those divisions of the country call for no special comment. The situation presented is to be found in the following statement:

COTTON CONSUMED PER SPINDLE.

GEOGRAPHICAL DIVISIONS.	1900	1890	1880
	Pounds.	*Pounds.*	*Pounds.*
United States	95.43	78.79	70.43
New England states	72.94	65.95	62.72
Middle states	88.24	78.46	78.58
Southern states	164.65	161.41	155.94
Western states	111.07	147.55	171.55

Table 20, which is a continuation of one in the report on the Eleventh Census, is valuable rather in detail and for purposes of comparison than in any general deduction that may legitimately be drawn from it. This will appear from a consideration of the fact that although the number of spindles to each wage-earner has increased 5.64 in New England and 1.42 in the South—the two sections which combined contain 90 per cent of all the spindles in the country—the number of spindles to each wage-earner in the United States as a whole has decreased 1.02. The explanation is a simple one, namely, the marvelous increase of the industry in the South, where the number of persons employed by a mill of a given size is much greater than in the great factory towns of the North. As employees become more skilled and experienced, a greater average amount of machinery can be put in charge of each individual. This result is already beginning to appear in the labor returns of the southern mills; but a great proportionate increase in the number of spindles in the South, and of hands employed, showing, even at the improved condition, an average number of spindles to hands barely half that in New England, makes the comparison for the whole country, as between 1890 and 1900, misleading.

TABLE 20.—COTTON GOODS, NUMBER OF SPINDLES TO EACH WAGE-EARNER, AND THE AMOUNT PAID FOR LABOR TO EACH SPINDLE, BY STATES, GEOGRAPHICALLY ARRANGED: 1880 TO 1900.

STATES.	Year.	WAGE-EARNERS. Average number.	WAGE-EARNERS. Total wages.	Number of spindles.	Number of spindles to each wage-earner.	Labor cost per spindle.
United States	1900	297,929	$85,126,310	19,008,352	63.80	$4.48
	1890	218,876	66,024,538	14,188,103	64.82	4.65
	1880	172,544	42,040,510	10,653,435	61.74	3.95
New England states	1900	162,294	55,367,541	12,850,987	79.18	4.31
	1890	147,359	47,832,943	10,836,155	73.54	4.41
	1880	125,779	32,170,861	8,632,087	68.63	3.73
Maine	1900	13,723	4,330,297	841,521	61.32	5.15
	1890	13,912	4,213,523	885,762	63.67	4.76
	1880	11,759	2,936,640	695,924	59.18	4.22
New Hampshire	1900	20,454	6,759,422	1,243,555	60.80	5.44
	1890	19,383	6,242,204	1,195,643	61.69	5.22
	1880	16,395	4,290,960	944,053	57.58	4.55
Vermont	1900	1,015	259,758	100,028	98.55	2.60
	1890	724	204,538	71,591	98.88	2.86
	1880	721	161,748	55,081	76.40	2.94
Massachusetts	1900	92,085	32,327,443	7,784,687	84.54	4.15
	1890	75,544	25,118,365	5,824,518	77.10	4.31
	1880	61,246	15,828,571	4,236,084	69.17	3.74
Rhode Island	1900	21,823	7,297,119	1,880,622	86.18	3.88
	1890	24,576	7,814,767	1,924,486	78.31	4.06
	1880	21,174	5,320,303	1,764,569	83.34	3.02
Connecticut	1900	13,194	4,393,502	1,000,574	75.84	4.39
	1890	13,220	4,239,546	934,155	70.66	4.54
	1880	14,484	3,632,639	936,376	64.65	3.88
Middle states	1900	34,843	11,396,710	1,647,251	47.28	6.92
	1890	31,841	10,184,589	1,633,722	51.31	6.23
	1880	28,118	6,613,260	1,391,164	49.48	4.75
New York	1900	8,659	2,582,394	720,268	83.18	3.59
	1890	8,316	2,448,031	606,796	72.97	4.03
	1880	9,227	1,994,755	561,658	60.87	3.55
New Jersey	1900	5,518	1,887,119	431,730	78.24	4.37
	1890	5,632	1,984,659	374,442	66.48	5.30
	1880	4,179	1,156,961	232,221	55.57	4.98
Pennsylvania	1900	15,567	5,602,339	306,637	19.70	18.27
	1890	12,666	4,388,017	439,638	34.71	9.98
	1880	9,879	2,502,688	425,391	43.06	5.88
Delaware	1900	372	138,844	34,552	92.88	4.02
	1890	971	308,346	53,916	55.53	5.72
	1880	791	192,727	46,188	58.39	4.17
Maryland	1900	4,727	1,186,014	154,064	32.59	7.70
	1890	4,256	1,055,536	158,930	37.34	6.64
	1880	4,042	766,129	125,706	31.10	6.09
Southern states	1900	97,494	17,501,648	4,298,188	44.09	4.07
	1890	36,415	7,116,865	1,554,000	42.67	4.58
	1880	16,317	2,750,986	542,048	33.22	5.08
Virginia	1900	2,931	668,556	126,827	43.27	5.27
	1890	1,990	373,993	94,294	47.38	3.97
	1880	1,085	169,789	44,340	40.87	3.83
North Carolina	1900	30,273	5,127,087	1,133,432	37.44	4.52
	1890	8,515	1,475,932	337,786	39.67	4.37
	1880	3,232	439,659	92,385	28.58	4.76
South Carolina	1900	30,201	5,066,840	1,431,349	47.39	3.54
	1890	8,071	1,510,494	332,784	41.23	4.54
	1880	2,018	380,844	82,334	40.80	4.63
Georgia	1900	18,283	3,566,951	815,545	44.61	4.37
	1890	10,314	2,167,036	445,452	43.19	4.86
	1880	6,215	1,135,184	198,656	31.96	5.71
Kentucky	1900	1,351	280,407	66,633	49.32	4.21
	1890	818	170,573	42,942	52.50	3.97
	1880	348	63,850	9,022	25.93	7.08
Tennessee	1900	2,108	422,935	123,896	58.77	3.41
	1890	2,124	444,573	97,524	45.92	4.56
	1880	1,015	161,071	35,736	35.21	4.51
Alabama	1900	8,332	1,482,226	411,328	49.37	3.60
	1890	2,088	402,905	79,234	37.95	5.09
	1880	1,448	239,998	49,432	34.14	4.86

TABLE 20.—COTTON GOODS, NUMBER OF SPINDLES TO EACH WAGE-EARNER, AND THE AMOUNT PAID FOR LABOR TO EACH SPINDLE, BY STATES, GEOGRAPHICALLY ARRANGED: 1880 TO 1900—Continued.

STATES.	Year.	WAGE-EARNERS. Average number.	WAGE-EARNERS. Total wages.	Number of spindles.	Number of spindles to each wage-earner.	Labor cost per spindle.
Mississippi	1900	1,675	$339,546	75,122	44.85	$4.52
	1890	1,154	263,997	57,004	49.40	4.63
	1880	695	133,214	18,568	26.72	7.17
Texas	1900	984	253,630	48,756	49.55	5.20
	[1] 1890					
	[1] 1880					
All other Southern states[2]	1900	1,356	293,470	65,300	48.16	4.49
	1890	1,341	307,359	66,980	49.95	4.59
	1880	261	27,377	11,576	44.35	2.37
Western states	1900	3,298	860,411	211,926	64.26	4.06
	1890	3,261	890,141	164,226	50.36	5.42
	1880	2,330	505,403	88,136	37.83	5.73
Ohio	1900	106	27,861			
	1890	554	161,613	16,560	29.89	9.76
	1880	481	104,500	13,328	27.71	7.84
Indiana	1900	1,421	323,949	102,488	72.12	3.16
	1890	1,309	310,342	74,604	56.99	4.16
	1880	708	162,829	33,396	47.17	4.88
Illinois	[1] 1900					
	1890	430	123,986	21,800	50.70	5.69
	[1] 1880					
Wisconsin	1900	347	80,567	21,496	61.95	3.75
	1890	490	131,170	32,592	66.51	4.02
	[1] 1880					
Missouri	[1] 1900					
	[1] 1890					
	1880	508	97,680	19,312	38.02	5.06
All other Western states[2]	1900	1,424	428,034	87,942	61.76	4.87
	1890	478	163,030	18,670	39.06	8.73
	1880	633	140,394	22,100	34.91	6.35

[1] Included in "All other states."
[2] Includes establishments distributed as follows: Southern states—1900, Arkansas, 2; Louisiana, 2; West Virginia, 1; 1890, Arkansas, 2; Louisiana, 2; Texas, 1; 1880, Florida, 1; Arkansas, 2; Louisiana, 2; Texas, 2. Western states—1900, California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1; 1890, California, 1; Iowa, 2; Missouri, 1; 1880, Illinois, 2; Michigan, 1; Wisconsin, 1; Minnesota, 1; Utah, 1.

The figures examined in detail are nevertheless instructive and useful. It will be seen that the number of spindles to each wage-earner has increased in three of the four geographical divisions and in most of the states. The decline in the Middle states is to be ascribed chiefly to the fact mentioned elsewhere—that the industry in Pennsylvania is becoming more and more a weaving industry and that the number of spindles has declined. This feature becomes almost startlingly apparent in the last column of the table, where the labor cost per spindle is correctly reported as more than twice that of any other state. Indeed, the character of the industry in Pennsylvania differs so widely from that of any other state that it is not properly included in any table intended to show averages for the whole country.

With reference to the "labor cost per spindle" it is to be said that it shows upon the whole an increase, by states, by geographical divisions, and for the United States. It thus indicates a certain increase of wages, as the column showing the relation of the number of spindles to that of wage-earners indicates an increase of skill. But even here it is necessary to exercise caution in making deductions, for the problem is complicated by the fact that, premising an equal amount of skill on the part of operatives, a coarse-goods mill requires more machinery and more hands for a given amount of output than a fine-goods mill. The average spinning in the South is coarser than that in New England, and consequently a larger force is needed. Moreover, the matter of the labor cost per spindle is complicated by considerations of the hours of labor in a working day, of the proportion of women and children, as compared with men, employed, and of other matters of less importance than these. The table invites analysis by students of industrial problems, but it would be hazardous to base any conclusions whatever upon it without a careful weighing of special conditions in each state—in some cases the conditions in individual manufacturing cities.

LOOMS.

Inasmuch as the American cotton manufacturing industry is essentially a weaving as well as a spinning industry, it follows naturally that the number of looms employed keeps pace practically with the corresponding number of spindles. Against an increase of 34 per cent in spindles, during the decade, there has been an increase of 38.7 per cent in the number of looms. In both cases, "cotton goods" only in 1900 are compared with all cotton manufactures, including "cotton small wares" in 1890. The total number of looms in 1900 was 450,682, compared with 324,866 in 1890. There was a numerical increase of 48,769 in New England, of 1,060 in the Middle states, of 73,744 in the Southern states, and of 2,243 in the Western states.

An analysis of the looms as classified in the following table brings out no important facts which are not deducible from other statistics here presented, but it is confirmatory of the inferences to be drawn from them. For example, it appears from the statement of looms operated upon fancy weaves, that there was an increase of 22,453 in the number of such looms, and that 12,735 of the increase was in New England mills and 7,673 in mills of the Middle states; which is in accordance with the fact of a large increase in the fine spinning and weaving of the one section and of a wonderful growth of the weaving of upholstery and similar goods in Philadelphia. On the other hand, of the great numerical increase of 73,744 looms in the Southern states, 66,130 represent plain looms of all widths, compared with an increase of 33,621 plain looms in the New England states. It is an interesting fact that the increase in the number of looms in the whole country operated in the weaving of goods more than 36 inches wide exceeds the increase in the number of looms making goods of less width.

TABLE 21.—COTTON GOODS, NUMBER AND CLASSIFICATION OF LOOMS, BY GEOGRAPHICAL DIVISIONS: 1890 AND 1900.

GEOGRAPHICAL DIVISIONS.	Year.	NUMBER OF LOOMS.								
		Total.	On plain cloths.				On twills and sateens.	On fancy weaves.	On tapes and other narrow goods.[1]	On bags and other special fabrics.
			Less than 28 inches wide.	28 to 32 inches wide.	32 to 36 inches wide.	36 inches wide and over.				
United States	1900	450,682	35,601	98,995	79,349	126,082	58,839	45,686	1,709	4,421
	1890	324,866	23,648	91,862	55,356	71,591	53,726	23,233	....	5,450
New England states	1900	298,885	16,765	77,326	37,722	84,916	47,080	31,635	1,586	1,855
	1890	250,116	12,609	72,928	35,063	62,508	46,346	18,900	....	1,762
Middle states	1900	36,134	6,442	3,023	3,501	8,035	3,403	10,031	123	1,576
	1890	35,074	5,196	10,601	3,628	5,708	4,930	2,358	....	2,653
Southern states	1900	110,010	12,374	17,930	34,446	32,323	8,356	3,856	....	725
	1890	36,266	5,803	8,309	13,956	2,875	2,442	1,975	....	906
Western states	1900	5,653	20	716	3,680	808	....	164	....	265
	1890	3,410	40	24	2,709	500	8	....	....	129

[1] Included with bags and other special fabrics in 1890.

Table 22 presents for 1900 the number and capacity of spinning mills, weaving mills, and mills which do both spinning and weaving, by states, geographically arranged.

Table 22 furnishes a basis for future comparisons, as well as showing the situation with respect to the operations carried on in the cotton mills of the United States. It will be seen from this table that, of the total number of establishments, more than half both spin and weave. In the matter of capacity the proportion is vastly greater, as 83.6 per cent of the spindles, and 96 per cent of the looms, are installed in what may be termed complete mills. Even these large proportions would be increased were the mills of the Middle states eliminated. More than one-third of all the spindles and looms in those states are in mills which spin only, and more than one-third of the looms in mills which weave only. This circumstance is due to the fact that half the product of New Jersey mills is sewing cotton, and that weaving is the principal feature of the industry in Pennsylvania. Excluding the Middle states, the percentage of spindles in spinning and weaving mills is 85 per cent and that of looms is almost 99 per cent. The figures for the Southern states indicate a tendency to erect yarn mills. In North Carolina more than two-fifths of the spindles are the equipment of such mills, and the proportion is large in some of the other Southern states also.

TABLE 22.—COTTON GOODS, NUMBER AND CAPACITY OF SPINNING MILLS, WEAVING MILLS, AND MILLS WHICH DO BOTH SPINNING AND WEAVING, BY STATES, GEOGRAPHICALLY ARRANGED: 1900.

STATES.	Number of establishments.	SPINNING AND WEAVING MILLS.			SPINNING MILLS.		WEAVING MILLS.		Number of establishments having no spindles or looms for spinning or weaving.
		Number.	Capacity.		Number.	Capacity.	Number.	Capacity.	
			Number of spindles.	Number of looms.		Number of spindles.		Number of looms.	
United States	973	502	15,882,095	432,959	274	3,126,257	168	17,723	29
New England states	332	223	11,233,326	295,710	76	1,617,661	17	3,175	16
Maine	15	13	837,021	23,229	1	4,500	1	137	......
New Hampshire	23	20	1,235,907	35,123	3	7,648	......	......	......
Vermont	5	3	81,576	2,099	2	18,452	......	......	......
Massachusetts	163	110	6,712,998	176,554	36	1,071,689	10	2,726	7
Rhode Island	71	44	1,469,404	39,366	20	411,218	3	106	4
Connecticut	55	33	896,420	19,339	14	104,154	3	206	5
Middle states	225	46	1,072,154	23,724	29	575,097	138	12,410	12
New York	34	14	626,040	14,110	7	94,228	10	435	3
New Jersey	20	3	101,688	1,576	4	330,042	10	650	3
Pennsylvania	154	17	168,810	4,791	17	137,827	114	11,024	6
Delaware	3	2	21,552	738	1	13,000	......	......	......
Maryland	14	10	154,064	2,509	......	......	4	301	......
Southern states	400	222	3,366,439	108,044	168	931,749	10	1,966	......
West Virginia	1	......	......	......	......	......	1	19	......
Virginia	7	7	126,827	4,608	......	......	......	......	......
North Carolina	177	75	649,442	23,992	94	483,990	8	1,477	......
South Carolina	80	57	1,304,181	42,193	22	127,168	1	470	......
Georgia	67	42	652,611	19,393	25	162,934	......	......	......
Kentucky	6	2	37,592	991	4	29,041	......	......	......
Tennessee	17	9	97,558	2,995	8	26,338	......	......	......
Alabama	31	18	325,560	8,549	13	85,768	......	......	......
Mississippi	6	5	73,872	2,464	1	1,250	......	......	......
Arkansas	2	2	9,700	257	......	......	......	......	......
Louisiana	2	2	55,600	1,584	......	......	......	......	......
Texas	4	3	33,496	1,018	1	15,260	......	......	......
Western states	16	11	210,176	5,481	1	1,750	3	172	1
Ohio	3	......	......	......	......	......	2	158	1
Indiana	4	4	102,488	2,712	......	......	......	......	......
Illinois	1	1	31,488	700	......	......	......	......	......
Wisconsin	3	2	21,496	577	......	......	1	14	......
Missouri	2	1	11,904	356	1	1,750	......	......	......
Nebraska	1	1	15,488	416	......	......	......	......	......
Colorado	1	1	17,312	480	......	......	......	......	......
California	1	1	10,000	240	......	......	......	......	......

MERCERIZATION.

During the past ten years the process known as mercerizing has been introduced, or, more strictly, reintroduced, as an adjunct of the cotton manufacturing industry. The process derives its name from its discoverer, John Mercer, an Englishman, who was born in 1791 and died in 1864. Mercer was a man of humble origin, by trade a handloom weaver, and self-taught. Entering a print works as an ordinary workman, he became interested in chemical processes, was made experimental chemist to the works, and in a short time introduced several new styles in calico printing. He was the first to prepare sulphated oil, which revolutionized the turkey-red industry; was the inventor of the blue-print photographic process, and even devised and improved several pharmaceutical preparations. In 1852 he was elected a Fellow of the Royal Society. About the year 1845 or 1846 appeared the first notice of the mercerizing process, and it was patented in 1850. It excited great attention at the first world's fair, in London, in 1851, and great commercial success was anticipated for it; but for various reasons it did not become successful in Mercer's lifetime, nor, in its original form, at any time.

The process of mercerizing, proper, consists in treating vegetable fiber, chiefly cotton, in the condition of yarn or of woven goods, to the action of caustic soda dissolved in water, and treating it subsequently with pure water and with dilute sulphuric acid for the purpose of washing out or extracting chemically the soda that remains in the yarn or fabric. The process effectuates both a chemical and a physical change in the constitution of the fiber. The wing of the cottonseed is pure cellulose, the chemical symbol of which is $C_{12}H_{20}O_{10}$—12 atoms of carbon, 20 of hydrogen, and 10 of oxygen. The caustic soda and the water in which it is held in solution unite with the cellulose; but the soda is afterward removed by washing with water and by "souring" with acid, and that which remains is hydrated cellulose—that is, cellulose combined with water. It is probably not strictly accurate to say that the cellulose and water are chemically combined, since the water contained may be removed by drying without restoring the cellulose to its original condition; but, on the other hand, after the desiccation the mercerized yarn or cloth will reabsorb water from the atmosphere naturally.

The structural change in the fiber is a marked one. The filament of cotton is a flattened tube or band, the sides of which are pressed closely together, leaving a central cavity which is enlarged at each edge of the flattened tube. It is opaque, and the surface is not smooth. The fiber has also a slight natural twist. All these characteristics are modified by the mercerizing process. The tube becomes rounded into cylindrical shape; the cavity is made smaller and the walls of the tube thicker; the surface is made smoother and the opacity is diminished; and the fiber acquires a spiral form. These are not the only physical changes introduced by the process, for there is a perceptible shrinkage in the length of either yarn or cloth treated by Mercer's formula. As will presently be noticed, the modern method overcomes the shrinkage, but as originally introduced the loss in linear dimension varied from 15 to 25 per cent. Moreover, the weight, and consequently the specific gravity, of the yarn or fabric is increased, as is also the strength of the material, this last gain varying from 35 to nearly 70 per cent, according to the conditions under which the mercerizing is done. Another important result of the process is that mercerized cotton has a much greater affinity for certain dyes and mordants than cotton which has not been so treated.

The changes heretofore mentioned were those which Mercer specified in his application for a patent. The chief advantages which he claimed were the greater strength of yarn or cloth and the greater affinity for dyes. These are not the advantages which have caused the reintroduction of the process. Reference has been made to the fact that mercerizing causes a contraction of the fiber and a loss of length. Advantage was taken of the shrinkage to produce crepon effects in cloth, particularly in union cloth, but it was not availed of to any large extent. It has been discovered, however, that if the mercerizing be done under tension—that is, if it be simply held from shrinking, but not stretched, while the material undergoing treatment is immersed in the caustic bath and while the alkali is being removed by water and acid—the fiber becomes more translucent, the surface smoother, and the yarn or woven goods treated acquire a luster similar, and not greatly inferior, to that of silk. The same result can be produced by stretching the material operated upon to its original length immediately after it has been subjected to the caustic bath, and before it has lost its pliable condition. The acquisition of a glossy appearance by mercerized goods was noticed in the early days of the process, but it is only recently that the increased luster imparted by holding the material from shrinking caused a revival of the manufacture.

The improved process in mercerization while the goods are in a state of tension is the subject of protracted patent litigation which has not yet been brought to a decision. The process itself is a simple one, but must be conducted with great care. As applied to yarn it consists in passing it through the bath between rollers which prevent all contraction, and then through the water bath and a weak solution of sulphuric acid under the same conditions. The rollers serve also the purpose of squeezing out the caustic, the water, and the acid, and so facilitating and rendering complete the removal of all chemicals which might cause a contraction after the tension is relaxed.

The uses to which mercerized material may be put are various. The process has not been applied with success to ordinary upland cotton, but only to Egyptian and sea-island cotton, which are naturally somewhat silky. These are the varieties of cotton which are employed in the production of underwear and the finest of woven goods, which are made much more beautiful by the luster imparted as well as by the brilliancy of the dyeing. It is believed, however, that the fact that mercerized yarn loses something of elasticity in gaining strength, is against its general availability in the manufacture of hosiery and knit goods.

The amount of yarn mercerized in cotton mills during the census year was 809,468 pounds. In dyeing and finishing establishments 868,851 pounds of yarn and 7,973,506 square yards of cloth were mercerized. The total additional value given to yarn and cloth by mercerizing, in all establishments, was $679,490.

Table 23 presents a comparative summary of the entire industry, cotton goods and cotton small wares, by states and territories, geographically arranged for the several censuses from 1840 to 1900, inclusive; and Table 24 presents the detailed statistics of cotton goods for 1900.

TABLE 23.—COMPARATIVE SUMMARY, COTTON GOODS AND COTTON SMALL WARES,

		Year.	Number of establishments.	Capital.	Salaried officials, clerks, etc.: Number.	Salaried officials, clerks, etc.: Salaries.	Average number of wage-earners and total wages: Total: Average number.	Total: Wages.	Men, 16 years and over.	Women, 16 years and over.	Children, under 16 years.
1	United States	1900	1,055	$467,240,157	4,902	$7,350,199	302,861	$86,689,752	135,721	126,882	40,258
		1890	905	354,020,843	[1]2,709	[1]3,464,734	218,876	66,024,538	88,837	106,607	23,432
		1880	756	208,280,346	(2)	(2)	[3]174,659	42,040,510	61,760	84,558	28,341
		1870	956	140,706,291	(2)	(2)	135,369	39,044,132	42,790	69,637	22,942
		1860	1,091	98,585,269	(2)	(2)	122,028	23,940,108	46,859	75,169	(2)
		1850	1,094	74,500,931	(2)	(2)	92,286	(5)	33,150	59,136	(2)
		1840	1,240	51,102,359	(2)	(2)	72,119	(4)	(2)	(2)	(2)
2	New England states	1900	364	276,089,821	2,061	3,806,248	164,944	56,258,205	79,014	74,882	11,048
		1890	402	243,153,249	1,359	2,075,648	147,369	47,832,943	63,749	73,445	10,165
		1880	439	156,754,690	...	...	127,185	32,170,861	46,897	62,568	17,720
		1870	508	100,103,770	...	...	94,775	28,740,788	30,203	50,805	13,767
		1860	570	69,260,279	...	...	81,403	16,720,920	29,886	51,517	...
		1850	564	53,832,430	...	...	61,893	...	20,745	41,148	...
		1840	674	34,931,399	...	...	46,834	...	...	...	...
3	Maine	1900	15	21,087,190	100	231,815	13,723	4,330,297	6,197	6,760	766
		1890	23	20,850,754	80	158,950	13,912	4,213,523	5,193	7,856	863
		1880	24	15,292,078	...	...	11,864	2,936,640	3,962	6,481	1,421
		1870	23	9,839,685	...	...	9,439	2,565,197	2,606	6,246	587
		1860	19	6,018,325	...	...	6,764	1,368,888	1,828	4,936	...
		1850	12	3,329,700	...	...	3,739	...	780	2,959	...
		1840	6	1,398,000	...	...	1,414	...	...	...	...
4	New Hampshire	1900	23	29,261,835	175	370,777	20,454	6,759,422	9,229	10,362	863
		1890	27	26,801,933	150	186,880	19,383	6,242,204	8,144	10,345	894
		1880	36	19,877,084	...	...	16,529	4,290,960	5,235	9,596	1,698
		1870	36	13,332,710	...	...	12,542	3,989,853	3,752	7,490	1,300
		1860	44	12,586,880	...	...	12,730	2,883,804	3,829	8,901	...
		1850	44	10,950,500	...	...	12,122	...	2,911	9,211	...
		1840	58	5,523,200	...	...	6,991	...	...	...	...
5	Vermont	1900	5	1,932,983	20	26,579	1,015	259,758	438	495	82
		1890	6	1,431,986	13	16,204	724	204,538	325	309	90
		1880	7	936,096	...	...	735	161,748	214	350	171
		1870	8	670,000	...	...	451	125,000	125	242	84
		1860	8	271,200	...	...	379	78,468	157	222	...
		1850	9	202,500	...	...	241	...	94	147	...
		1840	7	118,100	...	...	262	...	...	...	...
6	Massachusetts	1900	177	156,289,451	1,104	2,046,052	92,615	32,478,697	45,245	41,298	5,972
		1890	187	128,838,837	669	1,112,302	75,544	25,118,365	33,101	38,352	4,091
		1880	175	72,291,601	...	...	61,844	15,828,571	22,774	31,497	7,573
		1870	191	44,714,375	...	...	43,512	13,589,305	13,694	24,065	5,753
		1860	217	33,704,674	...	...	38,451	7,798,476	13,691	24,760	...
		1850	213	28,455,630	...	...	28,730	...	9,293	19,437	...
		1840	278	17,414,099	...	...	20,928	...	...	...	...
7	Rhode Island	1900	87	40,150,824	380	734,465	24,032	8,033,007	10,980	10,619	2,433
		1890	94	38,798,161	256	316,375	24,576	7,814,767	10,507	10,887	3,182
		1880	115	28,047,331	...	...	21,474	6,320,303	8,344	9,199	3,931
		1870	139	18,836,300	...	...	16,745	5,224,650	5,583	8,028	3,134
		1860	153	10,052,200	...	...	14,077	2,847,804	6,363	7,724	...
		1850	158	6,675,000	...	...	10,875	...	4,959	5,916	...
		1840	209	7,326,000	...	...	12,086	...	...	...	...
8	Connecticut	1900	57	27,367,538	282	396,860	13,205	4,397,024	6,925	5,348	932
		1890	65	26,431,678	191	284,937	13,220	4,239,546	6,479	5,696	1,045
		1880	82	20,310,500	...	...	14,739	3,632,639	6,368	5,445	2,926
		1870	111	12,710,700	...	...	12,086	3,246,783	4,443	4,734	2,909
		1860	129	6,627,000	...	...	9,002	1,743,480	4,028	4,974	...
		1850	128	4,219,100	...	...	6,186	...	2,708	3,478	...
		1840	116	3,152,000	...	...	5,153	...	...	...	...
9	Middle states	1900	272	61,985,519	1,016	1,423,138	37,050	12,058,932	16,012	17,584	4,454
		1890	239	51,676,249	503	579,284	31,841	10,184,589	11,580	16,240	4,021
		1880	139	31,014,759	...	...	28,367	6,613,260	9,161	13,188	6,018
		1870	274	27,723,306	...	...	28,974	7,994,470	8,466	14,126	6,382
		1860[6]	340	18,789,069	...	...	29,078	5,464,772	12,212	16,866	...
		1850[6]	352	12,970,445	...	...	19,699	...	8,274	11,425	...
		1840	298	11,583,882	...	...	18,187	...	...	...	...
10	New York	1900	52	15,060,149	198	263,160	9,259	2,745,848	4,240	4,208	811
		1890	42	13,290,745	85	115,699	8,316	2,448,031	3,246	4,034	1,036
		1880	36	11,399,638	...	...	9,305	1,994,755	3,012	4,201	2,092
		1870	81	8,511,336	...	...	9,144	2,626,131	2,608	4,546	1,990
		1860	79	5,383,479	...	...	7,659	1,405,292	3,107	4,552	...
		1850	86	4,176,920	...	...	6,320	...	2,632	3,688	...
		1840	117	4,900,772	...	...	7,407	...	...	...	...
11	New Jersey	1900	25	14,399,291	157	269,278	5,681	1,930,940	2,144	2,869	668
		1890	17	13,519,972	51	69,623	5,632	1,984,659	1,828	3,391	413
		1880	17	3,807,750	...	...	4,222	1,156,961	1,223	2,291	708
		1870	27	2,762,000	...	...	3,514	1,009,351	1,086	1,745	683
		1860	44	1,320,550	...	...	2,534	468,336	1,010	1,524	...
		1850	21	1,483,500	...	...	1,712	...	616	1,096	...
		1840	43	1,722,810	...	...	2,408	...	...	...	...
12	Pennsylvania	1900	178	24,331,965	565	741,923	17,011	6,057,286	7,074	8,120	1,817
		1890	158	15,884,936	294	299,071	12,666	4,388,017	4,991	6,258	1,417
		1880	59	10,331,985	...	...	9,957	2,502,688	3,413	4,457	2,087
		1870	138	12,550,720	...	...	12,730	3,496,986	3,859	6,097	2,774
		1860	185	9,203,040	...	...	14,994	2,768,340	6,412	8,582	...
		1850	208	4,528,925	...	...	7,663	...	3,564	4,099	...
		1840	106	3,325,400	...	...	5,522	...	...	...	...

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 24.)
[2] Not reported separately.
[3] Includes 2,115 officers and clerks for whom no salaries are reported.

MACHINERY. Spindles.	MACHINERY. Looms.	Miscellaneous expenses.	MATERIALS USED. Total cost.	MATERIALS USED. Cotton. Bales.	MATERIALS USED. Cotton. Pounds.	MATERIALS USED. Cotton. Cost.	All other materials.	Value of products.	
19,050,952	455,752	$22,112,678	$176,551,527	3,646,708	1,817,643,390	$125,169,616	$51,381,911	$339,200,320	1
14,188,103	824,866	16,716,524	154,912,979	2,261,600	1,117,945,776	117,392,576	37,520,403	267,981,724	
10,653,435	225,759	(4)	102,206,347	1,570,344	750,343,981	86,945,725	15,260,622	192,090,110	
7,132,415	157,310	(4)	111,736,936	(4)	398,308,257	(2)	(2)	177,489,739	
5,235,727	126,313	(4)	57,285,534	(4)	422,704,975	(2)	(2)	115,681,774	
(4)	(4)	(4)	34,835,056	641,240	(4)	(2)	(2)	61,869,184	
2,284,631	(4)	(4)	(4)	(4)	(4)	(4)	(4)	46,350,453	
12,891,787	302,018	18,286,637	93,147,668	1,829,678	940,908,114	66,039,133	27,108,535	191,690,913	2
10,836,155	250,116	12,086,430	101,101,446	1,425,958	714,691,714	76,749,130	24,352,316	181,112,453	
8,632,087	184,701		74,290,026	1,129,498	541,373,880	63,169,434	11,120,592	143,363,030	
5,498,308	114,982		78,816,481		275,625,278		(2)	124,959,053	
3,858,962	93,344		37,670,782		283,701,306		(2)	79,359,900	
			23,800,904	430,603			(2)	42,040,178	
1,597,394							(4)	31,611,880	
841,521	23,366	1,440,425	7,036,287	157,428	79,765,573	5,463,293	1,572,994	14,631,086	3
885,762	21,825	1,185,336	8,446,736	132,504	65,717,252	7,053,168	1,393,568	15,316,909	
695,924	15,971		7,320,152	112,381	54,185,061	6,234,901	1,085,251	13,319,363	
459,772	9,902		6,746,780		25,887,771		(2)	11,844,181	
281,056	6,877		3,319,335		23,733,165		(2)	6,235,623	
			1,573,110	31,531			(2)	2,596,356	
29,736							(4)	970,397	
1,243,555	35,123	1,502,420	11,960,102	271,629	136,988,647	9,413,526	2,546,576	22,998,249	4
1,195,643	31,850	1,340,222	12,962,939	214,034	107,319,124	11,203,742	1,759,197	21,958,002	
944,053	24,299		10,146,904	157,673	76,386,499	8,629,063	1,517,841	17,953,403	
749,843	19,091		12,318,867		41,469,719		(2)	16,999,672	
636,788	17,336		7,128,196		51,002,324		(2)	13,699,994	
			4,839,429	83,026			(2)	8,830,619	
195,173							(4)	4,142,304	
100,028	2,099	43,282	526,235	13,048	6,828,403	432,455	93,780	999,886	5
71,591	1,175	59,893	542,065	8,954	4,647,389	498,348	43,717	914,685	
55,081	1,180		508,297	7,404	3,562,088	458,607	49,690	855,864	
28,768	628		292,269		1,235,652		(2)	546,510	
17,600	362		181,030		1,447,250		(2)	357,450	
			114,416	2,243			(2)	196,100	
7,254							(4)	113,000	
7,784,687	179,582	7,275,111	54,389,045	1,085,236	560,984,204	38,916,998	15,472,047	111,125,175	6
5,824,518	133,227	6,675,285	56,586,283	772,520	386,767,326	40,870,307	15,715,976	100,202,882	
4,236,084	95,321		35,994,109	574,857	273,718,889	31,107,154	4,886,955	72,289,618	
2,619,541	55,343		37,371,599		130,654,040		(2)	59,493,153	
1,673,498	42,779		17,214,592		134,012,759		(2)	38,004,255	
			11,289,309	223,607			(2)	19,712,461	
665,095							(4)	16,553,423	
1,920,522	42,298	1,736,590	11,697,461	193,226	99,475,478	7,386,339	4,311,122	26,435,675	7
1,924,486	43,106	1,871,057	14,347,672	193,291	97,982,155	11,147,080	3,200,592	27,310,499	
1,764,569	29,669		12,291,437	167,480	81,137,172	10,457,770	1,833,667	22,875,111	
1,043,242	18,075		13,268,316		44,630,787		(2)	22,049,203	
814,554	17,315		5,799,223		41,614,797		(2)	12,151,191	
			3,484,579	50,713			(2)	6,447,120	
518,817							(4)	7,116,792	
1,001,474	19,550	1,288,809	7,538,538	109,111	56,865,809	4,426,522	3,112,016	15,500,842	8
934,155	18,933	954,637	8,215,751	104,655	52,257,968	5,976,485	2,239,266	15,409,476	
936,376	18,261		8,029,127	109,703	52,384,171	6,281,939	1,747,188	16,069,771	
597,142	11,943		8,818,651		31,747,309		(2)	14,026,334	
435,466	8,675		4,028,406		31,891,011		(2)	8,911,387	
			2,500,062	39,483			(2)	4,257,522	
181,319							(4)	2,715,964	
1,647,251	38,060	3,832,839	25,280,096	292,288	145,353,968	10,596,029	14,684,067	48,961,806	9
1,633,722	35,074	2,088,631	23,044,093	261,154	128,184,288	13,906,748	9,137,345	40,664,476	
1,391,164	27,318		16,191,758	228,729	109,321,428	13,258,526	2,933,232	29,389,286	
1,246,045	34,974		23,793,595		80,937,966		(2)	38,597,765	
1,042,480	25,185		13,928,671		87,113,715		(2)	26,634,700	
			7,349,795	125,392			(2)	12,782,718	
487,571							(4)	12,222,200	
720,268	14,737	943,848	5,718,295	102,590	52,243,049	3,743,267	1,975,028	10,788,003	10
606,796	13,466	724,405	5,564,251	78,824	39,522,057	4,270,665	1,293,586	9,777,295	
561,658	12,403		4,652,745	64,614	31,656,594	3,981,106	671,639	8,266,836	
492,573	17,218		6,990,626		24,783,351		(2)	11,178,211	
348,584	7,885		3,061,105		23,945,627		(2)	6,676,878	
			1,985,973	37,778			(2)	3,691,989	
211,659							(4)	3,640,237	
431,730	2,276	428,384	3,157,768	29,644	15,287,868	1,411,743	1,746,025	6,930,766	11
374,442	3,673	194,474	3,028,933	25,723	12,301,151	1,816,468	1,212,465	5,902,615	
232,221	3,180		2,018,175	21,069	9,950,609	1,319,422	698,753	4,548,275	
200,580	2,176		1,964,758		7,920,035		(2)	4,015,768	
123,548	1,567		1,165,435		9,094,649		(2)	2,217,728	
			666,645	14,437			(2)	1,109,524	
63,744							(4)	2,086,104	
306,637	17,499	2,057,143	13,176,718	76,425	36,549,533	2,690,532	10,486,186	25,447,697	12
439,638	13,974	730,125	10,435,247	92,705	44,629,588	4,371,693	6,113,554	18,431,773	
425,391	8,488		6,105,700	83,997	40,311,809	4,749,428	1,356,272	11,021,054	
434,246	12,862		10,724,052		32,953,318		(2)	17,490,080	
476,979	12,994		7,386,213		37,496,203		(2)	13,650,114	
			3,152,530	44,162			(2)	5,322,262	
146,494							(4)	5,013,007	

[4] Not reported.
[5] This item was not fully reported at the census of 1850.
[6] Includes 1 establishment in the District of Columbia which is not shown separately.

TABLE 23.—COMPARATIVE SUMMARY, COTTON GOODS AND COTTON SMALL WARES,

		Year.	Number of establishments.	Capital.	Salaried officials, clerks, etc.		Average number of wage-earners and total wages.				
					Number.	Salaries.	Total. Average number.	Total. Wages.	Men, 16 years and over.	Women, 16 years and over.	Children, under 16 years.
	Middle states—Continued.										
13	Delaware	1900	3	$484,858	11	$15,449	372	$138,844	108	222	42
		1890	7	1,683,803	16	15,982	971	308,346	266	488	217
		1880	8	874,570			797	192,727	243	362	192
		1870	6	1,165,000			726	190,069	225	286	215
		1860	11	582,500			1,109	220,224	520	589	
		1850	12	460,100			838		413	425	
		1840	11	330,500			566				
14	Maryland[3]	1900	14	7,709,256	84	133,338	4,727	1,186,014	1,446	2,165	1,116
		1890	15	7,296,793	57	78,909	4,256	1,055,536	1,249	2,069	938
		1880	19	4,600,816			4,086	766,129	1,270	1,877	939
		1870	22	2,734,250			2,860	671,933	688	1,452	720
		1860	21	2,299,500			2,782	602,580	1,163	1,619	
		1850	25	2,321,000			3,166		1,049	2,117	
		1840	21	1,304,400			2,284				
15	Southern states	1900	401	124,596,874	1,760	2,013,362	97,559	17,509,189	40,555	32,545	24,459
		1890	239	53,827,303	753	700,204	36,415	7,116,865	12,517	15,083	8,815
		1880	161	17,375,897			16,741	2,750,986	5,056	7,587	4,098
		1870	151	11,088,315			10,173	1,929,779	3,640	4,190	2,343
		1860	165	9,840,221			10,152	1,481,704	4,113	6,039	
		1850	166	7,256,056			10,043		3,886	6,157	
		1840	248	4,331,078			6,642				
16	Virginia	1900	7	4,403,206	32	50,387	2,931	668,556	1,280	1,000	651
		1890	9	2,966,889	29	32,831	1,990	373,993	563	951	476
		1880	8	1,190,100			1,112	169,789	301	530	281
		1870	11	1,128,000			1,741	229,750	921	507	313
		1860	16	1,367,543			1,441	260,856	694	747	
		1850	27	1,908,900			2,963		1,275	1,688	
		1840	22	1,299,020			1,816				
17	North Carolina	1900	177	33,011,516	669	586,730	30,273	5,127,087	12,780	10,364	7,129
		1890	91	10,775,134	227	170,264	8,515	1,475,932	2,788	3,656	2,071
		1880	49	2,855,800			3,343	439,659	875	1,727	741
		1870	33	1,030,900			1,453	182,951	258	916	279
		1860	39	1,272,750			1,755	189,744	440	1,315	
		1850	28	1,058,800			1,619		442	1,177	
		1840	25	995,300			1,219				
18	South Carolina	1900	80	39,258,946	415	537,193	30,201	5,066,840	13,418	8,673	8,110
		1890	34	11,141,833	121	136,080	8,071	1,510,494	2,849	3,070	2,152
		1880	14	2,776,100			2,053	380,844	696	772	585
		1870	12	1,337,000			1,123	257,680	289	508	326
		1860	17	801,825			891	123,300	342	549	
		1850	18	857,200			1,019		399	620	
		1840	15	617,450			570				
19	Georgia	1900	68	24,222,169	338	435,201	18,348	3,574,492	7,336	6,512	4,500
		1890	53	17,664,675	216	199,049	10,314	2,167,036	3,849	4,005	2,460
		1880	40	6,348,657			6,349	1,135,184	1,987	2,951	1,411
		1870	34	3,433,265			2,846	611,868	1,147	1,080	619
		1860	33	2,126,103			2,813	415,332	1,131	1,682	
		1850	35	1,736,156			2,272		873	1,399	
		1840	19	573,835			779				
20	Kentucky	1900	6	1,867,605	24	33,761	1,351	280,407	430	591	330
		1890	5	1,376,132	16	18,466	818	170,573	268	372	178
		1880	3	360,000			352	63,850	128	91	133
		1870	5	405,000			269	57,951	77	71	121
		1860	6	244,000			246	41,280	130	116	
		1850	8	239,000			402		181	221	
		1840	58	316,113			523				
21	Tennessee	1900	17	3,767,726	47	54,364	2,108	422,935	807	918	383
		1890	20	2,928,657	50	50,865	2,124	444,573	670	997	457
		1880	16	1,145,600			1,044	161,071	311	502	231
		1870	28	970,650			890	178,156	252	463	175
		1860	30	965,000			899	139,180	323	576	
		1850	33	669,600			891		310	581	
		1840	38	463,240			1,542				
22	Alabama	1900	31	11,638,757	159	197,700	8,332	1,482,226	3,152	2,743	2,437
		1890	13	2,853,015	49	44,265	2,088	402,908	735	852	501
		1880	16	1,246,500			1,490	239,998	426	631	433
		1870	13	931,000			1,032	216,679	303	445	284
		1860	14	1,316,000			1,312	198,408	543	769	
		1850	12	651,900			715		346	369	
		1840	14	35,575			82				
23	Mississippi	1900	6	2,209,749	46	60,212	1,675	339,646	526	683	466
		1890	9	2,053,743	30	26,984	1,154	263,997	450	398	306
		1880	8	1,122,140			722	133,214	208	313	206
		1870	5	751,500			265	61,833	78	88	99
		1860	4	230,000			215	36,264	106	109	
		1850	2	38,000			36		19	17	
		1840	53	6,420			81				
24	Arkansas	1900[4]									
		1890[4]									
		1880	2	75,000			64	7,339	20	17	27
		1870	2	13,000			17	4,100	8	3	6
		1860	2	37,000			25	4,428	14	11	
		1850	3	16,500			31		13	18	
		1840	2	2,125			7				

[1] Not reported separately.

[2] Not reported.

BY STATES AND TERRITORIES, GEOGRAPHICALLY ARRANGED: 1840 TO 1900—Continued.

MACHINERY.		Miscellaneous expenses.	MATERIALS USED.				All other materials.	Value of prducts.	
			Total cost.	Cotton.					
Spindles.	Looms.			Bales.	Pounds.	Cost.			
34,552	738	$6,448	$187,919	2,675	1,371,563	$106,358	81,561	$372,089	
53,916	996	85,149	587,646	8,876	4,465,825	475,490	112,156	1,095,001	
46,188	822		527,205	7,512	8,236,184	427,855	99,350	871,007	
29,534	771		704,733		2,587,615		(1)	1,060,898	13
38,974	986		570,102		3,403,000		(1)	941,703	
			312,068	4,730			(1)	588,439	
24,492							(2)	332,272	
154,064	2,810	397,016	3,039,396	80,954	39,901,955	2,644,129	395,267	5,423,251	
158,930	2,965	354,478	3,378,016	55,026	27,265,667	2,972,482	405,584	5,457,792	
125,706	2,425		2,887,933	51,537	24,166,232	2,780,715	107,218	4,682,114	
89,112	1,947		3,409,426		12,693,647		(1)	4,852,808	14
54,395	1,753		1,745,816		13,174,236		(1)	3,048,277	
			1,232,579	24,285			(1)	2,220,504	
41,182							(2)	1,150,580	
4,299,988	110,015	4,788,860	56,195,213	1,479,006	707,842,111	47,071,449	9,123,764	95,002,059	
1,554,000	36,266	2,257,660	27,764,055	526,856	250,837,646	24,508,776	3,255,279	41,513,711	
542,048	11,898		9,999,145	182,349	84,528,757	8,890,408	1,108,737	16,356,598	
327,871	6,256		7,419,010		34,351,195		(1)	11,372,186	15
298,551	6,789		4,954,126		45,786,510		(1)	8,460,337	
			3,332,631	78,140			(1)	6,464,488	
180,927							(2)	2,241,595	
126,827	4,608	135,173	1,412,332	38,118	17,832,465	1,154,215	258,117	2,655,002	
94,294	2,517	102,565	1,199,578	22,731	10,616,206	1,080,773	118,805	1,732,648	
44,340	1,322		640,391	11,461	5,087,519	601,796	38,595	1,040,962	
77,116	1,310		937,820		4,255,383		(1)	1,435,800	16
49,440	2,160		811,187		7,544,297		(1)	1,489,971	
			828,375	17,785			(1)	1,486,384	
42,262							(2)	446,063	
1,133,482	25,469	1,030,918	17,386,624	404,535	190,138,759	13,627,720	3,758,904	28,372,798	
337,786	7,254	423,324	6,239,902	114,371	53,546,289	5,396,974	842,928	9,563,443	
92,385	1,790		1,463,645	27,642	11,832,641	1,125,984	337,661	2,554,482	
39,897	618		963,809		4,238,276		(1)	1,345,052	17
41,884	761		622,363		5,540,738		(1)	1,046,047	
			531,903	13,617			(1)	831,342	
47,934							(2)	438,900	
1,431,349	42,663	1,507,824	17,263,882	485,234	230,053,807	14,929,546	2,334,336	29,723,919	
332,784	8,546	528,208	6,819,320	133,342	64,000,600	6,242,598	576,722	9,800,798	
82,334	1,676		1,808,300	33,624	15,601,065	1,723,187	85,113	2,895,769	
34,940	745		761,469		4,756,823		(1)	1,529,937	18
30,890	525		431,525		3,978,061		(1)	713,050	
			295,971	9,929			(1)	748,338	
16,355							(2)	359,000	
817,345	19,398	1,050,088	11,169,700	304,431	145,833,115	9,702,798	1,466,902	18,544,910	
445,452	10,459	724,822	7,832,230	145,859	69,139,410	6,663,560	1,168,670	12,035,629	
198,656	4,493		4,019,673	71,389	33,757,199	3,591,554	428,119	6,481,894	
85,602	1,887		2,504,758		10,921,176		(1)	3,648,973	19
85,186	2,041		1,466,375		13,907,904		(1)	2,371,207	
			900,419	20,230			(1)	2,135,044	
42,589							(2)	304,342	
66,633	991	105,796	972,244	23,982	11,971,815	770,363	201,881	1,663,712	
42,942	677	60,200	643,949	11,980	5,751,305	554,206	89,743	1,000,668	
9,022	73		253,818	4,050	1,882,234	188,856	64,962	418,286	
7,734	72		375,048		1,584,625		(1)	498,960	20
8,192	76		214,755		1,826,000		(1)	315,270	
			180,907	3,760			(1)	273,439	
12,358							(2)	329,380	
123,896	2,995	142,878	1,143,234	30,273	15,040,336	984,309	158,925	1,994,935	
97,524	2,043	173,853	1,765,162	33,114	15,779,360	1,554,851	210,311	2,507,719	
35,736	818		553,761	10,436	4,944,279	508,305	45,456	874,717	
27,923	313		595,789		2,872,582		(1)	941,542	21
29,850	243		384,548		4,072,710		(1)	698,122	
			297,500	6,411			(1)	510,624	
16,813							(2)	325,719	
411,328	8,549	511,296	4,825,981	134,371	67,987,299	4,206,721	619,260	8,153,136	
79,234	1,692	154,893	1,459,048	29,962	14,726,454	1,372,058	86,990	2,190,771	
49,432	863		783,711	14,702	7,271,791	729,202	54,509	1,228,019	
28,046	632		764,965		3,249,523		(1)	1,088,767	22
35,740	623		617,633		5,246,800		(1)	1,040,147	
			237,081	5,208			(1)	382,260	
1,502							(2)	17,547	
75 122	2,464	117,117	767,327	20,962	10,363,458	623,576	143,751	1,472,835	
57,004	1,352	57,622	871,970	17,366	8,449,834	793,600	78,370	1,333,398	
18,568	644		337,149	6,411	2,881,853	301,226	35,923	679,093	
3,526	152		123,568		580,764		(1)	234,445	23
6,344	90		79,800		698,800		(1)	176,328	
			21,500	430			(1)	30,500	
318							(2)	1,744	
2,015	28		33,305	680	340,000	25,000	8,305	50,000	
1,125			13,780		66,400		(1)	22,562	24
			11,600		187,500		(1)	23,000	
			8,975	170			(1)	16,637	
90							(2)		

[3] Maryland and the District of Columbia are combined in this table as Middle states for purposes of comparison.
[4] Included in "All other Southern states."

TABLE 23.—COMPARATIVE SUMMARY, COTTON GOODS AND COTTON SMALL WARES,

		Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		AVERAGE NUMBER OF WAGE-EARNERS AND TOTAL WAGES.				
							Total.		Men, 16 years and over.	Women, 16 years and over.	Children under 16 years.
					Number.	Salaries.	Average number.	Wages.			
		1900[1]	...	...	...	...	...	...	...	...	...
		1890[1]	...	...	...	...	...	...	...	...	...
	Southern states—Continued.	1880	2	$195,000	...	...	108	$12,572	43	41	24
25	Louisiana	1870	4	592,000	...	...	246	60,600	123	57	66
		1860	2	1,000,000	...	...	360	49,440	220	140	...
		1850[4]	...	...	...	...	...	...	...	...	...
		1840	2	22,000	...	...	23	...	...	...	...
		1900	4	2,227,184	21	$31,388	984	253,630	497	302	185
		1890[1]	...	...	...	...	...	...	...	...	...
		1880	2	50,000	...	...	71	2,466	45	10	16
26	Texas	1870	4	496,000	...	...	291	68,211	184	52	55
		1860	1	450,000	...	...	130	15,600	130	...	...
		1850[4]	...	...	...	...	...	...	...	...	...
		1840[4]	...	...	...	...	...	...	...	...	...
		1900[5]	5	1,990,016	19	26,426	1,356	293,470	329	759	268
		1890	5	2,067,225	15	21,400	1,341	307,359	345	782	214
		1880	1	11,000	...	...	33	5,000	21	2	10
27	All other Southern states	1870[4]	...	...	...	...	...	...	...	...	...
		1860	1	30,000	...	...	65	7,872	40	25	...
		1850	(5)	80,000	...	...	95	...	28	67	...
		1840[4]	...	...	...	...	...	...	...	...	...
		1900	18	4,567,943	66	107,451	3,308	863,426	1,140	1,871	297
		1890	25	5,364,042	94	109,598	3,261	890,141	991	1,839	431
		1880	17	3,135,000	...	...	2,366	505,403	646	1,215	505
28	Western states	1870	23	1,790,900	...	...	1,447	379,095	481	516	450
		1860	16	695,700	...	...	1,395	272,712	648	747	...
		1850	12	442,000	...	...	651	...	245	406	...
		1840	20	256,000	...	...	456	...	...	...	...
		1900	4	172,661	13	11,666	109	29,076	27	82	...
		1890	7	1,213,217	30	32,144	554	161,613	235	312	7
		1880	4	670,000	...	...	484	104,500	126	321	37
29	Ohio	1870	7	555,700	...	...	462	113,520	216	147	99
		1860	8	265,000	...	...	840	151,164	372	468	...
		1850	8	297,000	...	...	401	...	132	269	...
		1840	8	113,500	...	...	246	...	...	...	...
		1900	5	1,679,741	19	34,964	1,428	325,749	377	1,001	50
		1890	6	1,744,720	16	22,334	1,309	310,342	325	749	235
		1880	4	1,090,000	...	...	720	162,829	205	391	124
30	Indiana	1870	4	551,500	...	...	504	113,200	119	179	206
		1860	2	251,000	...	...	367	84,888	177	190	...
		1850	2	43,000	...	...	95	...	38	57	...
		1840	12	142,500	...	...	210	...	...	...	...
		1900	3	467,808	5	5,220	347	80,567	131	191	25
		1890	4	892,509	11	11,300	490	131,170	198	239	53
		1880	1	200,000	...	...	271	67,209	66	149	56
31	Wisconsin	1870[4]	...	...	...	...	...	...	...	...	...
		1860[4]	...	...	...	...	...	...	...	...	...
		1850[4]	...	...	...	...	...	...	...	...	...
		1840	...	...	...	...	...	...	...	...	...
		1900[3]	...	...	...	...	...	...	...	...	...
		1890	4	766,405	24	26,400	430	123,986	112	280	38
		1880	2	240,000	...	...	237	47,885	66	89	82
32	Illinois	1870	5	151,000	...	...	98	25,500	26	31	41
		1860	3	4,700	...	...	11	2,640	10	1	...
		1850[4]	...	...	...	...	...	...	...	...	...
		1840[4]	...	...	...	...	...	...	...	...	...
		1900[3]	...	...	...	...	...	...	...	...	...
		1890[3]	...	...	...	...	...	...	...	...	...
		1880	3	890,000	...	...	515	97,680	127	207	181
33	Missouri	1870	3	489,200	...	...	361	120,300	107	154	100
		1860	2	169,000	...	...	170	30,600	85	85	...
		1850	2	102,000	...	...	155	...	75	80	...
		1840[4]	...	...	...	...	...	...	...	...	...
		1900[4]	...	...	...	...	...	...	...	...	...
		1890[4]	...	...	...	...	...	...	...	...	...
		1880	1	20,000	...	...	29	2,100	16	8	5
34	Utah	1870	3	42,000	...	...	16	6,300	10	2	4
		1860	1	6,000	...	...	7	3,420	4	3	...
		1850[4]	...	...	...	...	...	...	...	...	...
		1840[4]	...	...	...	...	...	...	...	...	...
		1900	6	2,247,733	29	55,601	1,424	428,034	605	597	222
		1890	4	747,191	13	17,420	478	163,030	121	259	98
35	All other Western states[2]	1880	2	25,000	...	...	110	23,200	40	50	20
		1870	1	1,500	...	...	6	275	3	3	...
		1860[4]	...	...	...	...	...	...	...	...	...

[1] Included in "All other Southern states."
[2] Not reported separately.
[3] Not reported.
[4] No establishments reported.
[5] Includes states grouped in order that the operations of individual establishments may not be disclosed. These establishments are distributed as follows: 1900, Arkansas, 2; Louisiana, 2; West Virginia, 1. 1890, Arkansas, 2; Louisiana, 2; Texas, 1. 1880, Florida, 1. 1860, Florida, 1. 1850, Florida, number of establishments not reported.

BY STATES AND TERRITORIES, GEOGRAPHICALLY ARRANGED: 1840 TO 1900—Continued.

MACHINERY.		Miscellaneous expenses.	MATERIAL USED.				All other materials.	Value of products.	
			Total cost.	Cotton.					
Spindles.	Looms.			Bales.	Pounds.	Cost.			
...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	
6,096	120	...	$72,470	1,358	644,000	$68,018	4,452	86,776	
13,084	292	...	161,485	...	748,525	...	(2)	251,550	25
6,725	150	...	226,600	...	1,995,700	...	(2)	466,500	
706	...	...	...	...	...	...	(2)	...	
...	...	...	...	...	...	...	(8)	18,900	
48,756	1,018	$113,156	641,341	18,045	9,304,434	566,517	74,824	1,199,990	
...	...	...	...	...	...	...	...	...	
2,648	71	...	14,827	246	119,986	11,280	3,547	21,600	
8,878	235	...	216,519	...	1,077,118	...	(2)	374,598	26
2,700	100	...	64,140	...	588,000	...	(2)	80,695	
...	...	...	...	...	...	...	(2)	...	
...	...	...	...	...	...	...	(8)	...	
65,300	1,860	74,614	612,548	19,055	9,316,623	505,684	106,864	1,220,822	
66,980	1,726	32,173	932,896	18,131	8,828,188	850,156	82,740	1,348,637	
816	...	...	18,095	350	166,250	16,000	2,095	25,000	
...	...	...	...	...	...	...	(2)	...	27
1,600	20	...	23,600	...	200,000	...	(2)	40,000	
...	...	...	30,000	600	...	...	(2)	49,920	
...	...	...	...	...	...	...	(8)	...	
211,926	5,659	204,342	1,928,550	45,736	23,539,197	1,463,005	465,545	3,545,542	
164,226	3,410	283,803	3,003,385	47,632	24,232,128	2,227,922	775,463	4,691,084	
88,136	1,842	...	[6]1,725,418	29,768	15,119,916	[6]1,627,357	[6]126,538	[6]2,981,196	
60,191	1,098	...	1,707,850	...	7,393,818	...	(2)	2,560,735	28
35,734	995	...	731,955	...	6,103,444	...	(2)	1,326,837	
...	...	...	351,726	7,105	...	...	(2)	581,800	
18,739	...	...	...	...	...	...	(8)	274,778	
...	164	18,214	144,043	...	...	...	144,043	236,885	
16,560	40	106,399	903,446	11,023	5,840,078	383,556	519,890	1,468,204	
13,328	42	...	286,692	5,323	2,506,182	258,198	28,494	637,000	
23,240	208	...	493,704	...	2,226,400	...	(2)	681,835	29
19,664	540	...	374,100	...	3,192,500	...	(2)	723,500	
...	...	...	237,060	4,270	...	...	(2)	394,700	
13,754	...	...	...	...	...	...	(8)	139,378	
102,488	2,712	72,888	702,497	19,884	10,283,614	608,822	93,675	1,341,597	
74,604	1,649	73,941	919,566	16,306	8,240,434	798,178	121,888	1,350,425	
33,396	776	...	[7]651,434	11,558	6,364,887	[7]679,911	(7)	1,155,029	
17,360	448	...	542,875	...	2,070,318	...	(2)	778,047	30
11,000	375	...	229,925	...	1,813,944	...	(2)	344,350	
...	...	...	28,220	675	...	...	(2)	44,200	
4,985	...	...	...	...	...	...	(8)	135,400	
21,496	591	13,992	172,267	4,565	2,316,727	145,773	26,494	316,061	
32,592	870	52,477	382,833	6,924	3,470,388	359,117	23,716	620,196	
10,000	400	...	194,556	3,173	1,541,797	180,072	14,484	328,389	
...	...	...	...	...	...	...	(2)	...	31
...	...	...	...	...	...	...	(2)	...	
...	...	...	...	...	...	...	(2)	...	
...	...	...	...	...	...	...	(8)	...	
...	...	...	...	...	...	...	...	...	
21,800	465	18,986	337,773	6,405	3,267,188	312,621	25,152	563,988	
4,860	24	...	142,183	2,261	1,099,130	110,969	31,214	219,861	
1,856	16	...	177,525	...	857,000	...	(2)	279,000	32
...	...	...	11,930	...	95,000	...	(2)	18,987	
...	...	...	...	...	...	...	(2)	...	
...	...	...	...	...	...	...	(8)	...	
...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	
19,312	431	...	376,081	6,399	3,082,132	336,984	39,097	522,980	
16,715	415	...	481,745	...	2,196,600	...	(2)	798,050	33
5,000	80	...	110,000	...	990,000	...	(2)	230,000	
...	...	...	86,446	2,160	...	...	(2)	142,900	
...	...	...	...	...	...	...	(8)	...	
...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	
432	14	...	3,472	54	25,788	3,223	249	7,937	
1,020	11	...	7,051	...	23,500	...	(2)	16,803	34
70	...	...	6,000	...	12,000	...	(2)	10,000	
...	...	...	...	...	...	...	(2)	...	
...	...	...	...	...	...	...	(8)	...	
87,942	2,192	99,248	909,743	21,287	10,938,856	708,410	201,333	1,650,999	
18,670	386	32,000	459,767	6,974	3,414,040	374,450	85,317	688,271	
6,808	155	...	71,000	1,000	500,000	58,000	13,000	110,000	35
...	...	...	4,950	...	20,000	...	...	7,000	
...	...	...	...	...	...	...	...	...	

[6] The error referred to in note 7 is also contained in this total.
[7] Owing to error in the published statistics for 1880 the cost of cotton in Indiana is shown to be in excess of the total cost of all materials used.
[8] Included in "All other Western states."
[2] Includes establishments distributed as follows: 1900, California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1. 1890, California, 1; Iowa, 2; Missouri, 1. 1880, Michigan, 1; Minnesota, 1. - 1870, Iowa, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900.

STATES.	Number of establishments.	CHARACTER OF ORGANIZATION.			CAPITAL.				
		Individual.	Firm and limited partnership.	Incorporated company.	Total.	Land.	Buildings.	Machinery, tools, and implements.	Cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries.
United States	973	142	123	708	$460,842,772	$22,546,549	$91,621,757	$181,009,280	$165,665,186
New England states	332	36	22	274	272,668,914	14,820,308	55,523,593	99,093,175	103,231,838
Maine	15			15	21,087,190	988,306	3,498,246	7,988,603	8,612,035
New Hampshire	23	2	1	20	29,261,835	1,302,874	4,376,217	10,007,368	13,576,376
Vermont	5			5	1,932,988	188,754	451,745	796,312	496,172
Massachusetts	163	14	11	138	155,761,193	8,716,746	30,066,848	57,928,100	59,049,499
Rhode Island	71	8	5	58	37,274,125	2,791,426	10,352,863	12,065,017	12,064,819
Connecticut	55	12	5	38	27,351,588	832,202	6,778,674	10,307,775	9,432,937
Middle states	225	75	80	70	59,078,820	3,277,033	11,327,917	20,779,919	23,693,951
New York	34	12	6	16	14,509,211	740,927	3,621,305	5,341,881	4,805,098
New Jersey	20	4	4	12	13,989,374	800,018	2,888,476	5,128,363	5,172,517
Pennsylvania	154	56	68	30	22,386,121	1,193,575	3,364,273	8,152,753	9,675,520
Delaware	3			3	484,858	27,000	98,260	205,789	153,809
Maryland	14	3	2	9	7,709,256	515,513	1,355,603	1,951,133	3,887,007
Southern states	400	30	18	352	124,532,864	4,250,540	23,741,094	59,179,798	37,361,432
Virginia	7			7	4,403,206	108,559	784,481	2,236,136	1,274,030
North Carolina	177	16	12	149	33,011,516	1,395,341	6,848,808	16,290,457	9,476,910
South Carolina	80	4	1	75	39,258,946	805,742	7,705,755	18,748,418	11,999,031
Georgia	67	7	1	59	24,158,159	1,166,237	4,701,906	10,828,803	7,461,213
Alabama	31			31	11,638,767	327,152	2,364,991	5,198,990	3,747,624
Mississippi	6		1	5	2,209,749	46,014	438,105	1,050,665	674,965
Texas	4			4	2,227,184	64,869	378,234	922,991	866,090
Kentucky	6			6	1,867,605	77,016	273,428	869,363	647,798
Tennessee	17	2	2	13	3,767,726	152,243	891,197	1,832,928	891,358
All other Southern states[1]	5	1	1	3	1,990,016	107,367	369,189	1,201,047	322,413
Western states	16	1	3	12	4,662,174	198,668	1,029,153	1,956,388	1,377,965
Ohio	3	1	1	1	168,492	700	21,600	56,813	89,379
Indiana	4		1	3	1,678,141	60,900	373,097	715,980	528,164
Wisconsin	3		1	2	467,808	34,250	75,750	185,900	171,908
All other Western states[1]	6			6	2,247,733	102,818	658,706	997,695	588,614

STATES.	Proprietors and firm members.	SALARIED OFFICIALS, CLERKS, ETC.									
		Total number.	Total salaries.	Officers of corporations.		General superintendents, managers, clerks, etc.					
				Number.	Salaries.	Total number.	Total salaries.	Men.		Women.	
								Number.	Salaries.	Number.	Salaries.
United States	389	4,713	$7,123,574	1,179	$3,034,116	3,534	$4,089,458	3,220	$3,959,165	314	$130,293
New England states	72	1,988	3,705,238	412	1,561,045	1,576	2,144,193	1,402	2,068,702	174	75,491
Maine	1	100	231,815	33	124,500	67	107,315	63	105,515	4	1,800
New Hampshire		175	370,777	35	126,650	140	244,127	129	238,457	11	5,670
Vermont		20	26,579	8	11,500	12	15,079	12	15,079		
Massachusetts	37	1,080	2,013,902	220	951,380	860	1,062,522	733	1,009,543	127	52,979
Rhode Island	15	332	666,541	68	218,384	264	448,157	253	442,521	11	5,636
Connecticut	19	281	395,624	48	128,631	233	266,993	212	257,587	21	9,406
Middle states	249	907	1,303,339	127	410,147	780	893,192	706	862,481	74	80,711
New York	25	156	226,701	31	79,380	125	147,321	114	143,025	11	4,296
New Jersey	10	141	250,548	17	73,425	124	177,123	119	174,966	5	2,157
Pennsylvania	207	515	677,303	64	192,361	451	484,942	394	460,984	57	23,958
Delaware		11	15,449	1	6,000	10	9,449	10	9,449		
Maryland	7	84	133,338	14	58,981	70	74,357	69	74,057	1	300
Southern states	62	1,754	2,008,662	618	1,015,324	1,136	993,338	1,073	970,471	63	22,867
Virginia		32	60,387	15	29,066	17	21,322	17	21,322		
North Carolina	41	659	586,730	248	288,574	411	298,156	395	293,155	16	5,001
South Carolina	5	415	537,193	133	286,320	282	250,873	262	243,733	20	7,140
Georgia	10	332	430,501	111	206,274	221	224,227	204	217,386	17	6,841
Alabama		159	197,700	56	102,971	103	94,729	98	93,049	5	1,680
Mississippi	2	46	60,212	10	18,600	36	41,612	35	40,892	1	720
Texas		21	31,388	7	17,503	14	13,885	13	13,285	1	600
Kentucky		24	33,761	9	17,800	15	15,961	15	15,961		
Tennessee	3	47	54,364	25	37,517	22	16,847	21	16,607	1	240
All other Southern states[1]	1	19	26,426	4	10,700	15	15,726	13	15,081	2	645
Western states	6	64	106,335	22	47,600	42	58,735	39	57,511	3	1,224
Ohio	1	12	11,260	3	4,200	9	7,050	8	6,790	1	260
Indiana	3	18	34,264	8	19,900	10	14,364	9	14,000	1	364
Wisconsin	2	5	6,220	2	2,500	3	2,720	3	2,720		
All other Western states[1]		29	55,601	9	21,000	20	34,601	19	34,001	1	600

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	WAGE-EARNERS, INCLUDING PIECEWORKERS, AND TOTAL WAGES.									
	Greatest number employed at any one time during the year.	Least number employed at any one time during the year.	Average number.	Total wages.	Men, 16 years and over.		Women, 16 years and over.		Children under 16 years.	
					Average number.	Wages.	Average number.	Wages.	Average number.	Wages.
United States	328,913	275,369	297,929	$85,126,310	134,354	$46,923,365	123,709	$32,917,933	39,866	$5,285,012
New England states	173,562	149,814	162,294	55,367,541	78,217	31,083,393	73,258	22,236,019	10,819	2,048,129
Maine	14,262	13,378	13,723	4,330,297	6,197	2,342,275	6,760	1,864,335	766	123,687
New Hampshire	21,325	19,542	20,454	6,759,422	9,229	3,599,509	10,362	2,996,626	863	163,287
Vermont	1,226	901	1,015	259,758	438	131,465	495	114,375	82	13,918
Massachusetts	99,001	82,991	92,085	32,327,443	45,105	18,298,457	41,057	12,855,112	5,923	1,173,874
Rhode Island	23,272	20,484	21,823	7,297,119	10,330	4,062,540	9,240	2,813,883	2,253	420,696
Connecticut	14,476	12,518	13,194	4,393,502	6,918	2,649,147	5,344	1,591,688	932	152,667
Middle states	38,309	31,912	34,843	11,396,710	14,473	6,132,776	16,056	4,589,949	4,314	673,985
New York	9,341	8,202	8,659	2,682,394	4,094	1,412,902	3,761	1,024,845	804	144,647
New Jersey	5,980	5,166	5,518	1,887,119	2,088	1,002,178	2,789	792,990	641	91,951
Pennsylvania	17,328	13,833	15,567	6,602,339	6,737	3,149,455	7,119	2,194,413	1,711	258,471
Delaware	629	204	372	138,844	108	58,885	222	67,700	42	12,259
Maryland	5,031	4,507	4,727	1,186,014	1,446	509,356	2,165	510,001	1,116	166,657
Southern states	108,506	90,528	97,494	17,501,648	40,528	9,320,597	32,528	5,669,916	24,438	2,511,135
Virginia	3,078	2,746	2,931	668,556	1,280	392,540	1,000	202,906	651	73,110
North Carolina	33,621	28,256	30,273	5,127,087	12,780	2,765,457	10,364	1,629,036	7,129	732,594
South Carolina	33,298	27,678	30,201	5,066,840	13,418	2,785,285	8,673	1,477,621	8,110	803,934
Georgia	20,494	17,023	18,283	3,566,951	7,309	1,815,126	6,495	1,270,434	4,479	481,391
Alabama	9,553	7,519	8,332	1,482,226	3,152	789,225	2,743	463,244	2,437	229,757
Mississippi	1,877	1,432	1,675	339,546	526	153,859	683	128,209	466	57,478
Texas	1,290	1,094	984	253,630	497	164,325	302	64,997	185	24,308
Kentucky	1,431	1,250	1,351	280,407	430	126,130	591	116,081	330	38,196
Tennessee	2,485	2,190	2,108	422,935	807	214,140	918	168,135	383	40,660
All other Southern states[1]	1,379	1,340	1,356	293,470	329	114,510	759	149,253	268	29,707
Western states	3,536	3,115	3,298	860,411	1,136	386,599	1,867	422,049	295	61,763
Ohio	117	80	106	27,861	24	11,482	82	16,379	....	....
Indiana	1,637	1,358	1,421	323,949	376	123,259	997	195,150	48	6,540
Wisconsin	387	315	347	80,567	131	39,170	191	38,750	25	2,647
All other Western states[1]	1,495	1,362	1,424	428,034	605	212,688	597	171,770	222	43,576

STATES.	WAGE-EARNERS, INCLUDING PIECEWORKERS, AND TOTAL WAGES.											
	Men, 16 years and over.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
United States	134,941	135,497	136,254	134,684	136,649	133,099	132,151	129,830	133,139	134,265	135,622	137,217
New England states	77,972	78,428	78,951	78,674	78,236	77,906	77,583	75,649	78,042	78,288	78,894	79,977
Maine	6,212	6,243	6,253	6,260	6,186	6,177	6,158	6,131	6,105	6,165	6,197	6,274
New Hampshire	9,156	9,219	9,259	9,259	9,096	9,141	9,142	9,125	9,235	9,280	9,407	9,431
Vermont	421	457	435	437	418	429	448	425	427	431	458	468
Massachusetts	44,990	45,219	45,596	45,523	45,428	45,138	44,758	42,955	45,110	45,127	45,336	46,082
Rhode Island	10,287	10,341	10,481	10,460	10,389	10,279	10,280	10,178	10,214	10,233	10,302	10,510
Connecticut	6,906	6,949	6,927	6,735	6,719	6,742	6,797	6,835	6,951	7,052	7,194	7,212
Middle states	14,607	14,608	14,719	13,760	14,682	14,384	14,293	14,265	14,472	14,584	14,694	14,620
New York	4.099	4,182	4,193	4,155	4,115	4,054	3,934	3,942	3,966	4,134	4,167	4,192
New Jersey	2,051	1,959	2,103	2,089	2,116	2,051	2,095	2,082	2,071	2,140	2,159	2,142
Pennsylvania	6,872	6,917	6,813	5,849	6,814	6,785	6,745	6,722	6,919	6,814	6,847	6,749
Delaware	129	112	158	189	191	37	61	65	80	83	94	102
Maryland	1,456	1,438	1,452	1,478	1,446	1,457	1,458	1,454	1,436	1,413	1,427	1,435
Southern states	41,248	41,327	41,432	41,115	41,462	39,689	39,161	38,797	39,488	40,254	40,889	41,468
Virginia	1,249	1,251	1,254	1,262	1,268	1,283	1,287	1,295	1,304	1,298	1,308	1,305
North Carolina	12,921	12,813	12,813	12,998	13,186	12,655	12,435	12,231	12,632	12,752	12,874	13,057
South Carolina	13,961	13,810	13,946	13,240	13,372	13,044	13,025	12,905	13,056	13,283	13,569	13,802
Georgia	7,240	7,596	7,516	7,753	7,652	7,226	6,993	6,863	7,007	7,233	7,268	7,359
Alabama	3,520	3,308	3,308	3,259	3,268	2,893	2,873	2,949	2,940	3,081	3,290	3,334
Mississippi	461	490	492	507	498	484	539	550	573	570	574	576
Texas	489	484	488	488	574	583	474	478	471	474	474	483
Kentucky	433	411	442	424	415	430	437	433	432	450	425	427
Tennessee	844	838	842	853	898	763	766	767	760	781	776	793
All other Southern states[1]	330	326	331	331	331	329	332	326	313	332	331	332
Western states	1,114	1,134	1,152	1,135	1,169	1,120	1,114	1,119	1,137	1,139	1,145	1,152
Ohio	18	23	23	23	23	23	25	25	25	25	25	25
Indiana	373	385	401	389	410	360	359	365	366	366	369	369
Wisconsin	124	127	138	136	137	140	130	127	128	128	129	131
All other Western states[1]	699	599	590	589	599	597	600	602	618	620	622	627

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

WAGE-EARNERS, INCLUDING PIECEWORKERS, AND TOTAL WAGES—continued.

Women, 16 years and over.

STATES.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
United States	124,486	124,952	125,805	125,285	124,780	122,513	121,292	119,108	121,370	123,746	124,998	126,173
New England states	73,490	73,566	74,295	73,859	73,384	72,920	72,639	70,700	71,964	73,362	74,012	74,909
Maine	6,793	6,801	6,697	6,791	6,741	6,673	6,687	6,710	6,727	6,781	6,832	6,892
New Hampshire	10,268	10,375	10,576	10,418	10,215	10,025	10,349	10,345	10,354	10,448	10,483	10,484
Vermont	467	500	503	529	514	494	504	490	487	476	491	486
Massachusetts	41,344	41,221	41,870	41,692	41,571	41,388	40,706	38,742	39,819	40,894	41,384	42,057
Rhode Island	9,228	9,228	9,291	9,258	9,260	9,163	9,201	9,149	9,191	9,251	9,246	9,417
Connecticut	5,390	5,441	5,358	5,171	5,083	5,177	5,192	5,264	5,386	5,512	5,576	5,573
Middle states	16,227	16,239	16,287	16,258	16,281	15,952	15,655	15,637	15,879	15,999	16,160	16,098
New York	3,782	3,827	3,847	3,856	3,798	3,798	3,598	3,550	3,580	3,772	3,827	3,891
New Jersey	2,805	2,747	2,808	2,757	2,788	2,782	2,775	2,740	2,775	2,807	2,856	2,825
Pennsylvania	7,219	7,215	7,156	7,121	7,175	7,089	6,983	7,014	7,185	7,095	7,147	7,031
Delaware	251	294	329	345	348	98	115	149	171	173	188	206
Maryland	2,170	2,156	2,147	2,179	2,172	2,185	2,184	2,184	2,168	2,152	2,142	2,145
Southern states	32,950	33,287	33,336	33,239	33,175	31,823	31,170	30,933	31,658	32,512	32,959	33,277
Virginia	898	921	942	1,016	1,023	1,028	1,012	1,010	1,028	1,045	1,032	1,042
North Carolina	10,620	10,453	10,638	10,634	10,573	10,289	9,893	9,803	10,081	10,339	10,458	10,589
South Carolina	8,990	8,920	8,983	8,636	8,606	8,426	8,498	8,301	8,500	8,667	8,707	8,838
Georgia	6,405	6,859	6,669	6,806	6,690	6,331	6,078	6,081	6,299	6,525	6,616	6,581
Alabama	2,869	2,907	2,931	2,880	2,902	2,508	2,470	2,496	2,553	2,665	2,833	2,903
Mississippi	591	626	626	636	633	617	713	735	743	753	758	759
Texas	294	290	286	282	394	388	284	280	275	277	285	284
Kentucky	585	602	560	604	593	595	603	591	573	579	605	604
Tennessee	944	952	949	993	995	875	853	874	864	908	905	909
All other Southern states[1]	754	757	752	752	766	766	766	762	742	754	760	768
Western states	1,819	1,860	1,887	1,929	1,940	1,818	1,828	1,838	1,869	1,873	1,867	1,889
Ohio	62	75	76	85	83	80	87	84	88	89	92	89
Indiana	989	1,013	1,035	1,069	1,079	952	955	962	979	980	961	986
Wisconsin	185	184	193	191	186	196	190	193	194	193	194	195
All other Western states[1]	583	588	583	584	592	590	596	599	608	611	620	619

WAGE-EARNERS, INCLUDING PIECEWORKERS, AND TOTAL WAGES—continued.

Children, under 16 years.

STATES.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
United States	40,676	40,363	40,646	40,137	40,450	39,229	38,737	38,463	39,046	39,664	40,330	40,651
New England states	10,972	10,788	10,877	10,744	10,722	10,766	10,768	10,663	10,789	10,780	10,979	10,980
Maine	765	758	768	761	753	782	790	784	756	749	755	768
New Hampshire	866	867	879	864	849	863	856	859	845	856	873	878
Vermont	79	82	92	80	87	87	79	80	85	78	83	78
Massachusetts	6,101	5,902	5,914	5,877	5,881	5,860	5,842	5,713	5,955	5,950	6,028	6,053
Rhode Island	2,247	2,250	2,307	2,237	2,241	2,248	2,263	2,279	2,223	2,197	2,278	2,263
Connecticut	914	929	917	925	911	926	938	948	925	950	962	940
Middle states	4,358	4,283	4,343	4,298	4,340	4,218	4,232	4,270	4,307	4,367	4,415	4,329
New York	798	807	819	793	794	800	785	767	779	807	859	840
New Jersey	629	583	625	622	642	643	664	670	662	645	661	651
Pennsylvania	1,751	1,724	1,741	1,704	1,703	1,637	1,641	1,658	1,723	1,782	1,764	1,701
Delaware	57	61	60	75	80	20	20	20	20	27	26	32
Maryland	1,123	1,108	1,098	1,104	1,121	1,118	1,122	1,155	1,123	1,106	1,105	1,105
Southern states	25,063	25,008	25,144	24,810	25,104	23,958	23,443	23,236	23,637	24,205	24,624	25,032
Virginia	626	628	644	654	665	672	644	651	648	660	659	659
North Carolina	7,378	7,269	7,391	7,410	7,463	6,991	6,736	6,644	6,909	7,040	7,160	7,153
South Carolina	8,352	8,224	8,297	7,942	8,043	7,870	7,901	7,878	7,984	8,140	8,273	8,420
Georgia	4,599	4,723	4,683	4,704	4,730	4,446	4,243	4,124	4,181	4,360	4,459	4,501
Alabama	2,504	2,531	2,508	2,461	2,483	2,337	2,325	2,319	2,306	2,371	2,437	2,662
Mississippi	412	443	438	444	442	427	469	489	501	511	507	510
Texas	178	179	185	168	244	267	186	165	161	156	165	169
Kentucky	336	340	317	331	328	318	315	330	341	329	337	332
Tennessee	414	405	404	425	433	354	353	362	351	363	365	369
All other Southern states[1]	264	266	277	271	273	276	271	274	255	275	262	257
Western states	283	284	282	285	284	287	294	294	313	312	312	310
Ohio	48	48	48	48	48	48	48	48	48	48	48	48
Indiana	25	25	25	25	25	25	25	25	25	25	25	25
Wisconsin	210	211	209	212	211	214	221	221	240	239	239	237
All other Western states[1]	....	....	....	....	....	....	....	....	....	....	....	....

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	SKILLED OPERATIVES BY CLASSES. (AVERAGE NUMBER.)									MACHINERY.		
	Spinners, mule.			Spinners, frame			Weavers.			Producing spindles. (Not including twisting and doubling spindles.)		
											Mule.	Frame.
	Men, 16 years and over.	Women, 16 years and over.	Children, under 16 years.	Men, 16 years and over.	Women, 16 years and over.	Children, under 16 years.	Men, 16 years and over.	Women, 16 years and over.	Children, under 16 years.	Total number.	Number.	Number.
United States	5,328	108	563	7,323	19,171	16,513	41,776	47,941	1,798	19,008,352	5,563,480	13,444,872
New England states	3,973	40	277	3,013	10,640	2,477	23,656	28,804	690	12,850,987	4,477,199	8,373,788
Maine	240	...	48	198	1,081	193	1,945	2,600	...	841,621	256,948	684,573
New Hampshire	352	...	52	283	1,618	354	1,933	4,501	36	1,243,655	287,165	956,390
Vermont	37	...	...	11	41	18	86	146	7	100,028	43,316	56,712
Massachusetts	2,245	40	92	1,918	6,259	1,110	14,038	16,657	511	7,784,687	2,556,316	5,228,371
Rhode Island	748	...	46	326	1,024	666	3,632	3,404	27	1,880,622	940,328	940,294
Connecticut	351	...	39	277	617	236	2,022	1,596	9	1,000,674	393,126	607,448
Middle states	1,005	10	130	595	1,366	751	4,670	6,085	121	1,647,251	858,675	788,576
New York	576	9	55	295	392	295	877	1,855	7	720,268	367,136	353,132
New Jersey	194	...	2	18	77	54	373	245	...	431,730	367,092	64,638
Pennsylvania	235	1	73	191	395	226	3,180	3,001	78	306,637	124,447	182,190
Delaware	...	...	...	37	105	7	33	141	...	34,552	...	34,552
Maryland	...	...	...	54	387	169	207	843	36	154,064	...	154,064
Southern states	305	58	150	3,692	6,780	13,173	13,247	12,202	1,076	4,298,188	180,534	4,117,654
Virginia	8	...	1	120	176	424	441	573	12	126,827	2,325	124,502
North Carolina	42	...	...	1,392	2,624	4,241	3,739	3,265	243	1,133,432	35,352	1,098,080
South Carolina	45	16	6	1,347	1,984	4,913	5,343	3,641	594	1,431,349	10,752	1,420,597
Georgia	128	...	84	372	873	2,571	2,196	2,577	90	815,545	84,926	730,619
Alabama	49	42	17	207	450	330	936	738	44	411,328	8,000	403,328
Mississippi	...	...	...	10	136	165	105	319	66	75,122	...	75,122
Texas	...	...	...	86	35	61	114	98	...	48,756	...	48,756
Kentucky	15	...	10	17	108	89	27	214	5	66,633	18,399	48,234
Tennessee	18	...	32	112	217	223	317	353	19	123,896	20,780	103,116
All other Southern states[1]	...	...	...	29	177	156	29	424	13	65,300	...	65,300
Western states	45	...	6	23	395	112	203	850	11	211,926	47,072	164,854
Ohio	...	...	...	...	...	...	3	17	...	...	...	...
Indiana	17	...	...	2	186	10	1	485	4	102,488	16,320	86,168
Wisconsin	4	...	...	19	28	5	43	67	...	21,496	2,816	18,680
All other Western states[1]	24	...	6	2	181	97	156	281	7	87,942	27,936	60,006

STATES.	MACHINERY—continued.									MISCELLANEOUS EXPENSES.				
	Looms.													
		On plain cloths.												
	Total number.	Less than 28 inches wide.	From 28 to 32 inches wide.	From 32 to 36 inches wide, inclusive.	More than 36 inches wide.	On twills and sateens.	On fancy weaves.	On tapes and other narrow goods.	On bags and other special fabrics.	Total amount.	Rent of works.	Taxes.	Rent of offices, insurance, interest, etc.	Contract work.
		Number.	Number.	Number.	Number.	Number.	Number.	Number.	Number.		Amount.	Amount.	Amount.	Amount.
United States	450,682	35,601	98,995	79,349	126,082	58,839	45,686	1,709	4,421	$21,650,144	$691,075	$3,521,606	$15,844,509	$1,592,954
New England states	298,885	16,765	77,326	37,722	84,916	47,080	31,635	1,586	1,855	13,098,849	497,826	2,585,232	9,247,640	768,151
Maine	23,366	2,005	5,225	2,581	9,175	2,018	1,428	...	934	1,440,425	3,600	242,230	788,375	406,220
New Hampshire	35,123	214	14,528	6,265	7,799	5,627	335	...	355	1,502,420	1,500	314,357	1,173,856	12,707
Vermont	2,099	1,653	430	...	16	...	...	...	...	43,282	...	5,650	37,632	...
Massachusetts	179,280	11,079	51,177	25,336	39,415	28,213	23,748	...	312	7,243,357	13,714	1,664,300	6,391,813	183,530
Rhode Island	39,472	1,719	2,222	2,567	19,581	7,852	3,945	1,586	...	1,580,859	464,454	240,778	763,537	112,090
Connecticut	19,545	95	3,744	973	8,930	3,370	2,179	...	254	1,288,506	14,558	127,917	1,092,427	53,604
Middle states	36,134	6,442	3,023	3,501	8,035	3,403	10,031	123	1,576	3,567,960	180,147	279,546	2,385,463	722,804
New York	14,545	5,476	939	1,695	5,040	1,050	156	6	183	909,351	24,943	135,327	579,833	169,248
New Jersey	2,226	278	104	13	324	660	655	...	192	403,119	5,585	55,078	338,732	3,724
Pennsylvania	15,815	406	1,456	1,025	1,541	1,656	8,476	78	1,177	1,852,026	141,464	52,863	1,107,867	549,832
Delaware	738	...	...	...	238	...	500	...	...	6,448	...	1,761	4,687	...
Maryland	2,810	282	524	768	892	37	244	39	24	397,016	8,155	34,517	354,344	...
Southern states	110,010	12,374	17,930	34,446	32,323	8,356	3,856	...	725	4,780,635	7,478	630,340	4,040,818	101,999
Virginia	4,608	2,258	157	893	713	389	198	...	...	135,173	1,800	24,620	108,753	...
North Carolina	25,469	7,241	3,305	3,264	7,111	1,499	2,735	...	314	1,030,918	2,775	135,963	865,958	26,222
South Carolina	42,663	2,171	5,664	15,939	15,040	3,729	100	...	20	1,507,824	...	206,355	1,267,597	33,872
Georgia	19,393	316	4,409	6,652	6,261	1,163	463	...	129	1,041,863	...	178,564	831,920	31,379
Alabama	8,549	36	1,866	3,441	2,663	183	360	...	...	511,296	...	42,809	468,487	...
Mississippi	2,464	...	1,094	734	...	636	...	...	...	117,117	375	12,367	104,375	...
Texas	1,018	...	498	204	...	244	...	...	72	113,156	...	6,105	107,051	...
Kentucky	991	...	...	916	...	...	...	...	75	105,796	2,078	9,843	83,349	10,526
Tennessee	2,995	352	608	1,366	260	313	...	...	96	142,878	450	12,468	129,960	...
All other Southern states[1]	1,860	...	329	1,037	275	200	...	...	19	74,614	...	1,246	73,368	...
Western states	6,653	20	716	3,680	808	...	164	...	265	202,700	5,624	26,488	170,588	...
Ohio	158	...	...	5	2	...	...	...	151	17,812	4,844	1,728	11,240	...
Indiana	2,712	...	523	1,989	200	...	...	...	...	71,648	...	12,455	59,193	...
Wisconsin	591	...	...	577	...	...	...	...	14	13,992	...	3,934	10,058	...
All other Western states[1]	2,192	20	193	1,109	606	...	164	...	100	99,248	780	8,371	90,097	...

[1]Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1;

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	MATERIALS USED.									
	Total cost.	Cotton.								
		Sea island.			Other domestic.			Egyptian and other foreign.		
		Bales.	Pounds.	Cost.	Bales.	Pounds.	Cost.	Bales.	Pounds.	Cost.
United States	$173,441,390	47,207	18,442,634	$2,725,023	3,516,080	1,739,714,946	$116,108,879	76,208	55,844,932	$6,071,173
New England states	91,727,594	36,674	14,416,364	2,133,804	1,719,622	874,011,257	58,329,174	66,464	48,977,406	5,321,948
Maine	7,036,287				156,674	79,212,256	5,400,379	754	553,317	62,914
New Hampshire	11,960,102				271,262	136,805,127	9,394,529	367	183,520	18,997
Vermont	526,235				12,493	6,410,674	385,461	555	417,729	46,994
Massachusetts	54,068,038	21,474	8,502,845	1,194,021	1,015,305	517,088,846	33,771,414	48,257	35,292,324	3,944,845
Rhode Island	10,601,006	7,308	2,785,257	472,340	170,514	86,712,235	6,074,331	8,686	6,575,088	592,179
Connecticut	7,535,926	7,892	3,128,262	467,443	93,374	47,782,119	3,303,060	7,845	5,955,428	656,019
Middle states	23,650,270	10,146	3,872,270	568,219	272,947	135,004,971	9,327,774	9,195	6,476,727	700,036
New York	5,257,419	1,649	659,600	106,015	99.064	50,464,770	3,513,661	1,877	1,118,679	123,591
New Jersey	2,926,876	8,497	3,212,670	462,204	15,872	8,183,469	541,858	5,275	3,891,729	407,681
Pennsylvania	12,238,660				74,382	35,083,214	2,521,768	2,043	1,466,319	168,764
Delaware	187,919				2,675	1,371,563	106,358			
Maryland	3,039,396				80,954	39,901,955	2,644,129			
Southern states	56,138,869	387	154,000	23,000	1,477,775	707,159,521	46,988,926	549	390,799	49,189
Virginia	1,412,332				38,118	17,832,465	1,154,215			
North Carolina	17,386,624	387	154,000	23,000	404,148	189,984,759	13,604,720			
South Carolina	17,263,882				485,024	229,899,760	14,909,520	210	154,047	20,026
Georgia	11,113,356				303,836	145,470,324	9,665,464	300	225,000	27,000
Alabama	4,825,981				134,371	67,987,299	4,206,721			
Mississippi	767,327				20,962	10,363,458	623,576			
Texas	641,341				18,045	9,304,434	566,517			
Kentucky	972,244				23,982	11,971,815	770,363			
Tennessee	1,143,234				30,234	15,028,584	982,146	39	11,752	2,163
All other Southern states[1]	612,548				19,055	9,316,623	505,684			
Western states	1,924,657				45,736	23,539,197	1,463,005			
Ohio	142,090									
Indiana	700,557				19,884	10,283,614	608,822			
Wisconsin	172,267				4,565	2,316,727	145,773			
All other Western states[1]	909,743				21,287	10,938,856	708,410			

STATES.	MATERIALS USED—continued.											
	Yarns not made in mill.											
	Cotton.		Woolen.		Worsted.		Silk.		Spun silk.		Other yarns.	
	Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.
United States	83,832,216	$15,749,536	435,361	$176,467	687,019	$415,904	298,716	$1,158,321	208,403	$625,658	2,174,275	$520,223
New England states	26,066,155	5,744,449	120,776	29,960	113,850	89,417	216,040	895,989	78,679	306,273	1,247,062	276,745
Maine	1,417,213	225,219									83,200	20,800
New Hampshire	821,587	124,337									10,311	3,752
Vermont	74,349	10,836										
Massachusetts	14,770,086	3,307,608	120,776	29,960	113,850	89,417	142,249	676,210	78,679	306,273	1,005,784	219,561
Rhode Island	4,114,408	924,946									121,727	27,319
Connecticut	4,868,512	1,151,503					73,791	219,779			26,040	5,323
Middle states	42,487,453	8,102,738	313,885	146,257	573,169	326,487	82,676	262,332	129,724	319,385	720,587	209,424
New York	3,283,664	778,826	50	45			5	26	100	300	178,523	44,478
New Jersey	1,790,312	424,569					13,020	66,335	200	600	95,000	46,800
Pennsylvania	36,304,919	6,741,518	313,835	146,212	573,169	326,487	69,651	195,971	129,424	318,485	403,979	110,040
Delaware	182,089	40,369										
Maryland	926,469	117,456									43,085	8,106
Southern states	14,206,608	1,771,469	700	250							188,926	32,754
Virginia	231,372	33,281									148,689	31,225
North Carolina	10,284,488	1,268,058									4,237	1,079
South Carolina	2,866,925	365,106										
Georgia	76,026	10,775									36,000	450
Alabama	650,000	80,000										
Mississippi												
Texas												
Kentucky	11,527	2,439	700	250								
Tennessee	28,670	3,070										
All other Southern states[1]	57,600	8,740										
Western states	1,072,000	130,880									17,700	1,300
Ohio	1,040,000	125,400									17,700	1,300
Indiana												
Wisconsin	26,000	4,400										
All other Western states[1]	6,000	1,080										

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	MATERIALS USED—continued.											
	Waste of other mills.		Oil.		Starch.		Chemicals and dyestuffs.	Fuel.	Rent of power and heat.	Mill supplies.	All other materials.	Freight.
	Pounds.	Cost.	Gallons.	Cost.	Pounds.	Cost.	Cost.	Cost.	Cost.	Cost.	Cost.	Cost.
United States	40,835,400	$1,513,281	2,752,271	$494,179	53,656,304	$1,223,102	$5,671,768	$6,039,485	$382,676	$7,664,490	$4,614,468	$2,286,757
New England states	34,679,846	1,242,765	1,607,707	265,796	30,898,520	753,076	3,854,915	3,440,995	127,163	4,656,208	3,033,275	1,225,643
Maine	3,821,532	190,753	135,781	19,757	3,026,423	62,364	136,645	139,919	37,266	403,017	134,917	202,337
New Hampshire	434,053	24,518	246,466	34,799	4,719,506	144,940	765,948	410,996	15,767	613,970	352,931	154,619
Vermont	.....	.....	7,660	1,123	119,644	1,984	5,071	20,226	.....	32,761	4,100	17,679
Massachusetts	22,392,884	688,860	896,895	147,001	18,584,853	405,536	2,357,105	2,132,986	47,728	2,527,224	1,675,707	646,592
Rhode Island	5,963,702	269,853	222,756	46,191	2,374,573	67,817	331,017	519,653	997	748,558	497,023	28,782
Connecticut	2,067,674	68,781	98,149	16,925	2,073,522	70,434	259,129	217,216	25,405	430,678	468,597	176,634
Middle states	2,388,242	116,332	274,243	54,934	4,588,077	103,709	840,459	635,370	130,235	744,087	870,835	192,657
New York	124,628	7,140	119,486	17,903	1,107,898	27,465	77,884	160,156	62,896	180,678	108,431	47,925
New Jersey	.....	.....	25,283	7,954	1,396,068	26,821	295,015	122,996	.....	104,176	366,103	53,765
Pennsylvania	2,263,614	108,192	89,845	21,296	1,717,454	42,784	453,878	278,389	67,211	316,015	348,718	72,932
Delaware	.....	.....	2,124	335	35,691	1,163	6,000	18,876	.....	13,433	.....	1,385
Maryland	.....	.....	37,505	7,446	330,966	5,476	7,682	54,964	128	129,786	47,583	16,650
Southern states	3,767,313	155,184	831,317	165,581	17,525,258	353,658	953,757	1,879,055	123,098	2,159,706	676,580	806,662
Virginia	.....	.....	16,422	3,042	374,272	7,841	74,066	31,909	2,800	21,183	52,353	417
North Carolina	777,101	36,410	286,491	66,949	4,527,391	91,283	478,258	703,811	14,623	602,014	231,705	275,714
South Carolina	367,110	21,420	213,091	46,688	6,038,638	115,966	50,707	555,252	55,950	725,964	195,602	201,691
Georgia	48,641	1,946	189,036	34,117	3,413,851	66,960	226,971	269,722	48,935	425,302	96,809	241,905
Alabama	.....	.....	81,615	15,786	1,666,938	38,537	21,032	141,947	40	192,418	71,857	67,643
Mississippi	.....	.....	6,150	1,302	278,550	7,275	43,912	45,709	.....	41,873	3,680	.....
Texas	.....	.....	6,700	1,741	356,000	9,360	180	38,566	.....	22,643	2,334	.....
Kentucky	2,519,477	94,251	8,617	1,392	263,787	6,769	14,693	20,537	.....	35,887	14,179	11,484
Tennessee	.....	.....	12,443	2,854	374,319	6,900	29,764	39,826	.....	59,658	4,269	12,584
All other Southern states[1]	54,984	2,157	10,752	1,710	231,512	3,777	15,174	31,776	750	32,764	4,792	5,224
Western states	.....	.....	39,004	7,868	644,449	12,660	22,637	84,065	2,180	104,489	33,778	61,795
Ohio	.....	.....	395	307	1,420	38	3,316	1,695	1,100	1,848	4,850	2,237
Indiana	.....	.....	11,340	1,997	250,755	3,676	5,299	24,088	.....	38,776	12,173	6,726
Wisconsin	.....	.....	2,692	454	67,000	1,818	.....	7,604	.....	8,256	2,939	1,123
All other Western states[1]	.....	.....	24,677	5,110	325,274	7,128	14,023	50,778	1,080	55,609	13,816	62,709

STATES.	PRODUCTS.								
	Total value.	Plain cloths for printing or converting.				Brown or bleached sheetings and shirtings.		Twills and sateens.	
		Not finer than No. 28 warp.		Finer than No. 28 warp.					
		Square yards.	Value.	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.
United States	$332,806,156	1,056,278,952	$35,616,575	625,334,876	$22,164,365	1,212,403,048	$55,513,032	235,860,518	$14,301,302
New England states	188,653,165	847,946,980	27,958,118	383,196,030	17,357,642	481,298,187	25,203,827	198,815,724	12,324,450
Maine	14,631,086	3,967,731	199,847	35,052,077	1,659,366	94,416,781	4,825,924	25,188,579	1,626,978
New Hampshire	22,998,249	79,130,448	2,868,638	4,168,353	212,820	64,953,520	3,076,366	23,926,221	1,381,439
Vermont	999,886	21,585,818	698,733	.....	.....	.....	.....	.....	.....
Massachusetts	110,478,327	687,235,050	22,164,741	240,170,139	9,774,579	176,283,924	9,255,612	86,668,240	5,859,028
Rhode Island	24,056,175	53,893,978	1,951,636	45,378,596	2,403,175	128,276,782	7,160,965	43,308,277	2,504,620
Connecticut	15,489,442	2,133,955	74,523	58,426,865	3,307,702	17,367,180	884,960	19,724,407	952,385
Middle states	45,705,085	83,338,422	2,988,123	2,530,986	111,840	32,973,722	2,252,934	21,494,567	1,244,485
New York	9,947,986	79,523,329	2,800,881	599,781	28,793	24,599,240	1,500,821	8,582,190	468,930
New Jersey	6,540,289	2,497,136	127,854	297,235	14,450	.....	.....	4,540,034	280,411
Pennsylvania	23,421,470	.....	.....	.....	.....	5,102,057	572,454	8,345,486	493,264
Delaware	372,089	1,317,957	59,388	1,633,970	68,597	.....	.....	.....	.....
Maryland	5,423,251	.....	.....	.....	.....	3,272,425	179,659	26,857	1,880
Southern states	94,914,794	111,052,162	4,290,969	139,201,156	4,676,724	644,577,586	26,043,690	15,550,227	732,367
Virginia	2,655,002	1,368,539	62,270	.....	.....	18,206,054	710,591	.....	.....
North Carolina	28,372,798	28,674,257	1,075,624	22,570,687	867,944	88,085,411	3,471,329	114,166	5,789
South Carolina	29,723,919	77,848,108	3,034,475	97,343,526	3,171,198	283,105,383	11,553,073	11,379,712	485,481
Georgia	18,457,645	1,831,596	59,527	4,381,999	154,710	131,739,917	5,127,409	420,000	58,800
Alabama	8,153,136	1,329,662	59,073	9,130,864	283,617	72,432,173	2,841,008	1,397,609	55,805
Mississippi	1,472,835	.....	.....	5,774,080	199,255	3,797,382	363,764	.....	.....
Texas	1,199,990	.....	.....	.....	.....	3,854,609	173,457	.....	.....
Kentucky	1,663,712	.....	.....	.....	.....	14,659,303	634,237	.....	.....
Tennessee	1,994,935	.....	.....	.....	.....	11,012,670	501,576	2,238,740	126,489
All other Southern states[1]	1,220,822	.....	.....	.....	.....	17,684,884	767,246	.....	.....
Western states	3,533,112	13,941,388	379,365	406,703	18,159	53,553,453	2,012,581	.....	.....
Ohio	231,045	700,000	21,000	.....	.....	.....	.....	.....	.....
Indiana	1,335,007	8,727,333	196,365	.....	.....	28,076,438	968,388	.....	.....
Wisconsin	316,061	.....	.....	.....	.....	7,060,514	286,576	.....	.....
All other Western states[1]	1,650,999	4,514,055	162,000	406,703	18,159	18,416,501	757,617	.....	.....

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	PRODUCTS—continued.									
	Fancy woven fabrics.		Ginghams.		Duck.				Drills.	
					Sail.		Other.			
	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.
United States	237,841,603	$21,066,310	278,392,708	$16,179,200	11,750,151	$2,216,371	117,483,925	$12,046,637	237,206,549	$11,862,794
New England states	188,079,288	15,536,137	111,511,819	8,007,003	516,874	130,693	31,039,438	3,398,436	48,241,163	3,002,136
Maine	6,922,390	784,204	9,835,356	800,819					21,413,342	1,326,566
New Hampshire	2,019,785	263,296	44,760,333	3,092,400			8,162,191	991,123	6,330,915	356,244
Vermont										
Massachusetts	137,064,111	10,995,987	53,932,358	3,949,351	153,328	38,910	17,750,629	1,638,320	20,475,203	1,316,071
Rhode Island	21,554,243	1,997,352								
Connecticut	20,518,759	1,495,298	2,983,772	164,433	363,546	91,783	5,126,618	768,993	21,703	3,255
Middle states	38,278,513	4,708,095	14,975,361	948,769	8,510,148	1,693,334	19,189,921	2,986,002	186,932	10,281
New York							1,191,300	365,485		
New Jersey	4,455,994	580,577	2,972,723	156,909			1,369,127	277,248		
Pennsylvania	30,981,363	3,906,347	11,792,638	623,860						
Delaware			210,000	168,000						
Maryland	2,841,156	221,171			8,510,148	1,693,334	16,629,494	2,343,269	186,932	10,281
Southern states	11,486,802	822,078	151,905,528	7,223,428	2,723,129	392,344	66,813,750	5,632,615	188,762,583	8,849,672
Virginia	1,419,593	99,629	27,600,235	1,358,195			2,508,716	140,834	4,790,967	242,271
North Carolina	7,770,704	502,123	79,531,131	3,799,187			226,951	21,106	2,821,238	133,110
South Carolina	213,068	14,000	16,752,808	806,551	337,944	50,692	6,898,210	931,297	116,467,224	5,375,017
Georgia	965,038	142,887	25,302,954	1,117,529			31,673,022	2,143,546	36,378,866	1,801,586
Alabama					2,084,385	319,092	13,529,893	1,390,108	14,867,094	607,927
Mississippi							1,567,696	111,858	4,436,078	281,240
Texas			261,468	7,842			7,655,784	722,760	3,273,339	130,933
Kentucky										
Tennessee	1,115,399	63,439	2,456,932	134,124			1,934,666	106,503	2,975,075	163,016
All other Southern states[1]					300,800	22,560	818,912	64,613	2,752,702	114,572
Western states							440,816	29,584	15,871	705
Ohio										
Indiana										
Wisconsin										
All other Western states[1]							440,816	29,584	15,871	705

STATES.	PRODUCTS—continued.									
	Ticks, denims, and stripes.		Cottonades.		Napped fabrics.		Corduroy, cotton velvet, and plush.		Mosquito and other netting.	
	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.
United States	171,800,853	$16,446,633	26,323,947	$2,791,431	268,852,716	$18,231,044	7,961,523	$2,682,017	41,885,023	$875,868
New England states	108,420,059	10,724,795	6,645,907	570,431	218,637,011	15,005,477	3,653,019	1,129,243	22,158,370	455,119
Maine	5,243,675	588,764	3,901,386	377,849	14,190,745	995,867				
New Hampshire	32,201,176	3,226,598			62,253,909	4,394,860				
Vermont										
Massachusetts	63,794,395	5,380,689	1,190,555	146,606	137,199,384	9,328,653	1,687,597	349,343	1,958,116	137,175
Rhode Island							1,965,422	779,900	6,379,307	80,233
Connecticut	7,180,813	1,528,744	553,966	46,976	4,992,973	286,097			13,820,947	237,711
Middle states	12,947,985	1,165,017	8,288,467	1,238,303	5,814,757	882,836	4,308,504	1,552,774	19,726,653	420,749
New York			772,440	52,888	1,069,384	303,905	36,000	14,400	8,038,518	186,986
New Jersey							327,000	118,800	11,688,135	233,763
Pennsylvania	12,262,848	1,110,206	7,004,759	1,134,039	3,718,782	523,772	3,945,504	1,419,574		
Delaware										
Maryland	685,137	54,811	511,268	51,376	1,026,591	55,159				
Southern states	50,432,809	4,556,821	12,389,573	982,697	40,633,116	2,109,572				
Virginia										
North Carolina	23,228,007	2,521,849	6,289,031	409,634	30,175,177	1,555,920				
South Carolina	1,802,138	139,131			840,372	35,000				
Georgia	16,971,764	1,048,395	4,173,815	399,553	6,044,140	265,960				
Alabama		250,000	1,040,307	74,990						
Mississippi			886,420	98,520	3,573,427	252,692				
Texas										
Kentucky										
Tennessee	6,701,703	421,372								
All other Southern states[1]	1,729,197	176,074								
Western states					3,767,832	233,159				
Ohio										
Indiana										
Wisconsin										
All other Western states[1]					3,767,832	233,159				

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	PRODUCTS—continued.									
	Upholstery goods.								Bags and bagging.	
	Tapestries (piece goods and curtains).		Chenille curtains.		Lace and lace curtains.		Other, including covers.			
	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.	Square yards.	Value.
United States	10,181,638	$4,123,600	805,414	$257,840	36,880,198	$3,585,138	2,517,459	$703,806	30,039,616	$2,554,192
New England states	447,267	50,494			105,000	70,000	862,448	121,344	19,974,844	1,485,254
Maine							862,448	121,344	6,142,221	477,610
New Hampshire									5,591,681	695,512
Vermont										
Massachusetts	447,267	50,494							8,240,942	312,132
Rhode Island										
Connecticut					105,000	70,000				
Middle states	9,684,271	4,073,106	805,414	257,840	36,775,198	3,515,138	1,655,011	582,462	797,605	124,439
New York					5,850,000	486,523			614,696	100,913
New Jersey	60,000	15,000	60,000	13,000						
Pennsylvania	9,586,606	4,048,784	745,414	244,840	30,925,198	3,028,615	1,665,011	582,462		
Delaware										
Maryland	37,665	9,322							182,909	23,526
Southern states									8,767,167	907,099
Virginia										
North Carolina									1,285,365	301,682
South Carolina									229,109	20,984
Georgia									4,030,293	252,808
Alabama									16,600	500
Mississippi										
Texas									1,234,901	125,320
Kentucky									750,000	96,500
Tennessee									1,220,899	109,305
All other Southern states[1]										
Western states									500,000	37,400
Ohio										
Indiana										
Wisconsin										
All other Western states[1]									500,000	37,400

STATES.	PRODUCTS—continued.									
	Tape and webbing.		Yarns for sale.		Sewing cotton.		Twine.		Batting and wadding.	
	Pieces.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
United States	1,160,873	$328,801	332,186,012	$55,188,663	15,741,062	$11,825,218	11,132,250	$1,475,146	10,567,700	$864,016
New England states	374,607	19,015	118,351,581	24,091,176	10,674,886	8,349,456	1,902,761	252,951	7,537,820	645,535
Maine	1,753	263	2,768,234	406,426					199,040	11,600
New Hampshire			6,018,260	847,278			10,000	1,200		
Vermont			1,532,247	277,542					74,860	3,360
Massachusetts	2,166	363	87,656,177	18,205,806	3,390,883	2,800,495	1,245,540	135,639	380,500	18,524
Rhode Island	360,000	15,000	14,366,101	2,817,858	3,851,844	2,687,827	347,605	79,663	6,009,080	551,919
Connecticut	10,688	3,389	6,010,562	1,536,266	3,432,159	2,861,134	299,616	36,549	874,340	60,132
Middle states	476,014	190,786	41,710,540	6,656,129	4,208,522	3,349,997	1,890,992	277,112	25,625	2,804
New York	2,500	12,500	17,922,997	2,782,165	330,000	150,000			25,625	2,804
New Jersey			3,727,865	870,824	3,560,795	3,130,267				
Pennsylvania	154,000	77,000	18,718,490	2,811,123	258,719	60,880	53,000	6,750		
Delaware			433,632	72,054						
Maryland	319,514	101,286	907,556	119,963	59,008	8,850	1,837,992	270,362		
Southern states	310,000	55,000	170,674,870	24,184,366	557,654	74,765	6,111,115	775,160	1,457,545	82,243
Virginia			51,927	8.190	2,691	416	65,466	6,977	7,134	449
North Carolina	310,000	55,000	86,970,599	12,708,636	187,800	26,292	2,800,530	412,127	29,931	1,632
South Carolina			24,859,616	3,461,090			648,190	69,186	2,400	72
Georgia			35,748,694	4,882,437	338,310	42,863	636,769	74,394	122,437	5,222
Alabama			14,432,028	1,965,139			1,320,624	145,269	11,393	1,823
Mississippi			1,089,493	126,756					69,840	4,000
Texas			288,400	34,608					46,200	462
Kentucky			5,020,741	701,854			461,938	47,719	728,999	43,739
Tennessee			2,000,083	263,662			177,598	19,488	323,925	17,406
All other Southern states[1]			213,289	31,994	28,853	5,194			125,286	7,438
Western states	252	64,000	1,449,021	256,992	300,000	51,000	1,227,382	169,923	1,546,710	133,434
Ohio	252	64,000	440,000	96,000			40,000	10,000		
Indiana			791,521	136,367			39,382	4,923	219,888	15,096
Wisconsin										
All other Western states[1]			217,500	24,625	300,000	51,000	1,148,000	155,000	1,326.822	118,338

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	PRODUCTS—continued.				GOODS EXPORTED.			
	Waste for sale.		Other products of cotton.	All other products.	Exported during the year ending June 30, 1900.	Weight of products.		
						Piece goods.	Yarns spun and not woven in the mill.	Other products.
	Pounds.	Value.	Value.	Value.	Value.	Pounds.	Pounds.	Pounds.
United States	270,100,756	$5,552,234	$5,154,170	$9,199,753	$15,357,502	1,124,224,687	343,291,338	71,753,649
New England states	173,315,267	3,871,402	1,838,378	7,056,354	5,666,595	576,231,680	125,268.394	37,107,387
Maine	10,532,399	210,176	177,720	39,763	1,430,000	64,589,813	2,769,987	5,021,810
New Hampshire	18,748,350	395,035	101,662	1,093,778	739,757	103,725,761	6,018,260	5,001,126
Vermont	860,135	16,752		3,499		3,900,736	1,532,247	1,164
Massachusetts	114,256,895	2,609,039	1,182,466	4,829,304	3,489,240	361,768,746	88,970,825	14,557,121
Rhode Island	18,763,717	386,250	118,647	521,230	3,761	3,060,689	17,636,684	9,187,122
Connecticut	10,153,771	254,150	257,883	567,079	3,837	39,185,935	8,340,391	3,339,044
Middle states	18,492,250	388,496	2,345,009	1,736,524	554,225	105,901,658	42,275,212	16,960,035
New York	6,554,045	126,419	350,264	213,309	11,576	25,940,718	17,870,669	3,934,770
New Jersey	2,542,061	78,133	193,279	449,774		6,197,567	3,727,865	3,753,052
Pennsylvania	5,664,228	115,142	1,611,074	1,051,284	29,535	42,841,943	19,335,490	5,589,992
Delaware	209,428	4,050				809,931	433,632	
Maryland	3,522,488	64,752	190,392	23,858	513,114	30,111,499	907,556	3,682,221
Southern states	76,290,167	1,261,701	922,313	339,170	9,088,240	425,535,425	174,298,711	14,041,180
Virginia	1,948,592	25,180			10,812	15,438,367	51,927	68,151
North Carolina	22,039,030	335,571	118,341	49,902	145,573	77,127,435	88,509,326	3,326,766
South Carolina	25,582,434	433,986	74,309	68,374	6,994,651	173,451,460	25,359,616	1,902,797
Georgia	15,310,595	286,614	388,238	205,167	1,230,856	81,294,311	35,749,078	3,793,686
Alabama	6,764,490	101,696	46,355	10,734	641,045	42,523,657	15,993,105	847,979
Mississippi	1,181,753	14,366	20,384		36,000	6,827,632	1,083,993	292,797
Texas	441,439	4,618			29,303	7,922,226	288,400	46,200
Kentucky	1,224,276	24,000	212,100	3,563		4,062,530	5,020,741	1,034,107
Tennessee	1,150,099	22,769	45,586	200		9,180,854	2,000,383	2,271,359
All other Southern states[1]	647,459	12,901	17,000	1,230		7,706,953	242,142	457,338
Western states	2,103,072	30,635	48,470	67,705	48,442	16,555,924	1,449,021	3,645,047
Ohio	3,000	45		40,000		392,000	440,000	255,000
Indiana	773,306	11,163		2,705		7,874,551	791,521	109,270
Wisconsin	250,098	5,685	23,800			1,765,128		26,000
All other Western states[1]	976,668	13,742	24,670	25,000	48,442	6,524,245	217,500	3,244,777

STATES.	PRINTING, DYEING, BLEACHING, AND MERCERIZING CLOTH AND YARN IN COTTON MILLS.									
	Printing.			Dyeing.			Bleaching.		Mercerizing.	
	Printing machines.	Cloth printed.	Additional value given by printing.	Cloth dyed.	Yarn dyed.	Additional value given by dyeing.	Cloth bleached.	Additional value given by bleaching.	Yarn mercerized.	Additional value given by mercerizing.
	Number.	Square yards.		Square yards.	Pounds.		Square yards.		Pounds.	
United States	104	292,741,100	$5,242,695	125,894,626	[2]151,610,157	$6,803,077	[3]197,691,533	$932,452	2,149,722	$328,330
New England states	97	291,593,800	5,191,214	62,686,716	63,496,281	2,490,457	125,235,506	590,649	1,647,470	245,017
Maine					3,340,491	83,299	6,778,075	22,831		
New Hampshire	14	47,231,375	933,716	4,948,962	3,276,720	179,871	13,842,238	101,551		
Vermont					307,252	9,218				
Massachusetts	75	242,057,565	4,175,287	41,040,589	[2]41,590,782	1,551,298	[3]78,693,381	286,788	1,340,254	208,574
Rhode Island	7	2,270,000	81,750	8,818,198	4,525,039	403,777	25,921,612	147,936		
Connecticut	1	34,860	461	7,878,967	10,455,997	262,994		31,543	307,216	36,443
Middle states	6	1,115,808	51,166	55,965,346	18,166,563	1,070,248	46,677,444	194,121	502,252	83,313
New York				5,513,038	106,450	44,888	13,456,476	40,604	26,328	3,242
New Jersey				44,237,979	2,002,531	501,013	26,426,156	63,410	83,309	1,548
Pennsylvania	6	1,115,808	51,166	5,832,509	15,476,499	509,089	6,794,812	90,107	392,615	78,523
Delaware				381,820		7,636				
Maryland					581,083	7,622				
Southern states	1	31,492	315	5,741,892	68,361,413	3,211,107	25,278,583	142,682		
Virginia					5,727,300	85,909				
North Carolina	1	31,492	315	306,490	34,850,776	2,442,144				
South Carolina					2,250,514	43,647	300,000	1,500		
Georgia				5,435,402	14,747,021	432,654	24,265,583	124,893		
Alabama					2,123,809	33,095				
Mississippi					2,394,628	58,329	713,000	16,289		
Texas										
Kentucky					1,556,969	43,139				
Tennessee					2,710,396	52,190				
All other Southern states[1]					2,000,000	20,000				
Western states				1,500,672	1,585,900	31,265	500,000	5,000		
Ohio					320,000	4,300				
Indiana					675,900	6,759				
Wisconsin										
All other Western states[1]				1,500,672	590,000	20,206	500,000	5,000		

[1]Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

[2]Does not include 45,432 dozen underwear.

[3]Does not include 975,000 yards cotton, 11,989 dozen underwear, and 646,931 quilts.

TABLE 24.—COTTON GOODS, DETAILED SUMMARY, BY STATES, ARRANGED GEOGRAPHICALLY: 1900—Continued.

STATES.	COMPARISON OF PRODUCTS.			POWER.									
						Owned.							
						Engines.				Water wheels.		Electric motors.	
						Steam.		Gas or gasoline.					
	Number of establishments reporting for both years.	Value for census year.	Value for preceding business year.	Number of establishments reporting.	Total horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
United States	602	$241,797,279	$201,875,820	958	805,126	1,755	527,186	10	275	1,316	260,790	275	16,268
New England states	229	143,763,288	118,174,006	331	498,868	960	324,062	4	221	839	162,618	86	7,126
Maine	12	12,718,118	11,072,519	15	39,963	25	12,350			98	23,233	4	355
New Hampshire	17	19,388,543	15,607,259	23	68,788	59	35,822			98	32,231	6	315
Vermont	4	963,294	787,206	5	3,170	4	1,400			8	1,770		
Massachusetts	111	81,892,089	66,615,282	162	281,032	667	210,880	3	206	333	64,158	63	5,671
Rhode Island	49	17,040,685	14,173,689	71	63,996	122	44,105			152	19,872		
Connecticut	36	11,760,559	9,918,051	55	41,919	83	19,505	1	15	160	21,354	13	785
Middle states	149	37,290,359	33,110,371	221	72,861	275	56,580	3	44	88	13,564	29	296
New York	19	8,485,844	7,548,310	34	23,859	47	14,801	2	40	45	8,524	9	105
New Jersey	12	6,101,315	5,402,096	19	14,215	63	13,044	1	4	11	1,005	17	162
Pennsylvania	109	17,625,292	15,321,204	151	22,463	138	19,615			11	831	[illegible]	29
Delaware	1	130,445	110,082	3	1,460	3	1,250			1	210		
Maryland	8	4,947,463	4,728,679	14	10,864	24	7,870			20	2,994		
Southern states	211	57,867,329	48,064,876	390	222,811	498	138,069	2	5	371	72,568	157	7,835
Virginia	3	2,074,780	2,003,160	7	5,048	6	1,690			30	3,070	1	28
North Carolina	85	14,197,270	11,846,103	177	58,442	207	37,258	1	3	141	19,225	28	1,456
South Carolina	42	17,916,449	14,159,857	80	78,801	117	43,386	1	2	90	26,434	114	5,759
Georgia	38	11,902,167	9,886,277	67	39,864	70	22,946			70	16,011	11	557
Alabama	17	5,137,318	4,526,506	21	23,032	36	16,485			25	6,508	3	35
Mississippi	3	955,204	784,062	6	3,365	12	3,330			1	35		
Texas	2	1,038,699	909,734	4	2,950	8	2,950						
Kentucky	6	1,663,712	1,333,096	6	3,605	12	3,455			1	150		
Tennessee	11	1,869,268	1,659,601	17	5,525	23	4,590			11	935		
All other Southern states[1]	4	1,112,462	956,479	5	2,179	7	1,979			2	200		
Western states	13	2,876,303	2,626,568	16	10,586	22	8,475	1	5	18	2,040	3	11
Ohio	3	231,045	197,672	3	350	2	300	1	6	2	40	1	5
Indiana	4	1,335,007	1,243,615	4	4,006	11	4,000					2	6
Wisconsin	1	129,419	130,000	3	1,575	3	575			14	1,000		
All other Western states[1]	5	1,180,832	955,281	6	4,655	6	3,600			2	1,000		

STATES.	POWER—continued.			ESTABLISHMENTS CLASSIFIED BY NUMBER OF PERSONS EMPLOYED, NOT INCLUDING PROPRIETORS AND FIRM MEMBERS.									
	Rented.												
	Electric.	Other kind.	Furnished to other establishments.	Total number of establishments.	No employees.	Under 5.	5 to 20.	21 to 50.	51 to 100.	101 to 250.	251 to 500.	501 to 1,000.	Over 1,000.
	Horsepower.	Horsepower.											
United States	1,922	9,685	4,848	973	1	10	63	95	144	289	190	113	68
New England states	718	4,123	3,375	332		2	14	28	33	80	61	62	52
Maine		4,025	1,000	15					1	3	2	3	6
New Hampshire	420			23					4	3	5	5	6
Vermont				5				1		1	3		
Massachusetts	43	74	2,260	163		2	7	10	13	32	25	42	32
Rhode Island	5	14		71			3	7	10	21	18	7	5
Connecticut	250	10	115	55			4	10	5	20	8	5	3
Middle states	350	2,027	995	225	1	8	43	41	35	61	23	9	4
New York	350	39		34		1	4	7	6	8	3	2	3
New Jersey				20	1		5	3		5	3	2	1
Pennsylvania		1,988	995	154		7	32	31	24	42	13	5	
Delaware				3						2	1		
Maryland				14			2		5	4	3		
Southern states	854	3,480	198	400			5	25	74	144	99	41	12
Virginia		260		7						4	2		1
North Carolina	600			177			1	13	44	72	40	6	1
South Carolina		3,220	3	80				2	6	28	24	13	7
Georgia	350		160	67			1	5	12	21	14	12	2
Alabama	4		10	31			1		5	9	9	6	1
Mississippi				6				1		1	3	1	
Texas				4						1	3		
Kentucky				6					1	3	1	1	
Tennessee			25	17			1	4	5	4	2	1	
All other Southern states[1]				5			1		1	1	1	1	
Western states		55	280	16			1	1	2	4	7	1	
Ohio				3			1		2				
Indiana			280	4							3	1	
Wisconsin				3				1		2			
All other Western states[1]		55		6						2	4		

[1] Includes establishments distributed as follows: Southern states—Arkansas, 2; Louisiana, 2; West Virginia, 1. Western states—California, 1; Colorado, 1; Illinois, 1; Missouri, 2; Nebraska, 1.

COTTON SMALL WARES.

At the census of 1900 for the first time a separate classification was made of the establishments producing cotton small wares, including cotton lace, edgings, boot and shoe lacings, corset lacings, lamp and stove wicks, tapes, webbings, and trimmings.

A small number of these establishments may have been reported at the Eleventh Census under the head of "millinery and lace goods," and some others may have been included in the class of "boot and shoe findings." Most of them, however, were included with cotton goods. Inasmuch as a few only of these establishments make use of raw cotton, or operate spindles, and since their products are quite distinct in character from those of ordinary cotton mills, it seems desirable to group them by themselves, in order to avoid misleading deductions from the statistics of the cotton manufacture proper, to recognize the importance of a rapidly expanding industry, and to lay a basis for future comparisons.

Nevertheless, the following tables do not give an exact view of the magnitude of the industries included in this group. The rule necessarily followed in classifying establishments is to combine those whose chief product, measured by value, is similar. Evidently no rule of classification gives an entirely satisfactory result. In the present instance there are cotton mills that make nothing but sewing cotton, and establishments which must be classed as producing cotton small wares that make a certain quantity of sewing cotton. Although tape and webbings are frequently a minor and incidental product of cotton mills, a small establishment which buys its yarn and makes tape and webbings exclusively may not properly be classed as such a mill.

These considerations will explain why the use of a considerable amount of raw cotton and the operation of a certain number of cotton spindles are reported in a class of mills which, as a rule, do not spin their own yarn. They will also indicate that neither do the following tables disclose the entire product of the articles included under the designation of cotton small wares, nor do all the products of the mills here reported fall properly under that designation. But a fairly accurate statement can be deduced from a comparison with the reports of other textile industries.

Table 25 presents the leading statistics of cotton small wares for 1900.

TABLE 25.—COTTON SMALL WARES: SUMMARY, 1900.

Number of establishments	82
Capital	$6,397,385
Salaried officials, clerks, etc., number	189
Salaries	$226,625
Wage-earners, average number	4,932
Total wages	$1,563,442
Men, 16 years and over	1,367
Wages	$671,516
Women, 16 years and over	3,173
Wages	$828,732
Children, under 16 years	392
Wages	$63,194
Miscellaneous expenses	$462,534
Cost of materials used	$3,110,137
Value of products	$6,394,164
Active spindles, number	42,600
Looms, number	5,070
Cotton consumed, bales	7,213
Cotton consumed, pounds	3,640,878

The geographical distribution of the establishments reporting is as follows: New England states, 32; Middle states, 47; Georgia, 1; Ohio, 1; Indiana, 1. The several industries are of a class which tends to spring up within cities or in their suburbs, and a large proportion of those here reported are in, or in the immediate vicinity of, New York, Philadelphia, Boston, and Providence. They are for the most part small establishments. The average capital indicated is something less than $80,000. There are, however, some large establishments in Rhode Island. The combined capital of three of them is nearly $2,000,000, which is almost one-third of the amount reported for the whole country. The elimination of the returns of these three mills would bring the average capital down to about $56,000. The average number of hands employed in each establishment was 60; outside of Rhode Island, it was but 41. An inspection of the average number employed during each month indicates great steadiness of employment, the slight falling off during the summer months being no greater than is easily explained by the practice of allowing employees to take a vacation.

The chief materials used are shown by the following statement:

Materials.	Pounds.	Cost.
Raw cotton	3,640,878	$264,541
Cotton yarn	10,860,648	1,873,032
Woolen yarn	274,351	91,251
Worsted yarn	47,308	33,414
Silk yarn	43,709	134,296
Spun-silk yarn	9,852	25,394
Other yarn	718,444	139,666
Raw cotton and yarns	15,595,190	2,561,594
All other materials		548,543
Total cost		5,671,731

Ninety-three per cent in weight and 83 per cent in value of the raw or spun fiber used was cotton, but in the aggregate not a little of the product was mixed as to material.

A classification of products can not be made. Manufacturers were not asked to report with exactness the specific character of their goods, and indeed, the variety and the absence of standard units of quantity would have rendered such specification valueless. Nevertheless, from the total value of products reported, $6,394,164, the following items should be subtracted as not coming properly under the classification of cotton small wares: Upholstery goods, $35,000; yarns for sale, $27,403; sewing cotton, $83,453; and twine, $71,465—a total of $217,321. On the other hand, in order to obtain the actual total of cotton small wares produced in all the mills of the country, and not merely of these here reported, it is necessary to add to the remainder the sum of $328,801, value of tape and webbings made in cotton mills, and a large but unknown sum out of the item of more than $5,000,000 reported in the returns of cotton manufacturing proper, under the head of "All other products of cotton."

Table 26 presents the detailed statistics for the industry for 1900.

TABLE 26.—COTTON SMALL WARES, BY STATES: 1900.

	United States.	Massachusetts.	New Jersey.	New York.	Pennsylvania.	Rhode Island.	All other states.[1]
Number of establishments	82	14	5	18	24	16	6
Character of organization:							
Individual	30	5	2	10	6	5	2
Firm and limited partnership	24	3		6	11	3	1
Incorporated company	28	6	3	2	7	8	2
Capital:							
Total	$6,397,385	$528,258	$409,917	$550,938	$1,945,844	$2,876,699	$85,729
Land	$408,824	$19,774	$7,500	$12,500	$107,500	$259,000	$2,550
Buildings	$863,128	$77,353	$47,300	$42,000	$215,500	$468,875	$12,100
Machinery, tools, and implements	$2,159,876	$240,819	$222,312	$203,455	$627,758	$834,726	$30,806
Cash and sundries	$2,965,557	$190,312	$132,805	$292,983	$995,086	$1,314,098	$40,273
Proprietors and firm members	85	11	1	22	34	13	4
Salaried officials, clerks, etc.:							
Total number	189	24	16	42	50	48	9
Total salaries	$226,625	$32,150	$18,730	$36,449	$64,620	$67,924	$6,752
Officers of corporations—							
Number	43	12	4	4	9	11	3
Salaries	$82,660	$19,000	$7,560	$5,400	$23,900	$24,600	$2,200
General superintendents, managers, clerks, etc.—							
Total number	146	12	12	38	41	37	6
Total salaries	$143,965	$13,150	$11,170	$31,049	$40,720	$43,324	$4,552
Men—							
Number	118	10	8	33	31	30	6
Salaries	$129,788	$12,200	$8,500	$28,149	$36,805	$39,582	$4,552
Women—							
Number	28	2	4	5	10	7	
Salaries	$14,177	$950	$2,670	$2,900	$3,915	$3,742	
Wage-earners, including pieceworkers, and total wages:							
Greatest number employed at any one time during the year	5,504	519	176	684	1,647	2,299	179
Least number employed at any one time during the year	4,355	353	156	489	1,211	2,068	78
Average number	4,932	430	163	600	1,444	2,209	86
Wages	$1,563,442	$151,254	$43,821	$163,454	$454,947	$735,888	$14,078
Men, 16 years and over—							
Average number	1,367	140	56	146	337	650	38
Wages	$671,516	$68,636	$22,535	$70,315	$149,479	$351,686	$8,865
Women, 16 years and over—							
Average number	3,173	241	80	447	1,001	1,379	25
Wages	$828,732	$74,138	$18,059	$92,034	$287,328	$353,637	$3,536
Children, under 16 years—							
Average number	392	49	27	7	106	180	23
Wages	$63,194	$8,480	$3,227	$1,105	$18,140	$30,565	$1,677
Average number of wage-earners, including pieceworkers, employed during each month:							
Men, 16 years and over—							
January	1,393	148	59	148	352	641	45
February	1,398	143	59	154	357	640	45
March	1,441	148	59	161	375	651	47
April	1,439	145	60	167	377	655	35
May	1,408	138	59	154	377	649	31
June	1,280	128	44	118	315	637	38
July	1,249	123	35	132	272	644	43
August	1,270	132	59	137	271	647	24
September	1,345	148	58	143	309	652	35
October	1,384	144	58	150	334	660	38
November	1,390	141	60	145	351	653	40
December	1,407	140	59	144	354	671	39
Women, 16 years and over—							
January	3,203	239	82	466	1,021	1,366	29
February	3,191	226	82	467	1,021	1,366	29
March	3,229	253	85	469	1,025	1,368	29
April	3,144	247	82	465	945	1,380	25
May	3,124	239	82	439	945	1,393	26
June	2,979	232	66	374	899	1,382	26
July	3,075	223	66	419	969	1,378	20
August	3,114	232	80	426	982	1,379	15
September	3,216	251	84	454	1,021	1,384	22
October	3,261	249	84	467	1,053	1,384	24
November	3,274	250	86	456	1,073	1,384	25
December	3,266	252	81	462	1,063	1,384	24
Children, under 16 years—							
January	410	66	29	7	112	169	27
February	386	49	29	7	111	163	27
March	409	51	29	8	120	174	27
April	401	49	29	8	122	173	20
May	392	39	29	6	115	180	23
June	372	35	19	4	110	180	24
July	371	41	18	7	103	181	21
August	371	42	29	8	100	181	11
September	386	58	29	8	86	184	21
October	391	54	29	8	93	184	23
November	414	57	29	9	98	194	27
December	401	52	29	8	97	192	23
Skilled operatives by classes, average number:							
Spinners, mule—							
Men, 16 years and over	11			7		2	2
Women, 16 years and over	11			11			
Children, under 16 years	4					4	
Spinners, frame—							
Men, 16 years and over	39		20	7	4	7	1
Women, 16 years and over	117		20	14	23	60	
Children, under 16 years	25		12			6	7
Weavers—							
Men, 16 years and over	430	20	13	63	200	129	5
Women, 16 years and over	1,136	122	5	63	666	278	2
Machinery:							
Producing spindles, not including twisting and doubling spindles, number—							
Mule	4,300					3,400	900
Frame	38,300					36,500	1,800
Looms, number—							
On plain cloths—							
Less than 28 inches wide	10			10			
From 28 to 32 inches wide	38				38		
36 inches wide and over	47			6	41		
On fancy weaves	124			103	21		

[1] Includes establishments distributed as follows: Connecticut, 2; Georgia, 1; Indiana, 1; Ohio, 1.

TABLE 26.—COTTON SMALL WARES, BY STATES: 1900—Continued.

	United States.	Massachusetts.	New Jersey.	New York.	Pennsylvania.	Rhode Island.	All other states.[1]
Machinery—Continued.							
Looms, number—Continued.							
On tapes and other narrow goods	2,202	282	8	66	1,173	668	5
On bags and other special fabrics	2,649	20	42	7	411	2,158	11
Miscellaneous expenses:							
Total	$462,534	$31,754	$25,265	$34,497	$205,117	$155,731	$10,170
Rent of works	$51,543	$5,362	$1,000	$15,240	$22,179	$6,612	$1,150
Taxes, not including internal revenue	$25,931	$4,515	$1,086	$905	$4,222	$14,818	$385
Rent of offices, interest, insurance, and all sundry expenses not hitherto included	$275,621	$21,877	$17,954	$15,152	$88,306	$123,697	$8,635
Contract work	$109,439		$5,225	$3,200	$90,410	$10,604	
Materials used:							
Total cost	$3,110,137	$321,007	$230,892	$460,876	$938,058	$1,096,455	$62,849
Cotton—							
Domestics, other than sea-island, bales	7,213	200				6,718	295
Pounds	3,640,878	100,189				3,402,898	137,791
Cost	$264,541	$6,718				$247,489	$10,334
Yarns not made in mill—							
Cotton, pounds	10,860,648	1,767,690	1,126,016	1,014,020	3,632,287	2,916,843	403,792
Cost	$1,873,032	$255,157	$158,360	$304,778	$595,864	$515,415	$43,458
Woolen, pounds	274,351		421	40,190	233,000	740	
Cost	$91,251		$346	$37,875	$52,660	$370	
Worsted, pounds	47,308	250		18,700	25,916	1,675	767
Cost	$33,414	$150		$11,375	$19,962	$1,340	$587
Silk, pounds	43,709		400	4,771	22,410	16,128	
Cost	$134,296		$1,700	$20,187	$100,841	$11,568	
Spun silk, pounds	9,852			703	9,149		
Cost	$25,394			$3,010	$22,384		
Other yarns, pounds	718,444	1,042	302,625	96,660	165,727	152,390	
Cost	$139,666	$407	$21,633	$15,170	$38,858	$63,598	
Waste of other mills, pounds	399,500	6,500			3,000		390,000
Cost	$2,310	$390			$750		$1,170
Oil, gallons	19,458	2,157	150	841	2,570	12,515	1,225
Cost	$3,935	$425	$58	$173	$698	$2,351	$230
Starch, pounds	144,430	12,355			14,000	113,075	5,000
Cost	$3,908	$493			$400	$2,890	$125
Chemicals and dye stuffs	$46,339	$1,172	$3,000		$1,228	$40,689	$250
Fuel	$69,578	$6,690	$3,504	$1,777	$11,502	$44,670	$1,435
Rent of power and heat	$23,381	$3,510	$1,200	$3,749	$11,296	$3,626	
Mill supplies	$101,576	$18,061	$2,370	$2,298	$17,070	$60,931	$846
All other materials	$284,652	$26,543	$37,307	$56,372	$60,138	$101,430	$2,862
Freight	$12,864	$1,291	$1,414	$4,112	$4,407	$88	$1,552
Products:							
Total value	$6,394,164	$646,848	$390,477	$840,017	$2,026,227	$2,379,500	$111,095
Upholstery goods—							
Tapestries, piece goods, and curtains, square yards	35,000			35,000			
Value	$35,000			$35,000			
Tape and webbing, value	$2,192,601	$215,336		$91,000	$907,516	$963,249	$15,500
Yarns for sale, pounds	116,609					116,609	
Value	$27,403					$27,403	
Sewing cotton, pounds	165,996		74,000			91,996	
Value	$83,453		$37,000			$46,453	
Twine, pounds	510,468						510,468
Value	$71,465						$71,465
Waste for sale, pounds	761,857	340,379	5,000		300	396,178	20,000
Value	$11,336	$4,027	$75		$105	$6,829	$300
Other products of cotton	$2,711,268	$345,905	$330,402	$105,254	$628,771	$1,282,946	$17,990
All other products	$1,261,638	$81,580	$23,000	$608,763	$489,835	$52,620	$5,840
Goods exported during the year ending June 30, 1900	$23,447	$300	$900		$8,262	$13,985	
Weight of products, pounds:							
Piece goods	735,154	241,454			208,700	285,000	
Yarns spun and not woven in the mill	168,605					168,605	
Other products	10,373,860	1,021,560	1,153,330	1,171,244	2,691,749	3,560,771	775,206
Dyeing and mercerizing cloth and yarn in cotton mills:							
Dyeing—							
Yarn, pounds	1,607,271		485,000			1,122,271	
Additional value given by dyeing	$107,689		$58,000			$49,689	
Mercerizing—							
Yarn, pounds	10,000					10,000	
Additional value given by mercerizing	$1,000					$1,000	
Comparison of products:							
Number of establishments reporting for both years	54	10	3	9	17	10	5
Value for census year	$4,914,272	$552,141	$165,283	$585,500	$1,559,062	$1,941,191	$111,095
Value for preceding business year	$4,095,927	$484,312	$129,560	$426,700	$1,267,143	$1,708,859	$79,353
Power:							
Number of establishments reporting	80	13	5	18	24	16	4
Total horsepower	6,221	800	264	290	974	3,553	340
Owned—							
Engines—							
Steam, number	48	6	3	4	14	18	3
Horsepower	4,425	435	254	120	803	2,623	190
Gas or gasoline, number	4	1	1	2			
Horsepower	46	36	6	4			
Water wheels, number	19	5		2		9	3
Horsepower	1,060	240		36		634	150
Electric motors, number	5				1	4	
Horsepower	245				5	240	
Other power, horsepower	10					10	
Rented—							
Electric, horsepower	159	63		76	20		
Other kind, horsepower	276	26	4	54	146	46	
Furnished to other establishments, horsepower	40	15			5	20	
Establishments classified by number of persons employed, not including proprietors and firm members:							
Total number of establishments	82	14	5	18	24	16	5
Under 5	11	5		2	1	1	2
5 to 20	27	1	2	7	9	7	1
21 to 50	10	2	1	3	3	1	
61 to 100	21	6	2	5	6	1	1
101 to 250	8				4	3	1
251 to 500	4			1	1	2	
501 to 1,000	1					1	

[1] Includes establishments distributed as follows: Connecticut, 2; Georgia, 1; Indiana, 1; Ohio, 1.

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 216. WASHINGTON, D. C. June 28, 1902.

MANUFACTURES.

PRINTING AND PUBLISHING.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on printing and publishing, prepared under my direction by Mr. William S. Rossiter, of New York, acting in the capacity of an expert special agent of the division of manufactures of the Census Office.

This report is divided into two parts: Part I, tables and analysis; Part II, progress in the printing and publishing industry.

The statistics of the industry are presented in Part I in 19 main tables. Table 1 gives a general summary of the industry by classes for 1900, and Table 4 a comparative summary for 1890 and 1900. In Table 5 are presented comparative statistics relating to the main division of the industry, newspapers and periodicals, covering the period 1880 to 1900. All tables which follow, with the exception of Table 18, relate to this division of the subject. Table 11 classifies newspapers and periodicals according to period of issue and character of publication, 1880 to 1900, while Tables 15 and 19 deal with number and circulation, 1850 to 1900, and with average circulation per issue, 1880 to 1900, respectively, of newspapers and periodicals classified by period of issue. Table 21 gives the number of newspapers and periodicals in 1880, 1890, and 1900, classified according to the language in which printed. Tables 25 and 27 give cost of paper used and value of products, respectively, in 1900. In Table 28 the states and territories are ranked according to the aggregate circulation per issue of newspapers and periodicals in 1900. Table 29 gives statistics relating to daily publications in 50 cities for 1900, and Table 30 gives similar statistics for 27 cities for 1880, 1890, and 1900. Table 33 presents, by states and territories, the circulation and the number of inhabitants to each copy per issue of all newspapers and periodicals published in 1900. Table 34 is a comparative summary, by states and territories, of the newspaper and periodical industry for the years 1880, 1890, and 1900. Table 35 is a comparative statement, by states and territories, of the average and aggregate circulation per issue of newspapers and periodicals published in 1880, 1890, and 1900. Table 42 gives, by states and territories, the number of publications in 1880, 1890, and 1900, classified according to period of issue and character of publication. Table 49 gives, by states and territories, for newspapers and periodicals reporting in 1900, the aggregate circulation per issue and the aggregate number of copies issued, classified according to period of issue. Table 54 is a summary, for cities of over 20,000 inhabitants, of book and job printing in 1900. Table 58 is a detailed summary, by states and territories of the newspaper and periodical industry in 1900.

In addition to these main tables, a number of derivative tables have been prepared, in order to bring out comparisons of special interest in connection with the topics discussed in the text.

In Part II is presented a detailed description of the principal mechanical improvements and of the changes in news gathering which have marked this industry since 1890, and in some cases since 1880.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the general heads of the inquiry, except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890. With the exception of these and several other changes in the special features of the schedules, which do not affect the value of the statistics for comparative purposes, the investigation has been conducted along the lines followed at the census of 1890.

In some instances the number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations.

The reports show a capital of $292,517,072 invested in the 22,312 establishments reporting for the industry. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the corporations. The value of the products is returned at $347,055,050, to produce which involved an outlay of $36,090,719 for salaries of officials, clerks, etc.; $84,249,889 for wages; $55,897,529 for miscellaneous expenses, including rent, taxes, etc.; and $86,856,290 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of the products during the census year. The census schedule takes no cognizance of the cost of selling, or of interest on capital invested, or of depreciation in plant. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures.

PRINTING AND PUBLISHING.

By William S. Rossiter, *Expert Special Agent.*

The separation of the statistics of printing and publishing into "newspapers and periodicals" and "book and job printing" is necessarily so difficult that a complete division has not been attempted in the tables and discussion which appear in this report.

In this industry the practice of the large cities differs sharply from that of the smaller communities. In the former, book and miscellaneous printing and the printing and publishing of newspapers and periodicals are separated into two distinct industries. While it is true that type and printing presses are employed in both, the plant of a large city newspaper is adapted solely to its own routine requirements, would be practically useless in a job office, and seldom contains enough job material even to produce its own stationery. In the large communities newspaper proprietors have secured their experience in their own profession, and frequently are unfamiliar with job printing. The city job printer, on the other hand, considers his calling a distinct one, knows little of the mechanical requirements of the daily paper, and does not regard newspapers as competitors in the remotest sense. These are the extremes. Between them are the small publications and the numerous trade periodicals, which seldom own their own plants. Publications of this description patronize job printers to avoid the installation of individual plants, but in any division of the products of the industry they should, of course, be classed with newspapers.

In villages, towns, and cities of less than 20,000 inhabitants, with few exceptions, the newspaper office is the job office, and the accounts of the two ventures are so interwoven that satisfactory separation is impossible. The newspaper is merely one item of the total product, but generally gives the establishment its name, directs its policy, and often determines the success or failure of the office.

At the Tenth Census newspapers and periodicals were treated in an able and exhaustive report by Mr. S. N. D. North. The job office, however, received no attention, except in the most general way, at either the Tenth or the Eleventh Census. In 1900 the job offices in the large cities were so numerous, represented so great an investment, used such a diversity of materials, and turned out products of so great value, that more than passing reference to this branch of the industry is clearly due.

This report is divided into two parts: Part I, tables and analysis; Part II, progress in the printing and publishing industry. In Part I are presented 55 tables, preceded by a summary. Of these tables, 4 relate to the general subject of printing and publishing, 50 to newspapers and periodicals, and 1 to book and job printing. Of these tables the more important are so constructed as to be comparable with the tables presenting the statistics of this industry at the Eleventh Census. The remaining tables are merely comparisons derived from the 19 main tables, and with a few exceptions contain no original figures.

In Part II is presented a detailed description, also preceded by a summary, of the principal mechanical improvements, and of the changes in news gathering, which have marked this industry since 1890, and in some cases since 1880.

I. TABLES AND ANALYSIS.

The more important conclusions, which seem justified from careful consideration of the tables appearing in this report, may be thus summed up:

When the two branches of the industry are separated—as far as separation of products so closely related is possible—the total value of all book and job printing products is about equal to the total value of all distinctive newspaper products; the former, including the printing and publishing of music, being $168,930,707, or 48.7 per cent of the total, and the latter $175,789,610, or 50.7 per cent of the total.

The capital invested in both branches of this industry showed a marked increase, while the value of products per establishment declined. The number of establishments in the newspaper and periodical branch, proportionately 83 to every 100 publications in 1890, remained nearly stationary in 1900, being 84 to every 100 publications.

Of all newspaper and periodical establishments 63.3 per cent were owned by individuals, 19.7 per cent in partnership, and only 17.0 per cent by corporations, indicating that combinations of any consequence are unlikely in this industry.

The total number of wage-earners increased only 10 per cent, but the value of products earned by them increased 24 per cent. There was a much greater relative increase among women than men, suggesting that competition may have led to a search for a less expensive form of labor.

Of the total value of products, advertising formed 43 per cent, subscriptions and sales 35.8 per cent, and book and job printing, including miscellaneous products, 21.2 per cent. The proportion of subscriptions and sales steadily declined from 1880, while the proportion which advertising formed steadily increased until it was over half. This suggests that publications depend more and more upon advertising as their principal source of income.

In 1890 the increase in the number of all publications was greater than the increase in population, but in 1900 the increase in number of publications and in population was about the same. It appears, however, that the per cent of increase in the number of daily newspapers and the per cent of increase in urban population remained about the same for two decades, suggesting a certain degree of relationship between these figures.

During the decade there was an increase in the proportion of daily, triweekly, semiweekly, and monthly publications, indicating that the first three mentioned have attracted support from the weekly, and that the monthly has drawn away support from the quarterly.

There was a marked decline in the proportion of publications devoted to special topics, and an advance only in the classes devoted to news topics and to general reading. The total circulation per issue of dailies was enough to supply one for every five inhabitants. The total circulation per issue of weeklies and monthlies was one to two inhabitants.

Publications printed in English formed 94.3 per cent of all publications reporting for 1900, showing a considerable increase over the corresponding figures for the preceding decade. The figures for publications printed in foreign languages indicate a rather close connection with the movement of immigration. The publications printed in foreign languages appear to depend to a large extent upon recent arrivals speaking the language in which the publication is printed. The increase or decrease is, in general, in proportion with the increase or decrease in immigration. The decrease in the proportion of all publications printed in foreign languages may be compared with the facts brought out in Volume II, Twelfth Census, page cxxv, that in 1900 12.2 per cent, and in 1890 15.6 per cent of the foreign born white population at least 10 years of age were unable to speak English, suggests that the immigrants reaching the United States during the past decade have been more ignorant and less interested in the perusal of publications than those who preceded.

One and one-quarter billion pounds of paper were used during the census year. Of this amount 77.6 per cent was consumed for newspapers, 16.4 per cent for books and periodicals, and 6 per cent for job printing, but the proportionate cost was 58.7 per cent, 24.7 per cent, and 16.6 per cent, respectively.

Daily evening newspapers increased more rapidly than daily morning papers. In 1890 there were two evening papers to every morning paper; in 1900 the proportion was about one to three.

The circulation per issue of daily papers in certain large cities, compared with the population, indicates that the inhabitants of certain cities were tributary, in the matter of publication, to certain others. In the circulation of weeklies and monthlies, special publications issued in certain states had a marked effect upon the standing of the product of those states in this industry, as, for example, in Maine and Tennessee.

On analyzing the total circulation reported for each state, it is found that 10 leading states supplied four-fifths of the circulation per issue of all publications. This fact is shown to be true, to a greater or less degree, of all of the principal classes of publications, indicating the concentration of circulation in certain populous states.

However, the influence exerted by 10 states in circulation, is not maintained in number of establishments, capital, or value of products. During the last two decades the number of establishments increased more rapidly in states having a small number of establishments than in those having many. This also suggests, to some extent, concentration of establishments in the more populous states.

All but 16 states and territories showed an increase in the number of publications to each 1,000 inhabitants, but the per cent of increase in aggregate circulation per issue declined in 39 states.

The proportion of inhabitants to each weekly was far more uniform than the proportion to each daily, ranging in the former case from 2,016 for Nevada to 20,407 for Rhode Island; in the latter from 4,703 for Nevada to 191,474 for South Carolina.

Weekly publications were most numerous in proportion to inhabitants in the West and Northwest. New England ranked high in dailies but low in weeklies, suggesting that in that densely settled region the daily had to some extent supplanted the weekly. During the decade the number of inhabitants to each weekly publication increased in 26 out of 49 states, but in less than half of the states and territories did the increase in the number of weeklies keep pace with the increase in population.

The proportion of inhabitants to dailies decreased in 31 states and territories, showing a marked gain in the number of dailies in proportion to the population. All states bordering upon the Great Lakes, and 15 out of 21 seaboard states, showed an increase in the proportionate number of daily newspapers to the number of inhabitants. The states in which the daily lost ground were, in general, those in the far Northwest, where the weekly made its principal gain.

Of all the minor geographic divisions, the Southern North Atlantic—New York, New Jersey, and Pennsylvania—show the most striking advance in the proportion of the total circulation reported. In circulation of daily newspapers all states and territories showed a decided increase. In circulation of weekly publications the Southern South Atlantic group showed a decrease, but all other groups of states and territories showed a moderate increase. In circulation of monthly publications a decrease was shown in the Southern South Atlantic and the Western South Central groups; elsewhere in the United States the increase was very large.

While circulation was centralized, both for the 10 states mentioned as possessing a preponderance of the circulation, and for geographic divisions, no such centralization existed in number of establishments. New England and the Southern North Atlantic states possessed but 21.6 per cent of all establishments, while all except 4 of the states bordering on the Atlantic and Pacific oceans and the Great Lakes showed a per cent of increase less than the average increase for the United States.

The distribution of capital by geographic divisions varied radically from that of the number of establishments. In 8 out of 11 minor geographic divisions the proportion of the total capital reported was less in 1900 than in 1890. The only marked advance was in the Southern North Atlantic group, and this advance was made at the expense of nearly all the others. This fact suggests that the centralization of the industry made most rapid progress in this group. It should be noted that in all divisions the increase was large. So great, however, was the increase in capital in the group mentioned, that it materially affected the per cent of increase for the United States; this was 52.4 per cent, but for the United States, exclusive of the Southern North Atlantic group, it was only 39.3 per cent.

The value of products, considered by minor geographic divisions, showed greater uniformity than the other items mentioned. All divisions showed advances in 1900 except the Southern North Atlantic group.

Table 1 presents the totals, at the census of 1900, for the three classes into which this industry is divided. As already explained, complete separation was impracticable. The value of products for newspapers and periodicals includes the value of a large amount of job printing—shown in Table 5 to be $44,859,226. If this amount be added to $124,071,481, the combined value of products reported for book and job printing and the printing and publishing of music in Table 1, the resulting amount, $168,930,707, or 48.7 per cent of the total value of the products of the industry, represents that share which properly may be claimed for book and job printing, as distinguished from newspapers and periodicals; for the latter the value of products amounted to $175,789,610, or 50.7 per cent of the total. The remaining six-tenths of 1 per cent is a miscellaneous item which can not be classified.

TABLE 1.—SUMMARY BY CLASSES OF PRINTING AND PUBLISHING, 1900.

CLASSES.	Number of establishments.	Capital.	Salaried officials, clerks, etc. — Number.	Salaried officials, clerks, etc. — Salaries.	Wage-earners — Average number.	Wage-earners — Total wages.	Miscellaneous expenses.	Cost of materials used.	Value of products.
Total	22,312	$292,517,072	37,799	$36,090,719	162,992	$84,249,954	$55,897,529	$86,856,990	$347,055,050
Newspapers and periodicals	15,305	192,443,708	27,579	27,015,791	94,604	50,333,051	38,544,642	50,214,904	222,983,569
Book and job	6,920	97,759,398	9,906	8,830,413	67,610	33,541,701	16,690,190	36,191,712	121,799,096
Music	87	2,313,966	314	244,515	778	375,202	663,097	449,674	2,272,385

Classing the printing and publishing of music with book and job printing, the totals in Table 1 are divided between the two branches of the industry in the following proportions:

TABLE 2.—*Proportion in which the totals are divided between the two branches, 1900.*

	Newspapers and periodicals.	Book and job printing.
Number of establishments	68.6	31.4
Capital	65.8	34.2
Salaried officials, clerks, etc	73.0	27.0
Salaries	74.9	25.1
Wage-earners	58.0	42.0
Wages	59.7	40.3
Miscellaneous expenses	69.0	31.0
Cost of materials used	57.8	42.2
Value of products	64.3	35.7

It is here shown that newspapers and periodicals possessed a smaller proportion of capital than of number of establishments, indicating that the average capital per establishment was lower for that class than for book and job printing. Doubtless this is due to the fact, already explained, that book and job offices are generally located in the larger cities.

A comparison of the average capital, cost of materials, and value of products per establishment in the two main branches of the industry, not including the printing and publishing of music, is presented in Table 3.

TABLE 3.—*Comparison of the average capital, cost of materials, and value of products in the two main branches of the industry, 1900.*

	Newspapers and periodicals.	Book and job printing.
Capital	$12,574	$14,127
Cost of materials used	3,281	5,230
Value of products	14,569	17,601

From Table 1 it appears that 74.5 per cent of the value of all products of newspapers and periodicals was expended for wages, materials, and other items of expenditure, while the corresponding per cent for book and job printing was 78.2. In the newspaper and periodical class the cost of materials represented 22.5 per cent of the value of products, and in the book and job printing class 29.5 per cent, or about one-third greater. Were it possible to extricate from the statistics for the newspaper and periodical class the figures for book and job work produced in newspaper offices, it is probable the difference in these percentages would be still more significant. Newspapers and periodicals generally use inexpensive raw materials, while the materials required by the book and job printing office are varied and much more expensive.

If the ratio between cost of materials and value of products in the book and job printing class be applied to the value of book and job work produced in newspaper offices, it will appear that, of the total cost of materials shown in Table 5 for newspapers and periodicals, an expenditure of $36,891,714 was made for materials for newspapers and periodicals, and of $13,323,190 for those for book and job work produced in newspaper offices. According to these figures the cost of materials for newspapers and periodicals was 21 per cent of the value of newspaper products, and for book and job printing it was 29.7 per cent of the book and job products shown in Tables 1 and 5—indicating that the ratio of cost of materials to value of products was more than 40 per cent greater for book and job printing than for the printing and publishing of newspapers and periodicals.

Table 4 presents a comparative summary for the whole industry for 1890 and 1900. Comparison with the figures for the censuses of 1850 to 1880, although much to be desired, is impracticable. The figures for the earlier decades, and even some of those for 1880, are not comparable with those of the Eleventh and Twelfth censuses. The difficulty in separating the two parts of the industry, which already has been noted appears to have resulted in an underestimate of the number of establishments at one or more censuses. This, with other points of difference, renders the figures for 1850 to 1880, inclusive, practically valueless for purposes of comparison.

TABLE 4.—*Comparative summary of printing and publishing, 1890 and 1900, with per cent of increase.*

	1900	1890	Per cent of increase.
Number of establisbments	22,312	16,566	34.7
Capital	$292,517,072	$195,387,445	49.7
Salaried officials, clerks, etc., number	37,799	[1]28,391	33.1
Salaries	$36,090,719	[1]$26,272,756	37.4
Wage-earners, average number	162,992	136,836	19.1
Total wages	$84,249,954	$78,810,319	6.9
Men, 16 years and over	125,964	110,434	14.1
Wages	$74,288,521	$71,310,415	4.2
Women, 16 years and over	28,765	19,026	51.2
Wages	$8,878,073	$6,604,046	34.4
Children, under 16 years	8,263	7,336	12.0
Wages	$1,083,360	$895,858	20.9
Miscellaneous expenses	$55,897,929	$46,971,768	19.0
Cost of materials used	$86,856,290	$68,[illegible]58,915	26.1
Value of products	$347,055,050	$275,452,515	26.0

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900.

The figures for all the items appearing in Table 4 have become so great that a small per cent of increase now represents an absolute increase greater than that shown by a relatively high per cent in earlier decades. While the percentages of increase for the several items are very moderate, the absolute increases are gratifyingly large.

For the censuses from 1850 to 1880, inclusive, the statistics of capital were regarded, even at the time of enumeration, as difficult to secure and of uncertain value. Gen. F. A. Walker, Superintendent of the Ninth Census, expressed this opinion: "No man in business knows what he is worth; far less can he say what portion of his estate is to be treated as capital."[1] Prior to 1890 the inquiry concerning capital was a general one, different in form from that now employed.

NEWSPAPERS AND PERIODICALS.

A comparative summary of the figures relating to newspapers and periodicals, from 1880 to 1900, inclusive, is presented in Table 5.

To some extent this table also illustrates the difficulty of making satisfactory comparisons prior to 1890. Out of 23 items shown for 1890 and 1900, only 9 were reported in 1880, the number of establishments, capital, and certain other items being omitted.

TABLE 5.—*Comparative summary of newspapers and periodicals, 1880 to 1900, with per cent of increase for each decade.*

	DATE OF CENSUS.			PER CENT OF INCREASE.	
	1900	1890	1880	1890 to 1900	1880 to 1890
Number of establishments	15,305	12,362	(2)	23.8	......
Capital	$192,443,708	$126,269,885	[3]$53,000,000	52.4	138.2
Salaried officials, clerks, etc., number	27,579	[3]20,120	(5)	37.1	......
Salaries	$27,015,791	[4]$17,777,173	(5)	52.0	......
Wage-earners, average number	94,604	85,975	71,615	10.0	20.1
Total wages	$50,333,051	$50,824,359	$28,559,336	[6]1.0	78.0
Men, 16 years and over	73,653	70,424	(5)	4.6	......
Wages	$44,961,533	$46,960,047	(5)	[6]4.3	......
Women, 16 years and over	14,815	9,587	(5)	54.5	......
Wages	$4,628,221	$3,222,192	(5)	43.6	......
Children, under 16 years	6,136	5,964	(5)	2.9	......
Wages	$743,297	$642,120	(5)	15.8	......
Miscellaneous expenses	$38,544,642	$35,727,039	(2)	7.9	......
Materials used:					
Total cost	$50,214,904	$38,955,322	(2)	28.9	......
Paper, pounds	1,233,142,248	522,876,161	189,145,048	123.0	192.3
Products:					
Total value	$222,983,569	$179,859,750	(2)	24.0	......
Newspaper products	$175,789,610	$143,586,448	$89,009,074	22.4	61.3
Advertising	$95,861,127	$71,243,361	$39,136,306	34.6	82.0
Subscriptions and sales	$79,928,483	$72,343,087	$49,872,768	10.5	45.1
Book and job printing products	$44,859,226	$32,812,113	(2)	36.7	......
All other products	$2,334,733	$3,461,189	(2)	[6]325	......

[1] Tenth Census: The Newspaper and Periodical Press, by S. N. D. North, page 79.
[2] Not reported.
[3] Estimated.
[4] Includes proprietors and firm members, with their salaries; number only reported in 1900. (See Table 58.)
[5] Not reported separately.
[6] Decrease.

TABLE 5.—*Comparative summary of newspapers and periodicals, 1880 to 1900, with per cent of increase for each decade*—Continued.

	DATE OF CENSUS.			PER CENT OF INCREASE.	
	1900	1890	1880	1890 to 1900	1880 to 1890
Number of publications[1]	18,226	14,901	10,132	22.3	47.1
Aggregate circulation per issue[2]	114,299,334	69,138,934	31,779,686	65.3	117.6
Aggregate number of copies issued during the census year[3]	8,168,148,749	4,681,113,530	2,067,848,209	74.5	126.4

[1] Does not include certain publications which did not report operations as follows: In 1880, 1,182; in 1890, 2,715; in 1900, 3,046.
[2] "Aggregate circulation per issue" is the sum of the totals for the average circulation per issue reported by each establishment.
[3] Obtained for each class of publication by multiplying the aggregate circulation per issue by the number of issues during the year.

PUBLICATIONS NOT REPORTING.

In any discussion of the statistics of newspapers and periodicals, early reference should be made to the number of publications from which no report was received.

The numbers reporting and not reporting at the censuses of 1880, 1890, and 1900 were as follows:

TABLE 6.—*Publications reporting and not reporting, 1880 to 1900.*

YEAR.	NUMBER OF PUBLICATIONS.			Per cent those not reporting form of total.
	Total.	Reporting.	Not reporting.	
1900	21,272	18,226	3,046	14.3
1890	17,616	14,901	2,715	15.4
1880	11,314	10 132	1,182	10.4

The number of publications classed as not reporting was ascertained by reference to the standard newspaper directories. By this method of comparison it appears that at the Twelfth Census the number of publications not reporting amounted to 14.3 per cent of the total, a proportion slightly less than that for 1890. Of the 3,046 publications stated as not reporting, a considerable number undoubtedly had gone out of existence; many others were so small and unimportant that they were in no respect a factor in this enumeration; and still others were doubtless of a class not reported by the census. It is clear, therefore, that the number of unreported publications which, by reason of standing, capital, and value of products, were entitled to consideration, was so small that had the totals been obtained, they would have but slight influence upon the figures presented in this report. Therefore, the publications not reporting in 1900 will be regarded as a negligible quantity.

NUMBER OF ESTABLISHMENTS AND PUBLICATIONS.

As the census of 1880 did not record the number of establishments, the figures relating to this subject can be compared only for 1890 and 1900. The proportion of establishments to publications remained practically stationary during the decade, being 82.9 to every 100 publications in 1890, and 84 in 1900. In the absence of information concerning the number of establishments in 1880, it is interesting to observe that if the ratio for 1880 was the mean of those given above, the number of establishments in 1880 was approximately 8,450, but for obvious reasons no statistical value can be claimed for this figure.

By considering here the details presented in Table 58 concerning number of establishments, it appears that 9,686, or 63.3 per cent of the total number, were owned and operated by individuals; 3,016, or 19.7 per cent, were owned and operated by some form of partnership; and 2,603, or 17.0 per cent, were owned and operated by corporations (including 183 miscellaneous forms of ownership). These figures indicate the complete absence of the extended combinations and consolidations so frequently encountered in other industries.

Comparison of Tables 4 and 5 reveals the fact that the increase in the number of all establishments, 34.7 per cent, was more rapid than in the number in the newspaper and periodical class, which increased 23.8 per cent. This is due to the marked growth in the number of establishments in the book and job printing class, which increased 67.8 per cent.

It appears from Table 5 that the increase in the number of publications was less rapid from 1890 to 1900 than during the previous decade, and that the increase in the total number of copies of newspapers and periodicals issued during the census year, though very large, amounting to 74.5 per cent, was much less than that shown in 1890, which amounted to 126.4 per cent.

CAPITAL.

Analysis of the statistics of capital and products presented in Table 5, is given below:

TABLE 7.—*Average capital, average value of products, and per cent that value of products forms of capital, 1890 and 1900.*

YEAR.	Average capital.	Average value of products.	Per cent that value of products forms of capital.
1900	$12,574	$14,569	115.9
1890	10,214	14,549	142.4

In 1890 the average capital was $10,214, and in 1900 it was $12,574, an increase of 23.1 per cent. The average value of products, however, was almost stationary; therefore, the per cent of value of products to capital, which was 142.5 in 1890, fell to 115.9 in 1900. These figures are confirmatory of a change especially characteristic of the last decade, by which increasing capital is required to produce the same or even a smaller value of products.

Comparison of Tables 4 and 5 also shows that the increase in capital in newspaper and periodical establishments, 52.4 per cent, was more rapid than in all establishments, in which it was 49.8 per cent.

WAGE-EARNERS.

Table 5 shows that during the decade from 1890 to 1900 the total number of employees in the newspaper and periodical class increased 10 per cent. Table 8 shows the changes in the proportion of men, women, and children employed.

TABLE 8.—*Total number of wage-earners, and proportion of men, women, and children employed, 1890 and 1900.*

YEAR.	Total wage-earners.	PER CENT OF TOTAL.		
		Men.	Women.	Children.
1900	94,604	77.8	15.7	6.5
1890	85,975	81.9	11.2	6.9

The proportion of women to the total number increased from 11.2 to 15.7, a difference of 4.5 per cent. This gain was made practically at the expense of male wage-earners, the proportion of whom decreased from 81.9 to 77.9, a difference of 4.0 per cent. The proportion of children employed for wages remained practically stationary.

It has been explained in Volumes VII and VIII of the Twelfth Census Reports that for comparative purposes the figures for 1890 and 1900 relating to wage-earners and wages are less trustworthy than other items reported, because of changes in classification. In the reports mentioned these changes are explained in detail. Should the figures given in Table 5 be accepted as permitting an approximate comparison, it would appear that an increase of 10 per cent in wage-earners secured an increase of 24 per cent in value of products, and that the absolute increase in male wage-earners was but 3,229, while the absolute increase in female wage-earners was 5,228. Indeed, the latter figure would have been even larger had the age classification remained the same in 1900 as in 1890.

VALUE OF PRODUCTS.

The total value of all products of newspaper and periodical establishments increased $43,123,819, or 24 per cent, between 1890 and 1900. Of the items composing the total value of products, by far the lowest increase, 10.5 per cent, was shown for "subscriptions and sales." This fact, taken in connection with the decided increase in the amount of paper used, illustrates one of the marked features of the development of the industry—the increase in the number of pages issued by almost all newspapers and magazines. The causes of this increase in the size of publications are discussed elsewhere in this report.

Of the total value of products given in Table 5, advertising forms 43 per cent, subscriptions and sales 35.8 per cent, and book and job printing and all other products together 21.2 per cent. Of these three items book and job printing shows the largest per cent of increase during the last decade. Comparison of the percentages of increase in advertising and in subscriptions and sales for the decades from 1880 to 1890 and from 1890 to 1900 shows a shrinkage from 82 per cent to 34.6 per cent in the former and from 45.1 per cent to 10.5 per cent in the latter.

The decline in the relative importance of subscriptions and sales and the advance of advertising are clearly shown for three census years in Table 9.

TABLE 9.—*Proportion which advertising and subscriptions and sales form of total value of newspaper products, 1880 to 1900.*

YEAR.	Advertising, per cent.	Subscriptions and sales, per cent.
1900	54.5	45.5
1890	49.6	50.4
1880	44.0	56.0

A comparison, for 1890 and 1900, of the proportion contributed to the total value of all products by the two items referred to above, shows a decline in subscriptions and sales, an advance in advertising, and also a slight advance in book and job printing.

TABLE 10.—*Proportion which advertising, subscriptions and sales, and book and job printing form of the total value of all products, 1890 and 1900.*

YEAR.	Per cent which advertising forms of value of products.	Per cent which subscriptions and sales form of value of products.	Per cent which book and job printing forms of value of products.
1900	43.0	35.8	21.2
1890	39.6	40.2	20.2

Tables 9 and 10 establish the important fact that publishers are depending more on advertising and less on subscriptions and sales for financial return. This conclusion is confirmed by the fact that the most notable increases for the past decade, shown in Table 5—except that for paper, already referred to—are in "aggregate circulation per issue" and "aggregate number of copies issued during the census year," suggesting the conclusion that the publishers of newspapers and periodicals, pushed by competition and by the necessity for an increase of circulation to meet the exactions of the advertiser have increased their capital and forced a larger circulation, which has not shown a proportionate increase in the financial return.

PERIOD OF ISSUE AND CHARACTER OF PUBLICATION.

Publications are classified in Table 11 by period of issue and by character.

TABLE 11.—*Classified according to period of issue and character of publication, 1880 to 1900, with per cent of increase for each decade.*

	NUMBER OF PUBLICATIONS REPORTING.			PER CENT OF INCREASE.	
	1900	1890	1880	1890 to 1900	1880 to 1890
Total	18,226	14,901	[1]11,314	22.3	31.7
Period of issue:					
Daily	2,226	1,610	971	38.3	65.8
Triweekly	62	84	73	82.4	[2]53.4
Semiweekly	637	194	133	228.3	45.9
Weekly	12,979	10,814	8,633	20.0	25.3
Monthly	1,817	1,734	1,167	4.8	48.6
Quarterly	237	225	116	5.3	94.0
All other classes	268	290	221	[2]7.6	31.2
Character of publication:					
News, politics, and family reading	14,867	11,326	8,863	31.3	27.8
Religion	952	1,025	553	[2]7.1	85.4
Agriculture, horticulture, dairying, and stock raising	307	263	173	16.7	52.0
Commerce, finance, insurance, railroads, and trade	[3]710	671	363	5.8	84.8
General literature, including magazines	239	291	189	[2]17.9	54.0
Medicine and surgery	111	123	114	[2]9.8	7.9
Law	62	47	45	31.9	4.4
Science and mechanics	66	83	68	[2]20.5	22.1
Fraternal organizations	200	216	149	[2]7.4	45.0
Education and history	[4]259	256	248	1.2	3.2
Society, art, music, and fashion	88	152	72	[2]42.1	111.1
Miscellaneous	[5]365	448	477	[2]18.5	[2]6.1

[1] Includes 1,182 publications not reporting operations, as they can not be excluded from the classification.
[2] Decrease.
[3] Includes 520 "trade journals."
[4] Includes 139 "college and school periodicals."
[5] Includes 72 "Sunday newspapers."

It will be observed from Table 11 that while the triweekly, a class with unimportant totals, suffered a severe decline during the decade from 1880 to 1890, the other classes of publications under "period of issue" increased by percentages ranging from 25.3 to 94. In the decade from 1890 to 1900 there were no decreases, but the increases recorded for the daily, weekly, monthly, and quarterly classes were much smaller than for the same classes during the preceding decade. The most noteworthy increase was in the semiweekly publications, of which there were 133 in 1880, 194 in 1890, and 637 in 1900. The increase shown at the last-named date was 443 publications, or 228.4 per cent. This is in marked contrast to the moderate advances recorded for the other classes, and doubtless reflects an effort, on the part of a considerable number of publishers of weekly newspapers in towns located near large cities, to overcome the injurious effects of competition with city dailies. There have been many instances, during the decade, in which a weekly has been advanced to a semiweekly, thus doubling the number of issues with little or no increase in the subscription price.

As shown by this table, the absolute increase in the number of publications during the decade was 3,325. For the decade ending in 1890 the per cent of increase in the number of all publications was greater than the per cent of increase in population, the former being 31.7 per cent and the latter 24.9. In the decade from 1890 to 1900 the percentages for both items decreased, becoming 22.3 for all publications and 20.7 for population—a similarity which, while interesting, was doubtless merely a coincidence. It is worthy of note, however, that for two decades the per cent of increase in the number of daily newspapers has been nearly the same as the per cent of increase in urban population. The foregoing facts, together with the number of ininhabitants to each publication, are presented in Table 12.

TABLE 12.—*Number of inhabitants to each publication, 1880 to 1900, and per cent of increase for each decade in urban population and in number of daily newspapers.*

YEAR.	Number of inhabitants to each publication.	PER CENT OF INCREASE IN PRECEDING DECADE.	
		In urban population.	In number of daily newspapers.
1900	4,170	36.8	38.3
1890	4,224	61.4	65.8
1880	4,433	....	....

The two following tabular comparisons give the percentage which each class forms of the total number of publications for 1880, 1890, and 1900, when classified by "period of issue" and by "character of publication."

TABLE 13.—*Per cent that each class, by period of issue, forms of total number of publications, 1880 to 1900.*

PERIOD OF ISSUE.	1900	1890	1880
Daily	12.2	10.8	8.6
Triweekly	0.3	0.2	0.6
Semiweekly	3.5	1.3	1.2
Weekly	71.2	72.6	76.3
Monthly	10.0	11.6	10.3
Quarterly	1.3	1.5	1.0
All other classes	1.5	2.0	2.0

TABLE 14.—*Per cent that each class, by character of publication, forms of total number of publications, 1880 to 1900.*

CHARACTER OF PUBLICATION.	1900	1890	1880
News, politics, and family reading	81.6	76.0	78.3
Religion	5.2	6.9	4.9
Agriculture, horticulture, dairying, and stock raising	1.7	1.8	1.5
Commerce, finance, insurance, railroads, and trade	3.9	4.5	3.2
General literature, including magazines	1.3	2.0	1.7
Medicine and surgery	0.6	0.8	1.0
Law	0.3	0.3	0.4
Science and mechanics	0.4	0.6	0.6
Fraternal organizations	1.1	1.4	1.3
Education and history	1.4	1.7	2.2
Society, art, music, and fashion	0.5	1.0	0.7
Miscellaneous	2.0	3.0	4.2

From Table 13 it will be observed that for the twenty-year period from 1880 to 1900 the daily, the semiweekly, and the quarterly show small relative advances, and the weekly and the monthly show small declines. The changes shown for the past decade are of especial interest; the quarterly falls out of the advancing class, but the daily and the semiweekly continue to show moderate advances, made at the expense of the quarterly as well as of the weekly and the monthly. This result is a manifestation of the energetic and impatient spirit of the period.

Examination of the above comparison of character of publications reveals the fact that during the decade from 1880 to 1890 there was a slight decline in the relative importance of publications devoted to news, politics, and general reading, but that publications devoted to religion, to agriculture and kindred pursuits, to business interests, to general literature, to fraternal orders, and to society, art, music, and fashion, benefiting by the decline of the first-named class, showed small advances. The figures for the Twelfth Census show that a marked change took place during the last decade. The advance of publications devoted to special subjects was checked, while those devoted to news, politics, and general reading made a decided relative increase at the expense of all others, except those devoted to law, a relatively insignificant class, which remained stationary. The reason for the change thus indicated is unmistakable. Publications devoted to specialties slowly yielded ground to the large daily newspapers, which invaded every field of journalism.

This noteworthy situation seems to have been due principally to three causes: The resistless activity of the period, which made the Sunday edition of the daily newspaper a department store of journalism, ransacking all lines of thought and every public interest for material to present; the perfection of the composing machine, by the use of which one competent operator can accomplish the work of from 5 to 10 compositors; and the development of the inexpensive and satisfactory methods of illustration known as the "line cut" and the "half-tone," which made possible the rapid transference of a photograph to the columns of a newspaper.

It is impossible to measure the effect of the invention of mechanical composition. If it were not for the entirely new situation which it produced, the will and the ability to expand the daily from old-fashioned proportions might have struggled in vain against the high cost of hand composition, notwithstanding the mental activity of the period. The daily press and many other periodicals have been prompt to seize upon this advance in the industry, and are now equipped for machine composition. In this manner a revolution has been accomplished in the output of many publications; the number of printed pages has been greatly increased; the freer use of composition has made possible the introduction of departments or columns devoted to periodic or even daily consideration of special subjects, often cleverly treated; and the daily paper, or the Sunday edition of the daily, has to some extent supplanted publications devoted to specialties. The reading matter now presented is not only satisfying to the reader, but, in amount, often beyond his capacity to assimilate. This is true especially of many of the Sunday publications, which varied in 1900 from 24 to 120 pages, with special departments or supplements devoted to leading subjects, such as literature, art, religion, science, sports, music, the drama, etc.

Table 15 presents the number and circulation of newspapers and periodicals, classified according to period of issue, from 1850 to 1900.

Table 15.—NUMBER AND CIRCULATION OF NEWSPAPERS AND PERIODICALS, CLASSIFIED ACCORDING TO PERIOD OF ISSUE, 1850 TO 1900.

YEAR.	ALL CLASSES.			DAILY.		TRIWEEKLY.		SEMIWEEKLY.	
	Number.	Total circulation per issue.	Aggregate number of copies issued during the census year.	Number.	Total circulation per issue.	Number.	Total circulation per issue.	Number.	Total circulation per issue.
1900	18,226	114,299,334	[1]8,168,148,749	2,226	15,102,156	62	228,610	637	2,832,868
1890	14,901	69,138,934	4,681,113,530	1,610	8,387,188	34	50,067	194	561,743
1880	[2]11,314	[3]31,779,686	2,067,848,209	971	3,566,395	73	68,086	133	264,910
1870	5,871	20,842,475	1,508,548,250	574	2,601,547	107	155,105	115	247,197
1860	4,051	13,663,409	927,951,548	387	1,478,435	86	107,170	79	175,165
1850	2,526	5,142,177	426,409,978	254	758,454	115	75,712	31	53,511

YEAR.	WEEKLY.		MONTHLY.		QUARTERLY.		ALL OTHER CLASSES.[4]	
	Number.	Total circulation per issue.	Number.	Total circulation per issue.	Number.	Total circulation per issue.	Number.	Total circulation per issue.
1900	12,979	39,852,052	1,817	39,519,897	237	11,217,422	268	5,546,329
1890	10,814	28,954,515	1,734	19,624,038	225	8,124,500	290	3,436,888
1880	8,633	[3]16,266,830	1,167	[3]8,139,881	116	[3]1,944,299	221	[3]1,379,285
1870	4,295	10,594,643	622	5,650,843	49	211,670	109	1,381,470
1860	3,173	7,581,930	280	3,411,959	30	101,000	16	807,750
1850	1,902	2,944,629	100	740,651	19	25,875	105	543,345

[1] Obtained, for each class of publications, by multiplying the average circulation for each issue by the number of issues during the year.
[2] Includes 1,182 publications not reporting circulation, as they can not be excluded from the classification.
[3] The circulation of 5 weeklies, 1 semimonthly, 14 monthlies, and 12 quarterlies not reported separately, amounting to 150,000, is given only for "all classes."
[4] Includes publications issued semimonthly, semiannually, annually, etc.

By dividing a total circulation of 100 per cent proportionately among the different classes, for a period of half a century, the following results are obtained:

TABLE 16.—*Per cent that circulation per issue of each class forms of total circulation per issue, 1850 to 1900.*

PERIOD OF ISSUE.	1900	1890	1880	1870	1860	1850
All classes	100.0	100.0	100.0	100.0	100.0	100.0
Daily	13.2	12.1	11.2	12.5	10.8	14.7
Triweekly	0.2	0.1	0.2	0.8	0.8	1.5
Semiweekly	2.5	0.8	1.9	1.2	1.3	1.0
Weekly	34.9	41.9	51.2	50.8	55.5	57.3
Monthly	34.6	28.4	26.0	27.1	25.0	14.4
Quarterly	9.8	11.7	6.1	1.0	0.7	0.5
All other classes	4.8	5.0	4.4	6.6	5.9	10.6

From Table 16 it will be observed that the daily class, after fluctuating during the period from 1850 to 1880, advanced from 11.2 per cent in 1880 to 13.2 per cent in 1900; that the weekly declined steadily in relative importance from 57.3 per cent, or more than half of the circulation of all newspapers and periodicals, in 1850, to 34.9 per cent in 1900. Of the other classes the most notable change in circulation was shown by the monthlies, which advanced 6.2 per cent during the last decade. It is probable that this change is due to the establishment of inexpensive magazines, which have a large circulation, and which, in their present perfection, are distinctly a product of the decade from 1890 to 1900. Among the causes which have made them possible are cheapened composition and illustration, and the improvements in the manufacture of printing presses.

TABLE 17.—*Absolute increase in the total circulation per issue of each class, 1850 to 1900.*

PERIOD OF ISSUE.	1890 to 1900	1880 to 1890	1870 to 1880	1860 to 1870	1850 to 1860
All classes	45,160,400	37,359,248	10,937,211	7,179,066	8,521,232
Daily	6,714,968	4,820,793	964,848	1,123,112	719,981
Triweekly	178,543	[1]18,019	[1]87,019	47,935	31,458
Semiweekly	2,271,125	296,833	17,713	72,032	121,654
Weekly	10,897,537	12,687,685	5,672,187	3,012,713	4,637,301
Monthly	19,895,859	11,484,157	2,489,038	2,238,884	2,671,308
Quarterly	3,092,922	6,180,201	1,732,629	110,670	75,125
All other classes	2,109,446	2,057,598	[1]2,185	573,720	264,405

[1] Decrease.

This comparison, drawn from Table 15, throws additional light upon the increase in the circulation of newspapers and periodicals during the past decade. With the exception of the weekly and the quarterly, each class showed a greater absolute increase from 1890 to 1900 than during any other decade of the half century. For both the weekly and the quarterly, the increase during the decade from 1890 to 1900 was exceeded only by that of the preceding decade. This statement emphasizes the rapid growth in the circulation of monthly publications. The normal increase in the circulation of this class of periodicals, which during the twenty years from 1860 to 1880 remained nearly constant at about 2,500,000, advanced in 1890 to 11,484,157, and in 1900 this figure was almost doubled, the absolute increase being 19,895,859.

TABLE 18.—*Aggregate circulation per issue of daily, weekly, and monthly publications, and circulation per 1,000 inhabitants, 1880 to 1900.*

PERIOD OF ISSUE.	AGGREGATE CIRCULATION PER ISSUE.			CIRCULATION PER 1,000 INHABITANTS.		
	1900	1890	1880	1900	1890	1880
Daily	15,102,156	8,387,188	3,566,395	199	133	71
Weekly	39,852,052	28,954,515	16,266,830	524	460	324
Monthly	39,519,897	19,624,038	8,139,881	520	312	162

From Table 18 it appears that the total circulation per issue of daily newspapers was sufficient to supply about one in every five inhabitants, and of weeklies and monthlies each about one in every two inhabitants. In this respect the increase was most marked in the monthly class.

The average circulation per issue of newspapers and periodicals, by period of issue, from 1880 to 1900, is presented in Table 19.

TABLE 19.—*Average circulation per issue, 1880 to 1900.*

PERIOD OF ISSUE.	AVERAGE CIRCULATION PER ISSUE.		
	1900	1890	1880
All classes	6,271	4,640	3,122
Daily	6,784	5,209	4,137
Triweekly	3,687	1,473	1,001
Semiweekly	4,447	2,896	2,136
Weekly	3,071	2,678	2,113
Monthly	21,750	11,317	7,834
Quarterly	47,331	36,109	16,505
All other classes	20,695	11,851	6,474

Representing by percentages the fluctuations shown in this table, the movement of circulation for the past two decades was as follows:

TABLE 20.—*Per cent of increase in average circulation, by periods of issue, from 1880 to 1890 and from 1890 to 1900.*

PERIOD OF ISSUE.	1890 to 1900	1880 to 1890
All classes	35.2	48.6
Daily	30.2	25.9
Triweekly	150.3	47.2
Semiweekly	53.6	35.6
Weekly	14.7	26.7
Monthly	92.2	44.5
Quarterly	31.1	118.8
All other classes	74.6	83.1

The tendencies already pointed out appear again in this comparison. Of the important classes, the daily, semiweekly, and monthly show decided advances in the percentage of increase in average circulation during the decade just ended, while the weekly shows a marked decline.

PUBLICATIONS IN DIFFERENT LANGUAGES.

Table 21 presents an interesting classification of the total number of publications reported, into the languages in which they are published.

TABLE 21.—*Newspapers and periodicals classified according to language in which printed, 1880 to 1900.*

LANGUAGE.	NUMBER OF PUBLICATIONS. 1900	1890	1880
Total	18,226	14,901	[1] 11,314
English	17,194	13,848	10,515
Armenian	....	1	....
Bohemian	28	22	13
Bohemian and English	1	1	....
Catalan	....	....	1
Chinese	5	3	2
Dutch	12	16	9
Finnish	7	4	....
French	27	40	41
French and English	4	5	....
Gaelic	....	1	....
Gaelic and English	3	3	....
German	613	727	641
German and English	20	27	....
German and Hebrew	3	4	....
Hebrew	13	5	....
Hungarian	2	1	....
Indian and English	3	1	3
Irish	....	....	1
Italian	35	13	4
Italian and English	....	1	....
Lithuanian	9	1	....
Polish	33	18	2
Portuguese	2	2	2
Scandinavian [2]	115	112	49
Slavonic, not specified	4	2	....
Spanish	39	29	26
Spanish and English	1	7	....
Volapuk	....	1	....
Volapuk and English	....	1	....
Welsh	....	4	5
Welsh and English	1	1	....
All other languages	52	....	....

[1] Includes 1,182 publications not reporting operations, as they can not be excluded from the classification.
[2] Includes Danish, Norwegian, and Swedish.

There were 15 different languages or combinations of languages represented in 1880, 30 in 1890, and 25 in 1900. The principal languages in which increases in the number of periodicals published were shown in 1900, were English, Bohemian, Hebrew, Italian, Polish, Scandinavian, and Spanish. Decreases were shown in the number of periodicals published in Dutch, French, and German. The languages represented by publications in 1880 or in 1890, but not in 1900, were Armenian, Catalan, Gaelic, Irish, "Volapuk," and Welsh. The proportion of the total number of publications printed in each of the principal languages in 1880, 1890, and 1900 is best shown by percentages, as follows:

TABLE 22.—*Per cent that number of publications in each of the principal languages forms of the total number, 1880 to 1900.*

LANGUAGE.	1900	1890	1880
English	94.3	92.9	92.9
Bohemian	0.2	0.2	0.1
French	0.2	0.3	0.4
German	3.4	4.9	5.7
Italian	0.2	0.1	....
Polish	0.2	0.1	....
Scandinavian	0.6	0.8	0.4
Spanish	0.2	0.2	0.2

In 1880, 92.9 per cent of all publications were printed in English; in 1890, although the number of languages or combinations represented was doubled, the proportion of periodicals printed in English remained unchanged; but in 1900 it had advanced to 94.3 per cent. This advance is significant, when considered in connection with the accompanying decrease from 7.1 per cent in 1890 to 5.7 per cent in 1900 in the proportion of publications printed wholly or in part in other languages. On closer examination of Table 22 it will be observed that during the past decade there was an increase in the proportionate number of publications printed in Italian and in Polish; that there was a decline in the relative importance of publications printed in French, German, and the Scandinavian tongues; and that the proportion of publications printed in Bohemian and Spanish remained the same in 1900 as in 1890.

By considering the percentages of increase or decrease in the number of publications printed in the principal languages, in connection with the statistics of population born in the countries in which those languages are spoken, additional light is thrown on the figures presented in Table 21.[1]

TABLE 23.—*Comparison of the per cent of increase or decrease in the number of publications printed wholly or partly in the principal foreign languages, with the per cent of increase or decrease in population born in the countries in which those languages are spoken, from 1880 to 1890 and from 1890 to 1900.*

COUNTRY.	PER CENT OF INCREASE OR DECREASE IN NUMBER OF PUBLICATIONS. 1890 to 1900	1880 to 1890	PER CENT OF INCREASE OR DECREASE IN FOREIGN BORN POPULATION. 1890 to 1900	1880 to 1890
France	[1] 31.1	9.8	[1] 7.8	5.8
Germany	[1] 16.0	17.6	[1] 4.2	41.6
Italy	150.0	250.0	165.2	312.8
Poland and Russia	85.0	900.0	144.7	291.1
Scandinavia	2.7	128.6	14.0	112.0

[1] Decrease.

The percentages of increase and decrease in number of publications appearing in Table 23, though based upon figures too small to be of any value in themselves, are of great interest in comparison with the percentages given in the second part of the statement, because they indicate the degree of sympathy existing between the increase or decrease in the number of publications printed in the language and devoted to the interests of any one country, and the movement of emigration from that country. From these figures it is reasonable to conclude that publications of this character depend for support, to a large extent, upon comparatively recent arrivals, and that in general, when emigration from a country decreases, the number of publications printed in the language of that country decreases, and when immigration shows an increase the number of publications also increases. In 1900 the Scandinavian countries furnished the only exception to the conclusion that immigrants, after settling in the United States, soon lose interest in their native land to the extent of ceasing to support publications printed in their mother tongue. The immigration of Scandinavians decreased, while the

[1] Twelfth Census, Population, Part I, page clxxi.

number of publications printed in the Scandinavian languages showed a slight increase.

If the number of residents of the United States in 1900 reporting birth in each of six important foreign countries be divided by the total number of publications printed in the language of their native country, the following figures appear:

TABLE 24.—*Number of residents of the United States born in specified countries to each publication printed in the languages of those countries, 1880 to 1900.*

COUNTRY.	1900	1890	1880
Bohemia	5,413	5,135	6,566
France	3,366	2,515	2,609
Germany	4,213	3,693	3,068
Holland	8,754	6,114	6,454
Italy	13,834	13,041	11,058
Scandinavia	9,255	8,333	8,985

It will be recalled that the number of inhabitants to each publication in 1900 has been shown to be 4,169. From Table 24 it appears that the number of residents of the United States in 1900 born in each of the above-named countries, except France and Germany, to each publication printed in their native tongue, was much larger than the average for the United States. In each case, also, the figures for 1900 show an increase over 1890—that is, a decrease in the proportionate number of publications printed in the language of each of these countries to the number of natives of each residing in the United States.

QUANTITY AND COST OI PAPER USED.

Table 25 shows the quantity and cost of paper used, and the average cost per pound, in 1900.

TABLE 25.—*Quantity, cost, and average cost per pound of paper used, 1900.*

KIND.	Pounds.	Cost.	Average cost per pound (cents).
Total	1,233,142,248	$37,823,856	3.1
News	956,335,921	22,197,060	2.3
Book and periodical	202,296,263	9,356,490	4.6
Job printing	74,510,054	6,270,306	8.4

In this table is presented a division of the paper used in 1900, according to the several classes of products which, combined, produced the total value of products of newspaper and periodical establishments. About one and a quarter billions of pounds were used during the census year. This large quantity was utilized in the following proportions:

	Per cent.
News	77.6
Book and periodical	16.4
Job printing	6.0

It is important, however, to observe that these proportions in weight do not by any means hold good in cost. The latter shows the following proportions:

	Per cent.
News	58.7
Book and periodical	24.7
Job printing	16.6

TABLE 26.—*Per cent that quantity and cost of paper used form of total, 1890 and 1900.*

KIND.	QUANTITY.		COST.	
	1900	1890	1900	1890
Newspapers	77.6	74.1	58.7	61.1
Books and periodicals	16.4	25.9	24.7	38.9
Job printing	6.0		16.6	

It is clear that while the quantity of paper used for newspapers far exceeds that consumed in the other branches of the industry, it is proportionately much less expensive.

The average cost per pound shown in Table 25 adds confirmation to the deduction drawn from Table 5, that the cost of materials for book and job work was over 40 per cent greater than that for newspapers and periodicals. If the item of paper alone were considered, this per cent would be increased. The average cost per pound of paper consumed by newspapers and periodicals combined was 2.3 cents. The average cost per pound of paper for books and periodicals and job printing combined was 5.6 cents.

VALUE OF PRODUCTS.

The items composing the total value of products of newspaper and periodical establishments are presented in detail in Table 27.

TABLE 27.—*Value of products, with per cent which each class forms of the total, 1900.*

	Value.	Per cent of total.
Total	$222,983,569	100.0
Newspaper products:		
Advertising	95,861,127	43.0
Subscriptions and sales	79,928,483	35.9
Book and job printing products:		
Book and pamphlet publications	18,407,528	8.3
Sheet music and books of music	544,802	0.2
Job printing	22,793,322	10.2
Bookbinding	2,067,450	0.9
Blank books	554,557	0.3
Electrotyping, engraving, etc	491,567	0.2
All other products	2,334,733	1.0

The relative importance of these items was considered at some length under Table 5.

RANK OF STATES AND TERRITORIES ACCORDING TO CIRCULATION.

In Table 28 is shown the rank of the several states and territories, according to aggregate circulation, in each class of newspapers and periodicals, by period of issue. This table is of interest as showing relative position at the Twelfth Census, but obviously presents nothing of statistical value, since a decline in rank does not necessarily imply a decrease in aggregate circulation, but may be due, on the contrary, to greater increase of population, or greater increase in the circulation of publications of other classes, or in other sections of the country.

TABLE 28.—RANK OF STATES AND TERRITORIES ACCORDING TO AGGREGATE CIRCULATION PER ISSUE OF NEWSPAPERS AND PERIODICALS, 1900.

STATES AND TERRITORIES.	All classes.	Daily.	Triweekly.	Semi-weekly.	Weekly.	Monthly.	Quarterly.	All other classes.
Alabama	32	30	16	37	32	38		20
Arizona	47	45			48	49		
Arkansas	30	35	14	27	26	30	20	39
California	14	7	18	20	16	17	10	14
Colorado	24	18	19	38	23	22	26	34
Connecticut	25	15		18	31	25	25	17
Delaware	44	36		41	43	42		
District of Columbia	20	25		44	21	11	24	10
Florida	43	37	14	34	40	33		
Georgia	23	24		14	19	23	28	21
Idaho	46	47		36	45	46		37
Illinois	3	3	6	6	2	4	4	7
Indiana	11	9		12	10	9	11	12
Indian Territory	45	49			42	47		
Iowa	13	13	2	7	8	13	14	11
Kansas	16	23	15	22	14	12	15	15
Kentucky	17	17	12	9	17	15		9
Louisiana	28	22	10	15	35	31	18	29
Maine	5	28		23	24	2	16	28
Maryland	21	11		24	20	20	22	33
Massachusetts	6	5		16	5	5	7	4
Michigan	10	8	5	5	12	8	13	18
Minnesota	12	10	8	11	9	10	21	6
Mississippi	37	43	17	43	33	39		35
Missouri	7	6	20	2	6	7	6	5
Montana	40	34		28	41	40	17	
Nebraska	18	20	13	13	15	16	23	26
Nevada	50	46	21	40	50	48		
New Hampshire	34	33	7		30	43		
New Jersey	9	12		39	18	29	8	1
New Mexico	49	48			47	48	29	32
New York	1	1	1	1	1	1	1	2
North Carolina	29	31		19	25	34	30	27
North Dakota	39	41		32	38	36		
Ohio	4	4	3	4	4	6	3	3
Oklahoma	42	44		46	39	45		40
Oregon	26	29		25	28	21		31
Pennsylvania	2	2	4	3	3	3	2	8
Rhode Island	36	21	22	33	44	44	22	
South Carolina	38	40	20	21	36	35		36
South Dakota	31	42		42	34	28		13
Tennessee	8	16		31	7	14	5	23
Texas	19	19		10	13	24	27	24
Utah	41	39	11	17	46	32	32	19
Vermont	35	38		29	37	27	31	22
Virginia	22	26	9	26	22	19	9	25
Washington	27	27	19	30	29	26	19	30
West Virginia	33	32		35	27	41		38
Wisconsin	15	14	14	8	11	18	12	16
Wyoming	48	50	19	45	49	37		

It will be observed that the four most populous states—New York, Pennsylvania, Illinois, and Ohio—maintain the same rank in aggregate circulation that they do in population. At that point uniformity in rank ceases, except in the case of Nevada, which is last in rank, both in population and in aggregate circulation.

Table 29 presents statistics relating to daily publications in 50 cities, for 1900; Table 30 gives the same information for 27 cities, for 1880, 1890, and 1900.

TABLE 29.—STATISTICS RELATING TO DAILY PUBLICATIONS IN 50 CITIES, 1900.

CITIES.	Population of cities.	DAILY PAPERS. Total.	Morning.	Evening.	Aggregate circulation per issue.	Number of inhabitants to each copy per issue.	Rank of cities according to increasing number of inhabitants to each copy per issue.
New York, N. Y	3,437,202	58	29	29	2,732,089	1.26	8
Chicago, Ill	1,698,575	37	16	21	1,099,555	1.54	17
Philadelphia, Pa	1,293,697	21	10	11	1,008,752	1.28	10
St. Louis, Mo	575,238	13	7	6	373,030	1.54	17
Boston, Mass	560,892	16	8	8	761,039	0.74	3
Baltimore, Md	508,957	9	6	3	232,252	2.19	27
Cleveland, Ohio	381,768	11	3	8	258,473	1.48	14
Buffalo, N. Y	352,387	12	3	9	217,989	1.62	18
San Francisco, Cal	342,782	23	15	8	304,185	1.13	6
Cincinnati, Ohio	325,902	13	7	6	516,708	0.63	1
Pittsburg, Pa	321,616	11	7	4	421,741	0.76	4
New Orleans, La	287,104	9	5	4	96,360	2.98	39
Detroit, Mich	285,704	8	3	5	207,110	1.38	11
Milwaukee, Wis	285,315	11	4	7	132,805	2.15	25
Washington, D. C	278,718	8	3	5	100,848	2.76	38
Newark, N. J	246,070	3	1	2	71,832	3.43	40
Jersey City, N. J	206,433	2	....	2	19,580	10.54	43
Louisville, Ky	204,731	8	5	3	136,950	1.49	15
Minneapolis, Minn	202,718	9	6	3	137,906	1.47	13
Providence, R. I	175,597	3	1	2	76,000	2.31	31
Indianapolis, Ind	169,164	9	4	5	135,698	1.25	7
Kansas City, Mo	163,752	9	4	5	226,252	0.72	2
St. Paul, Minn	163,065	7	2	5	114,446	1.42	12
Rochester, N. Y	162,608	7	2	5	88,489	1.84	21
Denver, Colo	133,859	7	2	5	104,485	1.28	10
Toledo, Ohio	131,822	7	3	4	76,860	1.72	19
Columbus, Ohio	125,560	7	2	5	115,728	1.08	5
Worcester, Mass	118,421	5	2	3	49,440	2.40	32
Syracuse, N. Y	108,374	6	1	5	71,982	1.51	16
New Haven, Conn	108,027	5	2	3	42,000	2.57	35
Paterson, N. J	105,171	5	1	4	23,108	4.55	41
Fall River, Mass	104,863	4	....	4	18,890	5.56	42
St. Joseph, Mo	102,979	7	3	4	45,058	2.29	30
Omaha, Nebr	102,555	8	4	4	80,740	1.27	9
Los Angeles, Cal	102,479	6	3	3	48,250	2.12	24
Memphis, Tenn	102,320	3	2	1	95,000	1.08	5
Scranton, Pa	102,026	4	2	2	46,822	2.18	26
Lowell, Mass	94,969	7	2	5	45,160	2.10	23
Albany, N. Y	94,151	8	2	6	75,521	1.25	7
Cambridge, Mass	91,886	1	1	....	2,000	45.94	44
Portland, Oreg	90.426	4	3	1	37,400	2.42	33
Atlanta, Ga	8[illegible], 372	3	2	1	46,061	1.95	22
Grand Rapids, Mich	87,565	4	2	2	56,900	1.54	17
Dayton, Ohio	85,333	5	1	4	34,200	2.50	34
Richmond, Va	85,050	6	4	2	37,810	2.25	29
Nashville, Tenn	80,865	2	1	1	30,000	2.70	37
Seattle, Wash	80,671	5	3	2	44,580	1.81	20
Hartford, Conn	79,850	4	2	2	33,000	2.42	33
Reading, Pa	78,961	5	1	4	30,528	2.59	36
Wilmington, Del	76,508	6	2	4	34,277	2.23	28

TABLE 30.—STATISTICS RELATING TO DAILY PUBLICATIONS IN 27 CITIES, 1880 TO 1900.

CITIES.	Year.	Population of cities.	DAILY PAPERS. Total.	Morning.	Evening.	Aggregate circulation per issue.	Number of inhabitants to each copy per issue.	Rank of cities according to increasing number of inhabitants to each copy per issue.
New York, N. Y	1900	3,437,202	[1]58	29	[1]29	[1]2,732,089	1.26	....
Manhattan and Bronx boroughs	1900	2,050,600	47	28	19	2,632,213	0.78	5
	1890	1,515,301	50	34	16	1,698,553	0.89	1
	1880	1,206,209	29	20	9	765,843	1.58	2
Brooklyn borough	1900	1,166,582	6	1	5	95,476	12.22	25
	1890	806,343	5	....	5	82,448	9.78	27
	1880	566,663	4	....	4	48,537	11.67	22
Chicago, Ill	1900	1,698,575	37	16	21	1,099,555	1.54	15
	1890	1,099,850	27	14	13	644,000	1.71	11
	1880	503,185	18	10	8	220,577	2.28	9
Philadelphia, Pa	1900	1,293,697	21	10	11	1,008,752	1.28	9
	1890	1,046,964	24	13	11	804,008	1.30	6
	1880	847,170	24	13	11	375,274	2.26	8

[1] Queens borough had 5 evening daily newspapers, with a circulation of 4,400.

TABLE 30.—STATISTICS RELATING TO DAILY PUBLICATIONS IN 27 CITIES, 1880 TO 1900—Continued.

CITIES.	Year.	Population of cities.	DAILY PAPERS. Total.	Morning.	Evening.	Aggregate circulation per issue.	Number of inhabitants to each copy per issue.	Rank of cities according to increasing number of inhabitants to each copy per issue.
St. Louis, Mo	1900	575,238	13	7	6	373,030	1.54	15
	1890	451,770	15	9	6	238,525	1.89	13
	1880	350,518	9	8	1	99,364	3.52	14
Boston, Mass	1900	560,892	16	8	8	761,039	0.74	3
	1890	448,477	12	5	7	466,471	0.96	2
	1880	362,839	11	6	5	221,315	1.64	4
Baltimore, Md	1900	508,957	9	6	3	232,252	2.19	19
	1890	434,439	7	6	1	133,510	3.25	22
	1880	332,313	9	6	3	128,643	2.58	10
Cleveland, Ohio	1900	381,768	11	3	8	258,473	1.48	13
	1890	261,353	13	4	9	133,800	1.95	14
	1880	160,146	8	2	6	48,730	3.29	12
Buffalo, N. Y	1900	352,387	12	3	9	217,989	1.62	16
	1890	255,664	10	3	7	120,800	2.12	17
	1880	155,134	7	2	5	26,100	5.94	19
San Francisco, Cal	1900	342,782	23	15	8	304,185	1.13	6
	1890	298,997	21	14	7	286,912	1.04	5
	1880	233,959	21	11	10	143,232	1.63	3
Cincinnati, Ohio	1900	325,902	13	7	6	516,708	0.63	1
	1890	296,908	14	10	4	213,500	1.39	7
	1880	255,139	12	8	4	117,549	2.17	7
Pittsburg, Pa	1900	321,616	11	7	4	421,741	0.76	4
	1890	238,617	10	7	3	232,462	1.03	4
	1880	156,389	9	6	3	111,001	1.41	1
New Orleans, La	1900	287,104	9	5	4	96,360	2.98	22
	1890	242,039	9	4	5	73,900	3.28	23
	1880	216,090	10	6	4	37,565	5.76	18
Detroit, Mich	1900	285,704	8	3	5	207,110	1.38	10
	1890	205,876	8	2	6	134,388	1.53	8
	1880	116,340	6	3	3	41,533	2.80	11
Milwaukee, Wis	1900	285,315	11	4	7	132,805	2.15	18
	1890	204,468	10	5	5	63,200	3.24	21
	1880	115,587	7	4	3	24,300	4.76	16
Washington, D. C	1900	278,718	8	3	5	100,848	2.76	21
	1890	230,392	4	2	2	62,651	3.68	25
	1880	147,293	5	3	2	34,500	4.27	15
Newark, N. J	1900	246,070	3	1	2	71,832	3.43	23
	1890	181,830	6	3	3	50,600	3.59	24
	1880	136,508	6	4	2	18,300	7.46	20
Jersey City, N. J	1900	206,433	2		2	19,580	10.54	24
	1890	166,003	4	1	3	28,300	5.76	26
	1880	120,722	2		2	11,176	10.80	21
Louisville, Ky	1900	204,731	8	5	3	136,950	1.49	14
	1890	161,129	5	3	2	95,100	1.69	10
	1880	123,758	5	4	1	22,215	5.57	17
Minneapolis, Minn	1900	202,718	9	6	3	137,906	1.47	12
	1890	164,738	9	4	5	92,323	1.78	12
	[1]1880							
Providence, R. I	1900	175,597	3	1	2	76,000	2.31	20
	1890	132,146	3	1	2	52,000	2.54	20
	1880	104,857	5	2	3	29,900	3.51	13
Indianapolis, Ind	1900	169,164	9	4	5	135,698	1.25	7
	1890	105,436	7	3	4	64,213	1.64	9
	1880	75,056	4	3	1	35,587	2.11	6
Kansas City, Mo	1900	163,752	9	4	5	226,252	0.72	2
	1890	132,716	9	6	3	130,700	1.02	3
	[1]1880							
St. Paul, Minn	1900	163,065	7	2	5	114,446	1.42	11
	1890	133,156	7	3	4	67,850	1.96	15
	1880	41,473	6	3	3	19,893	2.08	5
Rochester, N. Y	1900	162,608	7	2	5	88,489	1.84	17
	1890	133,896	7	2	5	65,276	2.05	16
	[1]1880							
Denver, Colo	1900	133,859	7	2	5	104,485	1.28	9
	1890	106,713	5	3	2	48,000	2.22	18
	[1]1880							
Omaha, Nebr	1900	102,555	8	4	4	80,740	1.27	8
	1890	140,452	8	2	6	60,329	2.33	19
	[1]1880							

[1] Not reported separately.

DAILY NEWSPAPERS IN LARGE CITIES.

Scrutiny of Table 29 reveals the fact that in the 50 largest cities in the United States in 1900 there were published 451 daily newspapers, of which 204 were published in the morning and 247 in the evening, showing an excess of 43, or 17.4 per cent, for evening publications. The average number of dailies per city was 9—4.1 for morning and 4.9 for evening newspapers. Six cities reported the same number of morning as of evening newspapers; 14 cities reported more morning than evening newspapers; and 28 cities reported a greater number of evening than morning newspapers. An examination of the data given in Table 30 reveals the following figures:

TABLE 31.—*Number of morning and evening daily newspapers in 26 cities, with number of cities showing excess in each class, 1880 to 1900.*

YEAR.	DAILY NEWSPAPERS.			NUMBER OF CITIES SHOWING EXCESS IN—		Number of cities showing no difference.
	Total.	Morning.	Evening.	Morning.	Evening.	
1900	332	157	175	8	15	3
1890	309	163	146	11	12	3
1880[1]	217	124	93	15	4	2

[1] Five cities not separately reported.

Table 31 presents an interesting proof that evening newspapers have been increasing more rapidly than morning newspapers. In 1880, 21 leading cities reported 124 morning dailies and 93 evening dailies. In 1900 the same cities, with 5 new ones added because of increase in population, reported 157 morning newspapers and 175 evening newspapers—an increase of 33 publications in the former class and of 82 in the latter. Considering the cities as units, 15 out of 21 showed, in 1880, an excess of morning dailies, and 4, an excess of evening dailies, while in 2 cities the classes were equal. Out of the 26 largest cities in the United States in 1900, 15 showed an excess of evening publications and 8 an excess of morning publications, and 3 reported the same number in each class.

The tendency here shown for a limited number of large cities is confirmed by the figures for the United States.

In 1890 the total number of daily newspapers was 1,610, of which 559 were published in the morning and 1,051 in the evening; in 1900 there were 595 morning papers, an increase of 6.4 per cent, and 1,631 evening papers, an increase of 55.2 per cent. This difference appears more striking when it is recalled that the increase, during the decade, in all daily publications was 38.3 per cent. In 1890 the proportion of evening dailies to morning dailies was about 2 to 1; in 1900 about 3 to 1.

Intelligent consideration of the figures, for the cities treated in Tables 29 and 30, drawn from a comparison of aggregate circulation per issue with population, presupposes knowledge of their limitations. The figures thus secured, while interesting in themselves, possess no especial statistical value, because they are seriously affected by local conditions. It will be observed that the "rank of cities according to number of inhabitants to each copy per issue" bears no relation to the rank of these cities in population. What the aggregate circulation within a city really is, has never been ascertained. Were these statistics obtainable, it would doubtless appear that a fairly constant ratio exists between aggregate circulation and number of inhabitants.

According to figures presented in Tables 29 and 30, the rank of a city depends upon its ability to market, outside of its own limits, its newspaper and periodical products. The most important factors affecting rank as here recorded are the existence of a large adjacent community; of very populous and extended suburbs; and of a large tributary section. Of the first class, New York is the most conspicuous example: Brooklyn, which, although a part of New York city, is given separately in Table 30 for purposes of comparison, depends almost exclusively upon New York for newspaper and periodical service; Jersey City and Hoboken, N. J., are equally dependent; while Newark and Paterson, N. J., both within a radius of 20 miles, rely upon New York, to a great extent, for newspapers and periodicals. In this class, also, should be mentioned Allegheny, Pa., an independent municipality, but virtually a part of Pittsburg. Of the second class, Philadelphia, Pa., and Cincinnati, Ohio, are examples. Boston, Mass., is an example of the third class; the publications of that city not only fulfill most of the requirements of the many near-by cities, but circulate freely throughout all parts of New England.

The effect of these local conditions is twofold—the rank of the larger city is advanced, and that of the adjacent smaller city is reduced.

TABLE 32.—*Comparison of the number of inhabitants to each copy per issue in certain large cities, with that of adjacent smaller cities, 1900*

LARGE CITIES.	Rank.	Number of inhabitants to each copy per issue.	ADJACENT SMALLER CITIES.	Rank.	Number of inhabitants to each copy per issue.
New York (Manhattan and Bronx boroughs)	[1]5	0.78	Brooklyn	[1]25	12.22
			Newark	40	3.43
			Jersey City	43	10.54
			Paterson	41	4.55
Philadelphia	10	1.28	Camden		4.69
Boston	3	0.74	Fall River	42	5.56
			Cambridge	44	45.94
San Francisco	6	1.13	Oakland		4.03
Cincinnati	1	0.63	Covington		13.42
Pittsburg	4	0.76	Allegheny		(2)
Kansas City, Mo	2	0.72	Kansas City, Kans.		22.35

[1] As shown in Table 30. [2] No daily papers.

Table 32 shows that in 1900 Cambridge, Mass., was a conspicuous example of dependence upon a larger city for newspapers and periodicals. Cambridge is practically a part of Boston. While it is a community noted for intelligence and cultivation, and the seat of a famous university, it has patronized the publications of its larger neighbor, thus elevating the rank of the latter and establishing an apparently low record for itself.

Business managers of daily newspapers in the larger cities have been prompt to take advantage of the constantly improving mail service, and of the increased ease and speed of railway communication. The improvements along these lines during the past twenty years are reflected in the changes shown by Table 29. In 1880 no city reported a circulation as great as the number of its inhabitants. The five cities having the smallest number of inhabitants to a copy per issue were—

Pittsburg	1.41
New York	1.58
San Francisco	1.63
Boston	1.64
St. Paul	2.08

The figures here given for Pittsburg would have entitled it to eleventh place in 1900. In 1880 there were but 4 cities with less than 2 inhabitants to a copy; in 1890 there were 15 cities with less than 2, and 2 cities with less than 1; but the city which ranked first in that year would have been fifth in 1900, when 19 cities had less than 2 inhabitants to a copy, and 4 cities had less than 1. It is likely that the figures for 1880 approximately reflect local demand, while those for 1900 reflect systematic and elaborate extension.

CIRCULATION.

In Table 33 are presented, for each state and territory, the population, circulation, and number of inhabitants to each copy per issue, in 1900.

TABLE 33.—*Aggregate circulation and number of inhabitants to each copy per issue, by states and territories, 1900.*

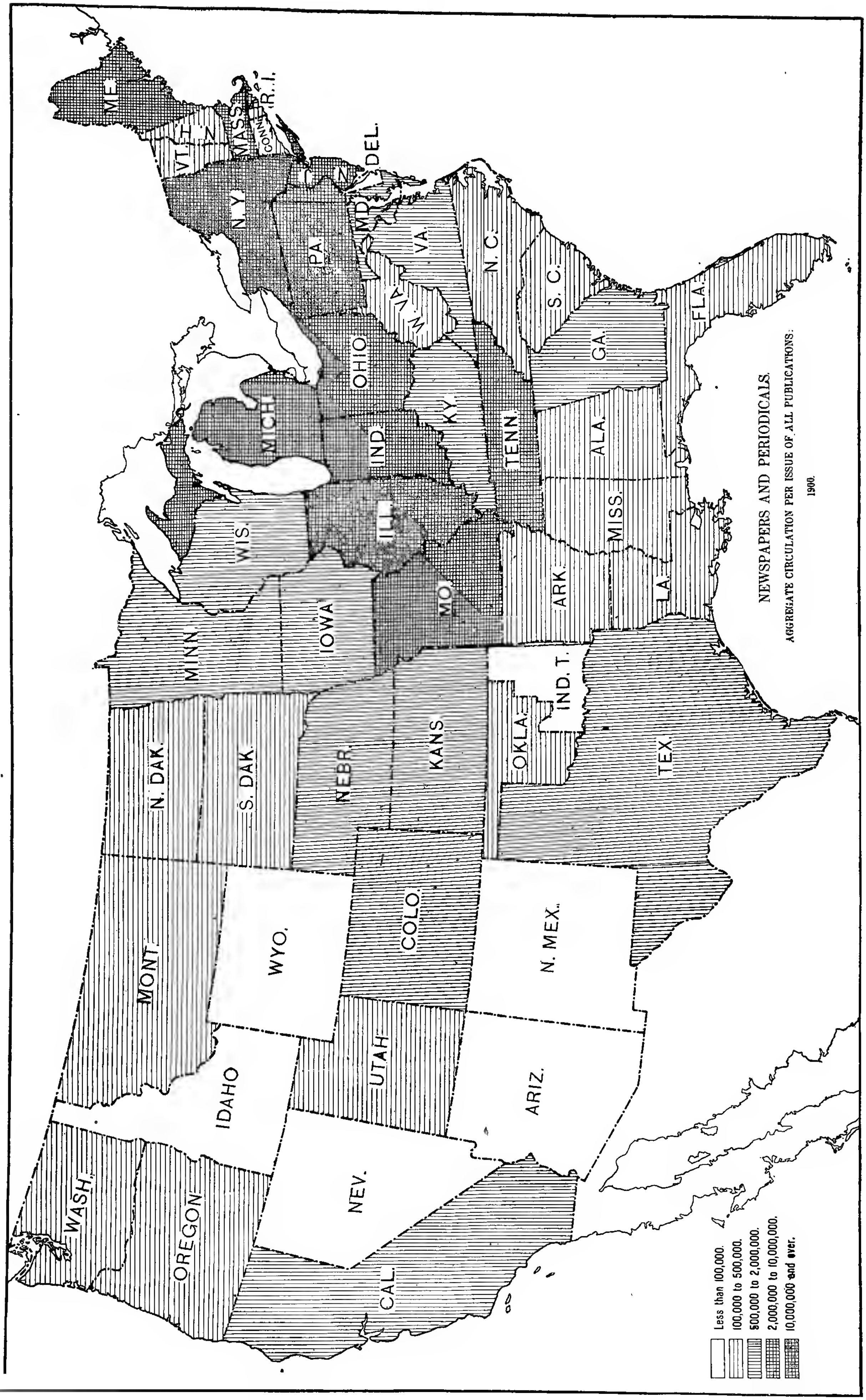
STATES AND TERRITORIES.	Population.	Aggregate circulation per issue.	Number of inhabitants to each copy per issue.
United States	[1]75,994,575	114,299,334	0.66
Alabama	1,828,697	230,079	7.95
Arizona	122,931	34,054	3.61
Arkansas	1,311,564	262,903	4.99
California	1,485,053	1,448,656	1.03
Colorado	539,700	521,213	1.04
Connecticut	908,420	457,622	1.99
Delaware	184,735	85,900	2.15
District of Columbia	278,718	820,835	0.34
Florida	528,542	112,302	4.71
Georgia	2,216,331	549,493	4.03
Idaho	161,772	48,795	3.32
Illinois	4,821,550	10,429,368	0.46
Indiana	2,516,462	2,108,805	1.19
Indian Territory	392,060	50,141	7.82
Iowa	2,231,853	1,884,875	1.18

[1] Exclusive of Alaska, Hawaii, and persons in the military and naval service of the United States (including civilian employees, etc.) stationed abroad, not credited to any state or territory.

TABLE 33.—*Aggregate circulation and number of inhabitants to each copy per issue, by states and territories, 1900*—Continued.

STATES AND TERRITORIES.	Population.	Aggregate circulation per issue.	Number of inhabitants to each copy per issue.
Kansas	1,470,495	1,144,320	1.29
Kentucky	2,147,174	1,099,172	1.95
Louisiana	1,381,625	300,072	4.60
Maine	694,466	6,434,065	0.11
Maryland	1,188,044	679,867	1.75
Massachusetts	2,805,346	6,199,127	0.45
Michigan	2,420,982	2,374,403	1.02
Minnesota	1,751,394	1,949,630	0.90
Mississippi	1,551,270	168,942	9.18
Missouri	3,106,665	5,495,802	0.57
Montana	243,329	127,148	1.91
Nebraska	1,066,300	1,095,538	0.97
Nevada	42,335	18,153	2.33
New Hampshire	411,588	211,819	1.94
New Jersey	1,883,669	3,009,104	0.63
New Mexico	195,310	32,420	6.02
New York	7,268,894	37,626,095	0.19
North Carolina	1,893,810	287,916	6.58
North Dakota	319,146	138,890	2.30
Ohio	4,157,545	7,467,358	0.56
Oklahoma	398,331	120,077	3.32
Oregon	413,536	311,950	1.33
Pennsylvania	6,302,115	11,280,367	0.56
Rhode Island	428,556	170,694	2.51
South Carolina	1,340,316	161,988	8.27
South Dakota	401,570	232,166	1.73
Tennessee	2,020,616	3,131,017	0.65
Texas	3,048,710	1,054,761	2.89
Utah	276,749	123,279	2.24
Vermont	343,641	188,646	1.82
Virginia	1,854,184	627,280	2.96
Washington	518,103	307,128	1.69
West Virginia	958,800	226,013	4.24
Wisconsin	2,069,042	1,426,499	1.45
Wyoming	92,531	32,687	2.83

The conditions described in connection with Tables 29 and 30, as to "number of inhabitants to each copy per issue," apply also to this table. The large cities showing heavy circulation in Tables 29 and 30 are important publishing centers, distributing their products far beyond city and state boundaries. This improves the relative standing of the states which produce, as compared with those which consume. The most notable example is New York, which may be termed the national producing center for leading publications of nearly all classes, as it distributes periodical literature over the entire United States, recording the enormous total of 37,626,095 aggregate circulation per issue of all classes, or more than three times the product of any other state. Another example is Maine, which records the noteworthy aggregate circulation per issue of all classes of 6,434,065 copies, the number of inhabitants to each copy per issue being a fraction so small that in this particular Maine heads the list of states. It is clear that the market for the products of these centers of commercial activity is a national one. The relation, therefore, of population to aggregate circulation might almost be termed fortuitous. On the other hand, it must not be overlooked that the states which are large exporters are likely to be also large importers of periodical literature.



NEWSPAPERS AND PERIODICALS.
AGGREGATE CIRCULATION PER ISSUE OF ALL PUBLICATIONS: 1900.

The aggregate circulation per issue attained by the periodicals of each state, when considered as representing the extent to which the enterprise of citizens markets the product of an industry at home and abroad, possesses much significance. This feature of Table 33 is considered in detail in connection with Tables 34 and 35.

Table 34 presents a comparative summary of the main facts relating to the industry, by states and territories, 1880 to 1900. Table 35 presents a comparative summary of average and aggregate circulation per issue, classified according to period of issue, by states and territories, 1880 to 1900.

TABLE 34.—COMPARATIVE SUMMARY OF NEWSPAPERS AND PERIODICALS, BY STATES AND TERRITORIES, 1880 TO 1900.

STATES AND TERRITORIES.	Year.	NUMBER OF PUBLICATIONS.			Aggregate circulation per issue.	Aggregate number of copies issued during the census year.	WAGE-EARNERS.		Pounds of paper used.	VALUE OF NEWSPAPER PRODUCTS.		
		Total.	Reporting.	Not reporting.[1]			Average number.	Total wages.		Total.	Advertising.	Subscriptions and sales.
United States....	1900	21,272	18,226	3,046	114,299,334	[2]8,168,148,749	[3]94,604	[3]$50,333,051	1,233,142,248	$175,789,610	$95,861,127	$79,928,483
	1890	17,616	14,901	2,715	69,138,934	4,681,113,530	[3]75,437	[3]40,074,937	652,876,161	[4]143,586,448	71,243,361	72,343,087
	[5]1880	11,314	[6]11,314	....	31,779,686	2,067,848,209	71,615	28,559,336	189,145,048	89,009,074	39,136,306	49,872,768
Alabama..............	1900	233	175	58	230,079	25,758,633	543	241,525	2,950,889	704,767	410,090	294,677
	1890	177	136	41	246,847	19,277,464	478	225,018	2,007,288	698,114	365,654	332,460
	1880	125	125	....	93,073	6,778,544	480	110,083	480,354	423,911	220,665	203,246
Arizona...............	1900	54	43	11	34,054	5,161,096	139	73,640	548,651	170,083	110,143	59,940
	1890	35	29	6	22,309	2,551,928	84	51,079	189,620	114,630	59,680	54,950
	1880	17	17	....	13,550	1,413,600	107	45,828	105,048	95,700	58,000	37,700
Arkansas..............	1900	261	236	25	262,903	25,077,996	600	215,410	2,455,256	532,869	268,424	264,445
	1890	193	164	29	192,749	13,768,353	480	214,083	1,083,505	461,261	232,376	228,886
	1880	117	117	....	103,501	4,990,595	488	119,048	383,857	340,103	182,201	157,902
California............	1900	709	622	87	1,448,656	205,789,752	2,683	1,804,619	35,113,672	5,801,721	3,437,976	2,363,745
	1890	555	455	100	1,151,389	163,716,618	2,376	1,681,240	20,229,809	5,595,605	3,099,453	2,496,152
	1880	361	361	....	640,026	72,861,836	2,349	1,300,140	6,375,390	3,936,238	2,150,917	1,785,321
Colorado..............	1900	329	248	81	521,213	71,702,076	1,303	770,382	12,083,992	2,105,892	1,289,888	816,004
	1890	257	186	71	229,669	30,022,108	868	699,509	4,984,842	1,804,280	1,125,534	678,746
	1880	87	87	....	95,744	8,877,831	617	338,345	721,305	1,015,110	567,442	447,668
Connecticut...........	1900	207	155	52	457,622	79,366,409	1,161	703,587	10,693,278	1,755,779	1,068,998	686,781
	1890	180	156	24	496,084	48,253,243	898	530,757	4,676,762	1,490,107	766,517	723,590
	1880	139	139	....	237,660	20,366,449	911	378,566	1,782,060	939,482	460,070	479,412
Delaware..............	1900	42	30	12	85,900	15,037,901	220	86,208	1,299,582	174,933	116,116	58,817
	1890	41	32	9	55,582	8,033,402	153	63,634	580,218	169,646	105,316	64,330
	1880	26	26	....	34,425	5,172,998	190	55,279	344,864	156,088	91,983	64,105
District of Columbia...	1900	87	69	18	820,835	56,720,860	600	393,220	8,787,333	1,690,643	1,069,480	621,163
	1890	48	17	31	321,151	31,715,418	347	236,690	5,357,486	1,136,783	582,918	553,865
	1880	44	44	....	213,923	15,874,432	343	205,924	1,157,520	569,657	225,928	343,729
Florida...............	1900	161	97	64	112,302	14,454,595	305	134,366	1,706,343	398,594	228,352	170,242
	1890	122	97	25	107,257	10,113,301	392	161,251	1,036,382	373,888	188,589	185,299
	1880	45	45	....	27,332	2,086,644	182	43,253	113,891	116,700	66,659	50,041
Georgia...............	1900	366	265	101	549,493	67,001,092	1,050	450,878	7,689,963	1,441,968	808,284	633,684
	1890	279	230	49	733,223	48,512,208	1,031	478,436	7,028,446	1,633,286	838,034	795,252
	1880	200	200	....	269,066	20,994,549	1,084	331,327	1,530,830	948,629	468,511	480,118
Idaho.................	1900	73	72	1	48,795	4,170,980	187	92,819	617,790	199,948	110,010	89,938
	1890	48	33	15	21,270	1,593,500	79	48,467	141,176	117,040	67,060	49,980
	1880	10	10	....	6,650	367,600	32	18,000	23,853	38,000	19,190	18,810
Illinois..............	1900	1,755	1,548	207	10,429,368	746,880,247	7,478	3,704,341	114,853,569	16,386,952	9,029,291	7,357,661
	1890	1,416	1,241	175	7,891,219	465,924,592	6,718	3,712,616	60,907,589	13,525,673	7,072,055	6,453,618
	1880	1,017	1,017	....	2,421,275	174,696,505	6,583	2,736,717	15,649,893	7,264,585	3,179,954	4,084,631
Indiana...............	1900	887	841	46	2,108,805	175,432,092	4,084	1,784,059	25,646,899	3,912,514	2,070,544	1,841,970
	1890	680	620	60	1,299,418	94,466,572	2,370	955,004	8,619,064	2,784,087	1,413,047	1,371,040
	1880	467	467	....	661,111	44,908,191	2,676	745,850	3,502,848	2,036,113	1,057,688	978,425
Indian Territory......	1900	85	64	21	50,141	3,554,882	138	48,389	396,180	110,916	60,394	50,522
	1890	13	9	4	8,995	480,740	19	7,728	43,766	18,290	9,360	8,930
	[5]1880	....	....	....	....	....	....	....	....	....	....	....
Iowa..................	1900	1,104	1,045	59	1,884,875	158,895,153	3,393	1,311,179	20,716,211	3,777,690	1,939,852	1,837,838
	1890	804	703	101	1,088,019	80,780,202	2,695	1,101,785	7,809,310	2,670,693	1,371,817	1,298,876
	1880	569	569	....	547,340	35,747,302	2,637	647,407	2,765,927	2,088,170	1,150,806	937,364
Kansas................	1900	711	684	27	1,144,320	75,387,961	1,766	623,783	8,512,671	1,698,656	893,780	804,876
	1890	786	693	93	756,746	57,469,332	1,865	681,404	5,276,496	1,881,248	1,007,019	874,229
	1880	347	347	....	280,729	18,569,223	1,499	335,438	1,347,475	1,006,800	591,723	415,077
Kentucky..............	1900	332	282	50	1,099,172	96,862,156	1,154	521,739	11,416,789	1,818,706	942,010	876,696
	1890	270	218	52	727,781	71,543,310	1,350	692,959	5,780,580	1,831,485	953,254	878,231
	1880	205	205	....	397,564	25,332,423	1,356	272,136	2,041,378	1,468,617	671,884	796,733
Louisiana.............	1900	195	160	35	300,072	49,348,430	873	532,895	6,982,114	1,300,338	751,304	549,034
	1890	173	129	44	358,183	40,145,248	634	383,429	3,906,224	1,281,005	717,586	563,419
	1880	112	112	....	131,630	15,602,320	786	411,616	1,625,250	1,130,665	617,262	513,393
Maine.................	1900	178	177	1	6,434,065	106,420,850	1,309	473,026	16,055,808	1,876,214	1,044,695	831,519
	1890	172	146	26	2,442,046	53,206,443	853	353,407	5,779,649	1,405,150	575,122	830,028
	1880	123	123	....	1,214,460	25,661,345	1,036	317,006	2,567,686	1,236,461	214,394	1,022,067

[1] Publications which were in existence, but from which no returns were received.
[2] Obtained, for each class of publications, by multiplying the aggregate circulation per issue by the number of issues during the year.
[3] Includes the employees engaged in the book and job printing branch of the industry, and their wages.
[4] For purposes of comparison the figures for "book and job printing" and "all other products" are excluded.
[5] In 1880 Indian Territory and Oklahoma were reported as Indian Territory, and North Dakota and South Dakota as Dakota; the 1880 figures are included only in the totals.
[6] Includes 1,182 publications not reporting operations, as they can not be excluded from the classification.

TABLE 34.—COMPARATIVE SUMMARY OF NEWSPAPERS AND PERIODICALS BY STATES AND TERRITORIES, 1880 TO 1900—Continued.

STATES AND TERRITORIES.	Year.	NUMBER OF PUBLICATIONS. Total.	Reporting.	Not reporting.[1]	Aggregate circulation per issue.	Aggregate number of copies issued during the census year.	WAGE-EARNERS. Average number.	Total wages.	Pounds of paper used.	VALUE OF NEWSPAPER PRODUCTS. Total.	Advertising.	Subscriptions and sales.
Maryland	1900	213	166	47	679,867	98,959,220	1,529	$768,335	16,464,816	$2,263,338	$1,490,189	$773,149
	1890	170	124	46	392,068	56,855,415	857	424,666	6,477,706	1,739,705	1,039,291	700,414
	1880	143	143	......	414,693	50,115,182	1,163	486,958	3,983,128	1,567,893	859,847	708,046
Massachusetts	1900	627	486	141	6,199,127	531,739,780	5,432	3,769,204	92,347,453	13,170,875	6,906,320	6,264,555
	1890	668	568	100	4,662,159	261,440,450	4,214	2,473,531	34,734,860	8,549,920	3,970,820	4,579,100
	1880	427	427	......	2,012,929	149,319,973	3,416	2,074,749	15,118,634	6,367,760	2,512,522	3,855,238
Michigan	1900	802	698	104	2,374,403	200,457,376	2,916	1,302,493	24,267,484	3,819,560	2,137,461	1,682,099
	1890	657	589	68	1,511,915	122,904,401	2,772	1,122,366	11,680,577	3,274,089	1,711,309	1,562,780
	1880	464	464	......	620,974	46,659,470	2,439	729,673	4,648,339	2,057,438	1,002,092	1,055,346
Minnesota	1900	669	622	47	1,949,630	169,257,418	2,714	1,304,229	26,663,512	3,981,874	2,295,482	1,686,392
	1890	445	392	53	1,023,006	95,551,359	1,919	1,045,013	10,193,158	3,153,605	1,639,136	1,514,469
	1880	223	223	......	222,074	18,097,781	1,178	390,161	1,545,303	947,903	524,540	423,363
Mississippi	1900	223	178	45	168,942	13,398,752	440	164,435	1,560,884	395,068	195,133	199,935
	1890	161	119	42	108,061	7,266,800	272	90,169	493,593	279,025	139,576	139,449
	1880	123	123	......	87,904	5,293,418	468	109,036	426,012	380,893	211,934	168,959
Missouri	1900	1,052	940	112	5,495,802	446,832,760	3,758	2,056,148	66,173,770	8,144,216	4,615,545	3,528,671
	1890	803	707	96	2,615,135	225,731,297	3,831	2,028,061	27,462,453	6,826,120	3,465,701	3,360,419
	1880	530	530	......	965,285	79,265,309	3,215	1,284,831	9,925,367	3,578,921	1,710,241	1,868,680
Montana	1900	95	89	6	127,148	19,012,404	455	310,802	2,918,505	705,229	390,598	314,631
	1890	61	52	9	68,980	9,106,770	229	230,890	783,627	427,744	227,865	199,879
	1880	18	18	......	20,827	1,280,480	94	66,700	114,990	177,750	84,130	93,620
Nebraska	1900	626	538	88	1,095,538	85,959,730	1,334	626,597	11,644,598	1,887,933	1,002,462	885,471
	1890	550	446	104	635,605	52,037,259	1,331	656,001	5,683,456	2,007,990	1,091,110	916,880
	1880	189	189	......	154,570	11,717,103	762	250,732	903,207	712,544	391,825	320,719
Nevada	1900	36	35	1	18,163	2,395,582	68	35,024	156,676	93,702	49,272	44,430
	1890	25	15	10	14,530	3,010,210	51	46,121	158,962	93,209	51,835	41,374
	1880	37	37	......	27,745	5,820,575	202	162,338	354,444	338,800	215,139	123,661
New Hampshire	1900	107	88	19	211,819	22,421,947	571	261,871	3,445,068	507,663	274,818	232,845
	1890	127	111	16	261,040	21,314,338	527	234,272	1,911,461	544,786	263,253	281,533
	1880	87	87	......	185,968	9,635,410	412	119,203	581,916	359,859	179,015	180,844
New Jersey	1900	389	298	91	3,009,104	103,924,361	2,077	1,162,033	17,034,314	2,663,899	1,813,518	850,381
	1890	318	263	55	1,486,777	75,855,311	1,594	857,750	6,447,571	2,234,291	1,201,280	1,033,011
	1880	215	215	......	249,478	22,150,096	1,364	454,633	1,698,173	1,175,015	694,157	480,858
New Mexico	1900	55	42	13	32,420	3,020,460	142	76,477	330,587	128,839	76,513	52,326
	1890	41	34	7	23,157	2,524,262	97	55,047	160,834	152,480	78,230	74,250
	1880	18	18	......	6,355	838,860	79	31,292	56,352	70,972	35,883	35,089
New York	1900	2,067	1,477	590	37,626,095	2,324,952,983	16,460	10,924,755	378,603,033	49,216,268	25,369,048	23,847,220
	1890	1,938	1,627	311	18,031,391	1,177,147,744	11,838	7,654,864	165,413,361	37,842,822	17,861,315	19,981,507
	1880	1,411	1,411	......	9,374,134	577,755,819	12,402	6,460,071	57,823,682	24,266,911	8,674,173	15,592,738
North Carolina	1900	261	200	61	287,916	28,081,732	653	230,941	2,562,834	610,418	290,566	319,852
	1890	176	135	41	178,077	14,821,936	460	161,616	1,111,101	440,710	211,733	228,977
	1880	142	142	......	105,501	6,819,382	502	119,809	460,690	344,132	178,324	165,808
North Dakota	1900	157	139	18	138,890	12,544,161	326	143,096	1,662,800	420,195	259,041	161,154
	1890	112	87	25	86,425	6,357,508	260	140,563	510,604	307,392	179,216	128,176
	[2]1880	......	......	......	......	......	......	......	......	......	......	......
Ohio	1900	1,236	1,039	197	7,467,358	591,526,155	6,360	3,119,596	73,544,764	9,643,982	4,863,620	4,780,362
	1890	1,093	932	161	6,639,781	306,568,217	5,407	2,554,436	29,823,811	8,360,115	3,850,306	4,509,809
	1880	774	774	......	3,093,931	152,579,380	5,313	1,761,038	11,065,159	6,109,448	2,460,642	3,648,806
Oklahoma	1900	127	110	17	120,077	10,698,566	379	139,021	1,407,298	250,681	138,537	112,144
	1890	30	21	9	14,654	1,462,332	69	25,183	98,445	45,495	26,300	19,195
	[2]1880	......	......	......	......	......	......	......	......	......	......	......
Oregon	1900	207	188	19	311,950	29,434,167	610	292,579	4,276,251	825,455	463,172	362,283
	1890	137	126	11	208,855	19,159,764	509	346,317	2,150,770	951,827	544,328	407,499
	1880	74	74	......	85,786	8,578,213	343	128,430	709,836	367,189	177,095	190,094
Pennsylvania	1900	1,444	1,365	79	11,280,367	923,178,870	9,565	5,094,769	155,846,813	18,364,367	10,741,028	7,623,339
	1890	1,476	1,271	205	9,472,083	633,014,599	7,587	3,841,669	71,130,406	16,380,582	7,345,234	9,035,348
	1880	973	973	......	5,031,061	297,559,892	7,238	2,913,162	28,026,402	9,319,497	4,218,770	5,100,727
Rhode Island	1900	61	40	21	170,594	43,692,180	488	318,219	5,564,505	866,401	555,503	310,898
	1890	72	54	18	148,868	26,228,741	432	238,611	3,135,927	727,040	443,901	283,139
	1880	44	44	......	97,121	14,496,498	443	206,526	123,745	455,726	244,155	211,571
South Carolina	1900	134	117	17	161,988	15,355,730	413	156,924	1,849,953	416,594	198,422	218,172
	1890	100	84	16	121,672	11,248,784	330	146,287	1,007,108	445,661	212,081	233,580
	1880	81	81	......	69,902	5,774,415	393	110,081	432,478	309,238	145,907	163,331
South Dakota	1900	269	218	51	232,166	14,597,255	422	164,456	1,569,169	475,668	245,737	229,931
	1890	227	174	53	142,362	10,336,238	416	192,575	813,714	450,415	249,433	200,982
	[2]1880	......	......	......	......	......	......	......	......	......	......	......
Tennessee	1900	298	251	47	3,131,017	124,423,368	951	456,418	9,786,819	1,715,886	761,785	954,101
	1890	254	219	35	1,450,118	72,094,743	965	489,948	5,185,720	1,479,767	737,741	742,026
	1880	193	193	......	293,288	18,293,872	901	265,456	1,423,483	784,081	373,450	410,631
Texas	1900	820	722	98	1,054,761	100,811,006	1,829	916,029	11,075,808	2,864,387	1,600,616	1,263,771
	1890	512	437	75	658,183	55,640,136	1,455	761,824	5,345,193	2,212,990	1,263,338	949,652
	1880	280	280	......	263,289	19,883,792	1,457	772,059	1,791,588	1,100,295	570,089	530,206

[1] Publications which were in existence, but from which no returns were received.
[2] In 1880 Indian Territory and Oklahoma were reported as Indian Territory, and North Dakota and South Dakota as Dakota; the 1880 figures are included only in the totals.

TABLE 34.—COMPARATIVE SUMMARY OF NEWSPAPERS AND PERIODICALS BY STATES AND TERRITORIES, 1880 TO 1900—Continued.

STATES AND TERRITORIES.	Year.	NUMBER OF PUBLICATIONS.			Aggregate circulation per issue.	Aggregate number of copies issued during the census year.	WAGE-EARNERS.		Pounds of paper used.	VALUE OF NEWSPAPER PRODUCTS.		
		Total.	Reporting.	Not reporting.[1]			Average number.	Total wages.		Total.	Advertising.	Subscriptions and sales.
Utah	1900	80	72	8	123,279	14,304,587	431	$235,174	2,424,121	$455,498	$234,087	$221,411
	1890	39	28	11	68,000	9,626,740	294	183,651	1,206,050	483,555	271,770	211,785
	1880	22	22	....	36,175	3,867,500	168	88,580	321,039	177,058	81,270	95,788
Vermont	1900	80	79	1	188,646	15,281,431	436	176,748	1,943,599	371,110	200,307	170,803
	1890	76	70	6	207,565	9,189,590	307	134,386	996,377	322,160	141,027	181,133
	1880	82	82	....	130,192	5,681,464	371	92,959	538,391	262,719	102,619	160,100
Virginia	1900	255	204	51	627,280	51,213,030	771	338,618	4,581,295	907,025	510,729	396,296
	1890	231	185	46	346,056	28,172,077	652	272,634	1,977,387	818,073	424,255	393,818
	1880	194	194	....	256,471	18,422,845	961	261,362	1,352,930	698,826	356,204	342,622
Washington	1900	223	199	24	307,128	38,239,106	626	315,500	4,505,960	1,178,721	772,517	406,204
	1890	172	144	28	204,488	23,547,244	569	434,710	2,615,931	1,149,285	759,784	389,501
	1880	29	29	....	16,751	1,062,103	109	34,975	76,968	87,400	48,840	38,560
West Virginia	1900	192	176	16	226,013	24,453,873	707	295,413	2,916,238	576,493	282,845	293,648
	1890	144	112	32	130,328	12,428,686	401	135,312	1,080,543	389,257	188,351	200,906
	1880	109	109	....	85,958	4,903,466	511	99,671	378,670	301,411	169,280	132,131
Wisconsin	1900	654	595	59	1,426,499	132,510,954	2,679	1,174,242	17,383,974	2,900,231	1,414,475	1,485,756
	1890	521	456	65	1,053,389	86,422,737	2,040	769,046	7,574,249	2,354,825	1,015,423	1,339,402
	1880	340	340	....	436,576	27,901,051	1,980	531,903	2,428,546	1,589,725	754,920	834,805
Wyoming	1900	44	42	2	32,687	2,446,644	86	47,840	302,462	108,851	62,150	46,701
	1890	31	25	6	24,370	2,473,860	62	48,942	172,995	149,242	88,028	61,214
	1880	11	11	....	5,686	803,260	46	25,900	77,506	47,300	32,950	14,350

[1] Publications which were in existence, but from which no returns were received.

TABLE 35.—COMPARATIVE STATEMENT OF NEWSPAPERS AND PERIODICALS, AVERAGE AND AGGREGATE CIRCU-

	STATES AND TERRITORIES.	Year.	AVERAGE CIRCULATION PER ISSUE.							
			All classes.	Daily.	Triweekly.	Semi-weekly.	Weekly.	Monthly.	Quarterly.	All other classes.
1	United States	1900	6,271	6,784	3,687	4,447	3,071	21,750	47,331	20,695
		1890	4,640	6,209	1,473	2,896	2,678	11,317	36,109	11,851
		1880	3,122	4,137	1,001	2,136	2,113	7,834	16,505	6,474
2	Alabama	1900	1,315	2,660	700	2,170	1,086	1,700	...	2,392
		1890	1,815	2,297	...	1,500	1,606	974	14,500	975
		1880	862	1,932	200	...	778	1,175	...	1,500
3	Arizona	1900	792	1,146	...	...	700	206	...	...
		1890	769	651	...	...	814	...	...	...
		1880	968	720	...	...	1,106	...	...	...
4	Arkansas	1900	1,114	1,907	1,000	2,821	943	2,363	5,000	333
		1890	1,175	1,137	...	...	1,172	1,393	...	600
		1880	1,067	1,006	...	1,500	927	500	...	5,283
5	California	1900	2,329	4,065	480	1,061	1,557	2,744	18,750	2,975
		1890	2,531	4,591	375	619	1,942	3,336	7,000	1,650
		1880	2,006	3,288	2,750	2,071	1,580	3,064	1,725	1,425
6	Colorado	1900	2,102	3,738	500	667	1,595	3,838	1,250	692
		1890	1,235	2,963	1,300	720	842	4,875	...	...
		1880	1,294	1,884	...	600	1,070	2,475	...	...
7	Connecticut	1900	2,952	4,746	...	1,333	2,101	4,931	900	4,450
		1890	3,180	3,448	...	745	1,921	9,264	4,600	1,275
		1880	1,917	2,968	...	850	1,737	2,583	700	794
8	Delaware	1900	2,863	6,713	...	1,700	2,084	3,075	...	...
		1890	1,737	4,090	...	...	1,310	1,250	...	...
		1880	1,434	3,950	...	...	928	1,000	...	...
9	District of Columbia	1900	11,896	12,606	...	1,000	9,808	16,093	1,380	11,628
		1890	18,891	15,663	...	...	22,136	7,500	...	...
		1880	6,485	9,125	...	...	5,535	4,747	1,050	...
10	Florida	1900	1,158	2,537	1,000	5,000	872	1,513	...	...
		1890	1,106	1,384	500	...	1,088	2,000	...	300
		1880	739	1,800	...	500	719	...	...	...
11	Georgia	1900	2,074	3,810	...	3,771	1,619	3,966	1,000	2,058
		1890	3,188	3,713	...	2,000	2,499	6,166	3,000	12,200
		1880	1,259	2,141	600	1,100	1,069	3,706	...	700
12	Idaho	1900	678	1,020	...	929	615	1,500	...	625
		1890	645	567	...	440	668	...	...	...
		1880	628	...	500	500	664	...	...	...
13	Illinois	1900	6,737	7,356	1,335	2,371	3,867	14,032	73,193	5,481
		1890	6,359	6,401	450	1,541	4,007	8,941	64,407	5,252
		1880	2,551	3,955	1,085	1,713	2,269	4,463	1,500	2,478
14	Indiana	1900	2,507	2,214	...	1,883	1,530	11,176	7,770	3,867
		1890	2,096	1,805	...	1,420	1,504	6,097	4,867	5,056
		1880	1,552	1,913	858	2,250	1,464	2,410	...	979
16	Indian Territory	1900	783	558	...	...	819	450	...	...
		1890	999	500	...	...	1,062	...	...	...
		[6]1880	...	...	...	...	...	...	...	...
16	Iowa	1900	1,804	3,347	2,746	2,908	1,331	4,706	3,441	3,749
		1890	1,548	2,404	2,400	1,028	1,341	8,411	3,188	3,480
		1880	1,071	1,479	200	633	997	1,990	3,000	832
17	Kansas	1900	1,673	1,988	800	6,680	1,161	6,296	4,260	2,722
		1890	1,092	1,913	...	827	960	3,317	700	743
		1880	961	1,528	...	1,800	878	1,871	...	1,200
18	Kentucky	1900	3,898	6,097	1,800	5,232	2,239	8,202	2,167	22,680
		1890	3,338	5,406	3,300	2,886	2,700	2,265	...	13,456
		1880	2,184	3,045	900	1,141	1,743	1,272	...	42,850
19	Louisiana	1900	1,875	4,652	1,200	5,450	1,227	983	...	2,900
		1890	2,777	6,550	...	5,200	2,282	3,123	1,700	2,067
		1880	1,330	3,460	1,000	8,000	969	475	...	2,200
20	Maine	1900	86,351	3,989	...	3,546	2,208	136,011	881	2,050
		1890	16,726	2,770	...	1,350	2,621	54 674	1,000	50,463
		1880	11,041	1,894	480	...	1,962	60,953	1,500	400
21	Maryland	1900	4,096	13,753	...	8,680	2,492	6,217	3,000	767
		1890	3,162	12,462	...	...	2,062	3,679	6,925	2,916
		1880	3,166	9,472	...	...	2,508	1,976	900	1,413
22	Massachusetts	1900	12,755	11,539	...	4,621	7,569	26,555	24,206	43,669
		1890	8,208	7,960	...	3,634	5,363	10,795	25,223	18,611
		1880	5,122	7,789	400	2,671	4,273	7,870	3,157	1,406
23	Michigan	1900	3,402	6,298	1,595	8,352	1,441	15,139	10,080	2,128
		1890	2,567	4,096	1,700	1,338	1,843	7,709	10,552	3,611
		1880	1,465	2,167	2,083	1,322	1,347	1,958	6,875	1,707
24	Minnesota	1900	3,134	6,824	5,000	10,629	1,843	7,539	2,275	14,104
		1890	2,610	6,014	...	15,000	1,667	3,546	1,000	26,346
		1880	1,116	3,562	750	...	909	5,030	...	475
25	Mississippi	1900	949	1,258	602	540	914	1,663	...	850
		1890	908	1,225	500	...	894	850	...	1,018
		1880	806	840	733	400	773	2,033	...	...

[1] Includes 150,000 circulation for 5 weeklies, 1 semimonthly, 14 monthlies, and 12 quarterlies in Georgia and Illinois, not separately returned.
[2] Includes 6 semiannual publications, having a circulation of 19,750, distributed as follows: Illinois, 1; Michigan, 1; New York, 3; Pennsylvania, 1.
[3] Includes 50,000 circulation for 1 weekly, 1 semimonthly, and 1 monthly not separately returned.

LATION PER ISSUE, CLASSIFIED ACCORDING TO PERIOD OF ISSUE, BY STATES AND TERRITORIES, 1880 TO 1900.

AGGREGATE CIRCULATION PER ISSUE.								
All classes.	Daily.	Triweekly.	Semiweekly.	Weekly.	Monthly.	Quarterly.	All other classes.	
114,299,334	15,102,156	228,610	2,832,868	39,852,052	39,519,897	11,217,422	5,546,329	1
69,138,934	8,387,188	50,067	561,743	28,954,516	19,624,038	8,124,500	3,436,883	
[1]31,779,686	3,566,395	68,086	264,910	16,266,830	8,139,881	[2]1,964,049	1,359,535	
230,079	48,645	700	4,340	155,244	6,800		14,350	2
246,847	32,154		1,500	173,477	8,766	29,000	1,950	
93,073	9,660	200		73,163	7,050		3,000	
34,054	11,456			22,392	206			3
22,309	5,210			17,099				
13,550	3,600			9,950				
262,903	38,140	1,000	11,285	187,578	18,900	5,000	1,000	4
192,749	15,917			166,482	9,750		600	
103,501	5,030		1,500	80,621	500		15,850	
1,448,656	475,596	480	23,342	618,146	194,792	112,500	23,800	5
1,151,389	399,454	750	6,810	604,050	123,425	7,000	9,900	
640,026	157,814	5,500	20,710	345,962	98,040	3,450	8,550	
521,213	157,016	500	2,000	285,425	72,947	1,250	2,075	6
229,669	68,150	1,300	2,160	128,809	29,250			
95,744	26,375		600	58,869	9,900			
457,622	208,815		29,325	155,507	44,375	1,800	17,800	7
496,084	117,246		1,490	182,472	185,276	4,500	5,100	
237,660	47,490		1,700	152,895	31,000	1,400	3,175	
85,900	34,277		1,700	43,773	6,150			8
55,582	20,450			30,132	5,000			
34,425	15,800			17,625	1,000			
820,835	100,848		1,000	304,037	354,050	2,760	58,140	9
321,151	62,651			243,500	15,000			
213,923	36,500			105,162	71,211	1,050		
112,302	27,907	1,000	5,000	66,295	12,100			10
107,257	16,605	1,000		87,052	2,000		600	
27,332	2,600		1,000	23,732				
549,493	102,872		33,941	331,905	67,425	1,000	12,350	11
733,223	70,546		2,000	442,250	178,827	3,000	36,600	
[3]269,066	27,830	1,800	3,300	150,686	33,350		2,100	
48,795	5,100		4,645	36,300	1,500		1,250	12
21,270	1,700		880	18,690				
5,650		500	500	4,650				
10,429,368	1,449,087	5,338	170,720	3,866,983	3,072,932	1,683,434	180,874	13
7,891,219	774,486	900	30,820	3,437,663	1,627,250	1,867,800	152,300	
[4]2,421,275	270,923	6,510	29,129	1,527,042	401,646	[5]31,500	54,525	
2,108,805	345,404		77,185	858,424	715,292	77,700	34,800	14
1,299,418	166,051		2,840	673,798	371,909	29,200	55,620	
661,111	72,698	1,716	2,250	518,322	60,250		5,876	
50,141	3,350			45,891	900			15
8,995	500			8,495				
1,884,875	217,589	19,224	168,672	1,105,666	301,205	27,529	44,990	16
1,088,019	110,563	4,800	14,397	795,077	133,032	12,750	17,400	
547,340	38,455	200	1,900	449,550	51,740	3,000	2,495	
1,144,320	105,348	800	20,040	653,607	321,050	21,800	21,775	17
756,746	82,266		2,480	596,089	72,983	700	2,228	
280,729	21,396		1,800	230,141	26,192		1,200	
1,099,172	164,624	1,800	125,575	425,323	262,450	6,500	112,900	18
727,781	135,150	3,300	20,200	445,485	29,451		94,195	
397,664	33,492	1,800	6,844	240,473	29,255		85,700	
300,072	106,990	2,400	32,698	137,434	14,750		5,800	19
358,183	78,600		5,200	225,883	40,600	1,700	6,200	
131,630	38,065	1,000	8,000	81,415	950		2,200	
6,434,066	59,838		17,728	220,759	6,120,490	7,050	8,200	20
2,442,046	41,545		1,350	230,642	1,964,659	2,000	201,859	
1,214,460	18,940	480		156,940	1,036,200	1,500	400	
679,867	247,552		17,360	316,505	93,250	3,000	2,200	21
392,068	137,086			210,310	22,075	13,850	8,748	
414,693	132,613			255,770	19,760	900	5,650	
6,199,127	1,130,820		32,350	2,066,369	2,257,142	363,096	349,350	22
4,662,159	446,781		25,440	1,802,125	1,327,740	781,910	279,163	
2,012,929	280,399	400	34,727	1,089,515	574,538	22,100	11,250	
2,374,403	370,848	7,975	192,098	752,032	984,025	50,400	17,025	23
1,511,915	212,975	1,700	6,690	869,764	377,734	10,652	32,500	
620,974	62,839	6,250	3,965	488,927	33,293	[5]13,750	11,950	
1,949,630	300,266	5,000	95,660	908,478	452,329	4,550	183,347	24
1,023,005	180,433		15,000	518,563	148,933	2,000	158,076	
222,074	28,493	750		167,206	25,150		475	
168,942	16,348	502	1,080	142,702	6,610		1,700	25
108,061	7,350	500		91,206	5,950		3,055	
87,904	4,200	2,200	400	75,004	6,100			

[4] Includes 100,000 circulation for 4 weeklies, 13 monthlies, and 12 quarterlies, not separately returned.
[5] Includes 1 semiannual.
[6] Indian Territory and Oklahoma were reported as Indian Territory in 1880. Average circulation, all classes, 2,030; weekly, 2,030. Aggregate circulation, all classes, 4,060; weekly, 4,060.

TABLE 35.—COMPARATIVE STATEMENT OF NEWSPAPERS AND PERIODICALS, AVERAGE AND AGGREGATE CIRCULA-

	STATES AND TERRITORIES.	Year.	AVERAGE CIRCULATION PER ISSUE.							
			All classes.	Daily.	Triweekly.	Semi-weekly.	Weekly.	Monthly.	Quarterly.	All other classes.
26	Missouri	1900	6,847	8,810	200	23,511	2,680	13,649	63,932	9,542
		1890	3,699	6,285	1,305	4,100	2,610	8,558	15,056	2,566
		1880	2,041	3,228	1,265	1,100	1,750	3,418	800	2,823
27	Montana	1900	1,429	3,833	...	2,345	887	2,165	7,000	...
		1890	1,327	2,130	960	1,250	1,209	617	...	1,000
		1880	1,388	304	...	...	1,660	...	...	...
28	Nebraska	1900	2,036	3,825	1,200	3,313	1,433	9,141	983	2,421
		1890	1,425	2,732	...	450	1,134	7,623	...	2,614
		1880	888	1,553	...	500	791	2,173	...	600
29	Nevada	1900	619	581	160	583	601	500	...	...
		1890	969	1,450	...	...	648	...	...	...
		1880	841	1,225	...	...	561	500	...	...
30	New Hampshire	1900	2,407	3,030	2,625	...	2,372	1,050	...	...
		1890	2,352	2,369	...	725	2,431	1,994	...	...
		1880	2,296	907	...	...	1,800	5,614	...	7,400
31	New Jersey	1900	10,098	4,556	...	950	1,631	1,703	34,126	2,251,500
		1890	5,653	3,420	650	2,200	1,499	49,348	1,042	1,433
		1880	1,306	2,116	750	900	1,112	1,811	6,000	517
32	New Mexico	1900	772	1,273	...	...	714	500	800	1,160
		1890	681	1,284	...	...	604	...	...	500
		1880	530	667	...	...	484	...	...	...
33	New York	1900	25,475	18,826	18,272	8,863	14,458	62,232	65,046	42,300
		1890	11,083	13,081	3,638	3,256	6,848	17,697	34,943	12,649
		1880	7,222	9,059	1,128	4,371	5,265	11,040	19,736	5,840
34	North Carolina	1900	1,440	1,716	...	1,633	1,392	1,205	700	1,392
		1890	1,319	1,156	...	667	1,371	1,810	500	1,275
		1880	894	793	375	700	878	1,125	...	1,308
35	North Dakota	1900	999	2,002	...	3,550	843	3,775	...	...
		1890	993	1,317	...	1,000	897	2,200	...	...
		[2]1880	...	...	...	...	...	...	...	...
36	Ohio	1900	7,187	7,204	1,663	3,984	3,484	15,783	119,707	35,536
		1890	6,051	4,130	1,404	2,328	3,144	9,024	53,720	41,584
		1880	4,345	4,507	838	1,563	2,460	7,880	51,109	17,689
37	Oklahoma	1900	1,092	1,630	...	800	1,041	1,383	...	600
		1890	698	675	...	...	722	1,100	...	...
		[3]1880	...	...	...	...	...	...	...	...
38	Oregon	1900	1,659	2,438	...	1,058	1,343	2,779	...	2,200
		1890	1,658	2,045	...	1,400	1,542	2,500	...	500
		1880	1,320	1,581	...	...	1,133	2,665	1,600	...
39	Pennsylvania	1900	8,264	9,788	1,641	6,003	4,181	18,240	47,424	10,146
		1890	7,462	8,682	1,900	5,006	4,067	10,390	43,912	16,726
		1880	5,628	6,285	1,500	4,600	3,266	10,926	29,180	20,096
40	Rhode Island	1900	4,265	9,904	100	2,251	1,794	2,112	3,000	...
		1890	2,757	7,551	...	426	1,989	1,574	350	...
		1880	2,490	5,176	...	700	1,984	1,013	...	400
41	South Carolina	1900	1,384	2,693	200	1,655	1,327	800	...	1,500
		1890	1,448	2,854	200	463	1,341	...	3,500	2,000
		1880	971	1,937	450	500	969	566	700	...
42	South Dakota	1900	1,066	1,029	...	1,600	801	3,822	...	9,422
		1890	818	727	...	800	745	1,715	...	4,000
		[2]1880	...	...	...	...	...	...	...	...
43	Tennessee	1900	12,474	10,357	...	1,283	6,076	9,648	154,090	2,588
		1890	6,622	4,608	...	2,070	4,474	4,929	82,563	3,213
		1880	1,822	3,099	...	850	1,714	2,385	2,450	1,223
44	Texas	1900	1,461	1,778	...	4,609	1,266	1,861	1,250	2,563
		1890	1,506	2,074	480	1,207	1,358	2,831	1,000	10,000
		1880	1,145	1,262	600	725	938	5,504	...	650
45	Utah	1900	1,712	4,027	2,000	4,376	735	3,450	75	5,500
		1890	2,429	2,281	...	2,868	1,367	3,000	...	3,600
		1880	1,904	1,987	...	2,050	1,707	1,525	...	3,500
46	Vermont	1900	2,388	2,967	...	4,200	2,030	3,525	300	2,600
		1890	2,965	2,140	...	...	1,729	13,800	...	...
		1880	2,245	1,050	...	...	1,492	17,167	1,100	285
47	Virginia	1900	3,075	2,496	1,033	2,172	2,315	4,213	20,083	3,233
		1890	1,871	2,243	192	620	1,632	3,127	5,833	1,250
		1880	1,449	1,892	740	699	1,073	2,363	1,767	6,308
48	Washington	1900	1,643	6,638	500	2,617	1,052	1,972	2,650	1,833
		1890	1,420	2,720	...	...	1,179	2,279	...	450
		1880	698	367	...	...	745	...	...	...
49	West Virginia	1900	1,284	2,294	...	1,225	1,205	582	...	1,200
		1890	1,164	2,511	...	250	1,065	1,100	...	425
		1880	868	2,050	500	625	852	961	1,000	150
50	Wisconsin	1900	2,397	3,565	1,000	7,714	1,666	4,523	13,920	6,167
		1890	2,310	2,289	...	44,368	1,762	2,586	6,875	8,305
		1880	1,404	1,856	1,267	700	1,230	1,814	...	4,138
51	Wyoming	1900	778	825	500	493	653	2,333	...	...
		1890	975	924	...	...	988	...	...	...
		1880	682	662	...	...	617	...	...	...

[1] Includes 3 semiannuals.

[2] North Dakota and South Dakota were reported as Dakota in 1880. Average circulation, all classes, 616; daily, 562; weekly, 612. Aggregate circulation all classes, 36,943; dailies, 4,500; weeklies, 32,443.

TION PER ISSUE, CLASSIFIED ACCORDING TO PERIOD OF ISSUE, BY STATES AND TERRITORIES, 1880 TO 1900—Cont'd.

AGGREGATE CIRCULATION PER ISSUE.								
All classes.	Daily.	Triweekly.	Semiweekly.	Weekly.	Monthly.	Quarterly.	All other classes.	
5,495,802	810,492	200	329,163	1,862,866	1,378,586	895,050	219,465	26
2,616,135	428,094	2,610	28,700	1,346,714	624,767	135,500	48,750	
965,285	122,660	10,120	1,100	646,747	163,800	800	31,068	
127,148	42,164	...	9,380	62,109	6,495	7,000	...	27
68,980	19,170	960	1,250	44,750	1,850	...	1,000	
20,827	912	...	...	19,915	...	...	...	
1,096,538	122,414	1,200	63,008	660,349	255,935	2,950	9,682	28
635,505	84,698	...	900	447,757	83,850	...	18,300	
154,570	18,630	...	500	121,800	13,040	...	600	
18,168	6,226	160	1,750	10,517	500	...	...	29
14,630	8,700	...	...	6,830	...	...	...	
27,746	17,155	...	...	10,090	500	...	...	
211,819	42,419	5,250	...	158,900	6,250	...	...	30
261,040	37,900	...	1,450	201,762	19,938	...	...	
185,968	9,070	...	...	107,998	39,300	...	29,600	
3,009,104	223,233	...	1,900	367,021	28,960	136,600	2,251,600	31
1,486,777	160,746	1,300	2,200	278,791	1,036,315	3,125	4,300	
249,478	50,776	750	3,600	164,602	16,300	12,000	1,550	
32,420	3,820	...	...	25,000	500	800	2,300	32
23,157	5,134	...	...	17,623	...	...	500	
6,355	2,000	...	...	4,355	...	...	...	
37,626,096	3,896,967	146,175	460,867	12,607,099	16,927,062	2,276,625	1,311,300	33
18,031,391	2,119,101	14,550	100,998	6,347,827	6,990,400	1,712,200	746,316	
9,374,134	996,561	4,510	100,544	4,253,908	2,903,527	[1]828,913	286,171	
287,916	44,620	...	24,490	197,706	12,050	700	8,350	34
178,077	23,110	...	2,000	139,867	9,050	1,500	2,650	
105,501	7,934	750	1,400	83,437	6,750	...	5,230	
138,890	18,021	...	7,100	106,219	7,550	...	...	35
86,425	9,220	...	2,000	66,406	8,800	...	...	
...	...	...	...	...	...	...	...	
7,467,358	1,224,715	13,300	211,161	2,411,172	1,420,501	1,795,609	390,900	36
6,639,781	499,712	9,825	44,230	1,996,400	966,522	1,342,997	790,095	
3,093,931	216,336	6,700	6,250	1,328,133	622,531	562,200	351.781	
120,077	14,674	...	800	99,953	4,160	...	500	37
14,654	3,450	...	...	10,104	1,100	...	...	
...	...	...	...	...	...	...	...	
311,950	51,191	...	14,810	166,611	75,038	...	4,400	38
208,855	32,712	...	1,400	154,243	20,000	...	600	
85,786	11,070	...	...	67,786	15,330	1,600	...	
11,280,367	1,917,426	8,206	282,142	3,691,954	3,246,779	1,991,819	142,041	39
9,472,083	1,241,514	5,700	65,078	3,135,664	2,763,798	1,624,741	636,688	
6,031,061	578,227	6,000	13,800	1,998,340	1,606,073	[4]466,886	361,735	
170,594	118,844	100	6,764	37,671	4,225	3,000	...	40
148,868	67,959	...	425	69,666	20,468	350	...	
97,121	41,402	...	700	61,579	3,040	...	400	
161,988	18,850	200	23,327	110,111	8,000	...	1,500	41
121,672	17,125	200	925	97,922	...	3,500	2,000	
69,902	7,750	1,350	600	68,492	1,110	700	...	
232,166	16,463	...	1,600	151,438	34,400	...	28,265	42
142,362	13,812	...	2,400	105,000	17,150	...	4,000	
...	...	...	...	...	...	...	...	
3,131,017	165,718	...	7,700	1,136,199	270,150	1,540,900	10,350	43
1,450,118	82,941	...	4,140	756,105	98,582	495,500	12,850	
293,288	30,995	...	1,700	224,503	23,850	4,900	7,340	
1,054,761	147,602	...	101,392	732,867	61,400	1,250	10,250	44
658,183	87,123	480	7,240	498,557	53,783	1,000	10,000	
263,289	30,297	600	1,450	180,102	49,540	...	1,300	
123,279	24,163	2,000	30,630	36,036	13,800	150	16,500	45
68,000	20,525	...	20,075	8,200	12,000	...	7,200	
36,175	7,950	...	8,200	11,950	4,575	...	3,500	
188,646	26,699	...	8,400	107,597	35,250	300	10,400	46
207,565	10,700	...	...	100,265	96,600	...	...	
130,192	4,200	...	...	73,107	51,500	1,100	285	
627,280	92,370	3,100	13,030	291,690	96,890	120,500	9,700	47
346,056	47,106	192	3,720	218,748	56,290	17,500	2,500	
256,471	32,172	3,700	4,191	121,281	70,902	5,300	18,925	
307,128	84,670	500	7,850	161,990	41,418	5,300	5,500	48
204,488	48,954	...	...	139,134	15,950	...	450	
16,751	1,100	...	...	15,651	...	...	...	
226,013	43,577	...	4,900	169,936	6,400	...	1,200	49
130,328	22,600	...	250	101,128	5,500	...	850	
85,958	4,100	500	1,250	74,152	4,806	1,000	150	
1,426,499	213,882	1,000	161,995	771,574	189,948	69,600	18,500	50
1,053,389	107,594	...	133,105	657,300	51,715	20,625	83,050	
436,576	33,400	3,800	1,400	316,179	36,282	...	45,515	
32,687	3,300	500	985	20,902	7,000	...	...	61
24,370	4,620	...	...	19,750	...	...	...	
5,686	1,986	...	...	3,700	...	...	...	

[3] Indian Territory and Oklahoma were reported as Indian Territory in 1880. Average circulation, all classes, 2,030; weekly, 2,030. Aggregate circulation, all classes, 4,060; weekly, 4,060.

[4] Includes 1 semiannual.

Consideration of Tables 33, 34, and 35 permits a significant grouping of facts relating to aggregate circulation and to the circulation of daily, weekly, and monthly publications. Of a total of 114,299,334 aggregate circulation per issue for all newspapers and periodicals, 10 states—New York, Pennsylvania, Illinois, Ohio, Maine, Massachusetts, Missouri, Tennessee, New Jersey, and Michigan, ranking in the order given—supplied 79.5 per cent in 1880, 79.8 per cent in 1890, and 81.8 per cent in 1900. Of a total of 15,102,156 aggregate circulation per issue for all daily newspapers, 10 states—New York, Pennsylvania, Illinois, Ohio, Massachusetts, Missouri, California, Indiana, Michigan, and Minnesota, ranking in the foregoing order—supplied 78.1 per cent in 1880, 77.1 per cent in 1890, and 78.9 per cent in 1900. Of a total of 39,852,052 aggregate circulation per issue for all weekly newspapers and periodicals, 10 states—New York, Illinois, Pennsylvania, Ohio, Massachusetts, Missouri, Tennessee, Iowa, Minnesota, and Indiana, ranking in the order given—supplied 75.1 per cent in 1880, 71.9 per cent in 1890, and 76.6 per cent in 1900. Of a total of 39,519,897 aggregate circulation per issue of monthly newspapers and periodicals, 10 states—New York, Maine, Pennsylvania, Illinois, Massachusetts, Ohio, Missouri, Michigan, Indiana, and Minnesota, ranking in the order named—supplied 91 per cent in 1880, 87.4 per cent in 1890, and 92.5 per cent in 1900. These facts are shown in Tables 36, 37, 38, and 39.

TABLE 36.—*Aggregate circulation per issue of all classes in 10 states, and per cent that aggregate circulation in each forms of the total, 1880 to 1900.*

STATES.	AGGREGATE CIRCULATION PER ISSUE.			PER CENT AGGREGATE CIRCULATION IN EACH STATE FORMS OF TOTAL FOR THE UNITED STATES.		
	1900	1890	1880	1900	1890	1880
Total	93,446,706	55,202,624	25,276,815	81.8	79.8	79.5
New York	37,626,095	18,031,391	9,374,134	32.9	26.1	29.5
Pennsylvania	11,280,367	9,472,083	5,031,061	9.9	13.7	15.8
Illinois	10,429,368	7,891,219	2,421,275	9.1	11.4	7.6
Ohio	7,467,358	5,639,781	3,093,931	6.5	8.2	9.7
Maine	6,434,065	2,442,046	1,214,460	5.6	3.5	3.8
Massachusetts	6,199,127	4,662,159	2,012,929	5.4	6.7	6.3
Missouri	5,495,802	2,615,135	965,285	4.8	3.8	3.0
Tennessee	3,131,017	1,450,118	293,288	2.7	2.1	0.9
New Jersey	3,009,104	1,486,777	249,478	2.6	2.2	0.8
Michigan	2,374,403	1,511,915	620,974	2.1	2.2	2.0

TABLE 37.—*Aggregate circulation per issue of daily newspapers in 10 states, and per cent that aggregate circulation in each forms of the total, 1880 to 1900.*

STATES.	AGGREGATE CIRCULATION PER ISSUE.			PER CENT AGGREGATE CIRCULATION IN EACH STATE FORMS OF TOTAL FOR THE UNITED STATES.		
	1900	1890	1880	1900	1890	1880
Total	11,921,621	6,467,601	2,786,950	78.9	77.1	78.1
New York	3,896,967	2,119,101	996,561	25.8	25.3	27.9
Pennsylvania	1,917,426	1,241,514	578,227	12.7	14.8	16.2
Illinois	1,449,087	774,486	270,923	9.6	9.2	7.6
Ohio	1,224,715	499,712	216,336	8.1	6.0	6.1
Massachusetts	1,130,820	445,781	280,399	7.5	5.3	7.9
Missouri	810,492	428,094	122,660	5.4	5.1	3.4
California	475,596	399,454	157,814	3.1	4.8	4.4
Indiana	345,404	166,051	72,698	2.3	2.0	2.0
Michigan	370,848	212,975	62,839	2.5	2.5	1.8
Minnesota	300,266	180,433	28,493	2.0	2.2	0.8

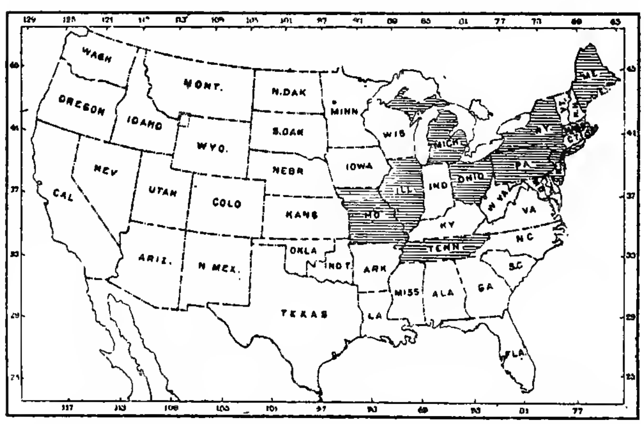
TABLE 38.—*Aggregate circulation per issue of weekly newspapers and periodicals in 10 states, and per cent that aggregate circulation in each forms of the total, 1880 to 1900.*

STATES.	AGGREGATE CIRCULATION PER ISSUE.			PER CENT AGGREGATE CIRCULATION IN EACH STATE FORMS OF TOTAL FOR THE UNITED STATES.		
	1900	1890	1880	1900	1890	1880
Total	30,515,200	20,809,936	12,202,266	76.6	71.9	75.1
New York	12,607,099	6,347,827	4,253,908	31.6	21.9	26.2
Illinois	3,866,983	3,437,663	1,527,042	9.7	11.9	9.4
Pennsylvania	3,691,954	3,135,664	1,998,340	9.3	10.8	12.3
Ohio	2,411,172	1,996,400	1,328,133	6.1	6.9	8.2
Massachusetts	2,066,369	1,802,125	1,089,515	5.2	6.2	6.7
Missouri	1,862,856	1,346,714	645,747	4.7	4.7	4.0
Tennessee	1,136,199	756,105	224,503	2.9	2.6	1.4
Iowa	1,105,666	795,077	449,550	2.8	2.7	2.8
Minnesota	908,478	518,563	167,206	2.3	1.8	1.0
Indiana	858,424	673,798	518,322	2.2	2.3	3.2

TABLE 39.—*Aggregate circulation per issue of monthly publications in 10 states, and per cent that aggregate circulation in each forms of the total, 1880 to 1900.*

STATES.	AGGREGATE CIRCULATION PER ISSUE.			PER CENT AGGREGATE CIRCULATION IN EACH STATE FORMS OF TOTAL FOR THE UNITED STATES.		
	1900	1890	1880	1900	1890	1880
Total	36,575,138	17,153,712	7,417,008	92.5	87.4	91.0
New York	16,927,062	6,990,400	2,903,527	42.8	35.6	35.7
Maine	6,120,490	1,964,659	1,036,200	15.5	10.0	12.7
Pennsylvania	3,246,779	2,763,798	1,606,073	8.2	14.1	19.7
Illinois	3,072,932	1,627,250	401,646	7.8	8.3	4.9
Massachusetts	2,257,142	1,327,740	574,538	5.7	6.8	7.1
Ohio	1,420,501	956,522	622,531	3.6	4.9	7.6
Missouri	1,378,586	624,767	153,800	3.5	3.2	1.9
Michigan	984,025	377,734	33,293	2.5	1.9	0.4
Indiana	715,292	371,909	60,250	1.8	1.9	0.7
Minnesota	452,329	148,933	25,150	1.1	0.8	0.3

CARTOGRAM 1.—*Ten states possessing 81.8 per cent of aggregate circulation per issue of all publications, 1900.*



By reference to cartogram 1, the geographic relation of the preponderance exerted by the 10 leading states is clearly perceived. The 10 states which possess 81.8 per cent of the aggregate circulation of all publications form a belt beginning at the eastern border of Kansas, and extending—with a break at Indiana—through Massachusetts, Maine, New York, and New Jersey to the Atlantic Ocean. From this belt Michigan is an offshoot northward and Tennessee southward. The 10 states leading in circulation of dailies form almost the same belt, made more marked by the addition of Indiana; California and Minnesota, also, are added, and Maine, New Jersey, and Tennessee omitted. The 10 states possessing the largest weekly and monthly circulation per issue are similar in general location, showing a band which extends from the Kansas border to Maine—Maine and Minnesota being isolated in the monthly class.

The tabular statements relating to this subject show that the production of monthlies is centralized in a few states to a greater degree than that of any other class of periodicals, 10 states possessing 92.5 per cent of the aggregate circulation. The production of weekly periodicals is most decentralized, perhaps because the weekly is the publication of the average community, and as a class is less the particular product of any state, or group of states, than any other class of publications.

While the figures presented in the foregoing comparisons indicate clearly the great importance of a small number of states in the aggregate circulation per issue, as well as in the circulation per issue for different classes, the fact is important that in number of establishments, capital, and value of products this preponderance is not so clearly maintained. The states already shown to possess more than four-fifths of the aggregate circulation of all newspapers and periodicals, reported but 45.4 per cent of all establishments, namely, 8,279 out of a total of 18,226. Moreover, these states showed a steady and considerable decrease in the proportionate number of establishments, having 54.2 per cent of the total in 1880, 50.7 per cent in 1890, and 45.4 per cent in 1900. They were not the 10 states having the largest numbers of establishments. The 10 states having the largest number of establishments reported but 60.4 per cent of the whole number in the United States in 1880, 59.2 per cent in 1890, and 56.8 per cent in 1900. Thus the relation which the number of establishments in the states selected bore to the whole number in 1880, 1890, and 1900 was also a declining one. It is clear, therefore, that in the last two decades the number of establishments has increased more rapidly in some states with a comparatively small number of establishments than in those possessing the largest number. In the latter class of states there appears to have been an actual decrease in number of establishments, though, as previously shown, not in actual circulation—an evidence, possibly, of consolidation.

Of the total capital, the 10 states possessing the largest circulation per issue of all publications, reported 65.6 per cent in 1890 and 68.9 per cent in 1900. Of the total value of products, they reported 69.8 per cent in 1880, 69.6 per cent in 1890, and 71.1 per cent in 1900.

THE RELATION OF CIRCULATION TO POPULATION.

It has been pointed out, in connection with Tables 29, 30, and 33, that the circulation of newspapers and periodicals reported by each state and by each large city, is in reality a product not governed by local consumption, but intended for distribution regardless of state lines, distances being limited only by the ability and energy of the producers in securing patronage. While the circulation reported by each state is of great importance as representing a product, it is difficult to dissociate this product from the state's own requirement, and to remember that of the total circulation reported, the state itself may use but a fraction. In some respects the number of publications forms a more reliable basis of comparison than circulation—the latter being often so exceptional as to make the standing of the state or territory appear very different from what it really is. In Table 40 the number of publications has been used as a basis, except in the last two columns, which are inserted because they furnish several interesting conclusions.

TABLE 40.—*Number of publications to each 1,000 inhabitants, by states, per cent that number of publications in each state forms of total number, and per cent of increase in aggregate circulation per issue, 1890 and 1900.*

STATES.	NUMBER OF PUBLICATIONS TO EACH 1,000 INHABITANTS.		PER CENT THAT NUMBER OF PUBLICATIONS IN EACH STATE FORMS OF TOTAL NUMBER.		PER CENT OF INCREASE IN AGGREGATE CIRCULATION PER ISSUE.	
	1900	1890	1900	1890	1890 to 1900	1880 to 1890
Alabama	0.10	0.09	1.0	0.9	[1]6.8	165.2
Arizona	0.35	0.49	0.2	0.2	52.6	64.6
Arkansas	0.18	0.15	1.3	1.1	36.4	86.2
California	0.42	0.38	3.4	3.1	25.8	79.9
Colorado	0.46	0.45	1.4	1.2	126.9	139.9
Connecticut	0.17	0.21	0.8	1.0	[1]7.8	108.7
Delaware	0.16	0.19	0.2	0.2	54.5	61.5
District of Columbia	0.25	0.07	0.4	0.1	155.6	50.1
Florida	0.18	0.25	0.5	0.7	4.7	292.4
Georgia	0.12	0.13	1.5	1.5	[1]25.1	172.5
Idaho	0.45	0.39	0.4	0.2	129.4	276.5
Illinois	0.32	0.32	8.5	8.3	32.2	225.9
Indiana	0.33	0.28	4.6	4.2	62.3	96.6
Indian Territory	0.16	0.05	0.3	0.1	457.4	([2])
Iowa	0.47	0.37	5.7	4.7	73.2	98.8
Kansas	0.47	0.49	3.8	4.7	51.2	169.6
Kentucky	0.13	0.12	1.5	1.5	51.0	83.1
Louisiana	0.12	0.12	0.9	0.9	[1]16.2	172.1
Maine	0.25	0.22	1.0	1.0	163.5	101.1
Maryland	0.14	0.12	0.9	0.8	73.4	[1]5.5
Massachusetts	0.17	0.25	2.7	3.8	33.0	131.6
Michigan	0.29	0.28	3.8	4.0	57.0	143.5
Minnesota	0.36	0.30	3.4	2.6	90.6	360.7
Mississippi	0.11	0.09	1.0	0.8	56.3	22.9
Missouri	0.30	0.26	5.2	4.7	110.2	170.9
Montana	0.37	0.39	0.5	0.3	84.3	231.2
Nebraska	0.50	0.42	2.9	3.0	72.4	311.1
Nevada	0.83	0.33	0.2	0.1	24.9	[1]47.6
New Hampshire	0.21	0.29	0.5	0.7	[1]18.9	40.4
New Jersey	0.16	0.18	1.6	1.8	102.4	496.0
New Mexico	0.22	0.22	0.2	0.2	40.0	264.4
New York	0.20	0.27	8.1	10.9	108.7	92.4
North Carolina	0.11	0.08	1.1	0.9	61.7	68.8
North Dakota	0.44	0.48	0.8	0.6	60.7	([3])
Ohio	0.25	0.25	5.7	6.3	32.4	82.3
Oklahoma	0.28	0.34	0.6	0.1	719.4	([3])
Oregon	0.45	0.40	1.0	0.8	49.4	143.5
Pennsylvania	0.22	0.24	7.5	8.5	19.1	88.3
Rhode Island	0.09	0.16	0.2	0.4	14.6	53.3
South Carolina	0.09	0.07	0.6	0.6	33.1	74.1
South Dakota	0.54	0.53	1.2	1.2	63.1	([3])
Tennessee	0.12	0.12	1.4	1.5	115.9	394.4
Texas	0.24	0.20	4.0	2.9	60.3	150.0
Utah	0.26	0.13	0.4	0.2	81.3	88.0
Vermont	0.23	0.21	0.4	0.5	[1]9.1	59.4
Virginia	0.11	0.11	1.1	1.2	81.3	34.9
Washington	0.38	0.41	1.1	1.0	50.2	1,120.8
West Virginia	0.18	0.15	1.0	0.8	73.4	51.6
Wisconsin	0.29	0.27	3.3	3.1	35.4	141.3
Wyoming	0.45	0.41	0.2	0.2	34.1	328.6

[1] Decrease.
[2] See note 6, page 25
[3] See note 2, page 26.

All but 16 states and territories showed an increase, during the past decade, in the number of publications to each 1,000 inhabitants, but in the majority of cases the increase was slight.

The number of publications to each 1,000 inhabitants was greatest in Nevada, where there was a marked decline in population—showing that the decreasing communities in that state retained local publications already in existence.

The states and territories showing, in 1900, an increase of more than 100 per cent in aggregate circulation per issue, were Colorado, the District of Columbia, Idaho, Indian Territory, Maine, Missouri, New Jersey, New York, Oklahoma, and Tennessee. Of these, Colorado, Idaho, Indian Territory, and Oklahoma doubtless owed their increase to the influx of population during the decade, and Maine and New Jersey to special publications producing a condition which is to some extent misleading for comparative purposes. The decline in the per cent of increase in aggregate circulation per issue, as compared with that shown in 1890, is very marked, appearing in no less than 39 states and territories. Upon this fact, however, the greater accuracy of enumeration in 1890, as compared with 1880, has an important bearing.

Table 41 presents the figures for the 16 states and territories showing a decrease in the number of publications to each 1,000 inhabitants.

TABLE 41.—*Comparison of increase in aggregate circulation per issue with increase in population, for the 16 states and territories showing decrease in number of publications per 1,000 inhabitants, 1900.*

STATES AND TERRITORIES.	Per cent of increase in aggregate circulation per issue.	Per cent of increase in population.
Arizona	52.6	68.0
Connecticut	[1]7.8	21.7
Delaware	54.5	9.6
Florida	4.7	35.0
Georgia	[1]25.1	20.6
Kansas	90.9	2.9
Massachusetts	33.0	25.3
Montana	84.3	75.2
New Hampshire	[1]18.9	9.3
New Jersey	102.4	30.4
New York	108.7	21.1
North Dakota	60.7	70.9
Oklahoma	719.4	518.2
Pennsylvania	19.1	19.9
Rhode Island	14.6	24.0
Washington	50.2	46.5

[1] Decrease.

It appears that in 8 of these 16 states and territories in which the number of publications per 1,000 inhabitants decreased, the circulation of existing publications nevertheless increased more rapidly than the population. These were Delaware, Kansas, Massachusetts, Montana, New Jersey, New York, Oklahoma, and Washington. This fact indicates clearly an extension of the circulation of existing publications, rather than the establishment of new ones. This tendency is not confined to the 7 states and the territory mentioned, but is characteristic of many of the states, especially the older ones.

Table 42 shows the total number of publications classified according to period of issue and character, by states and territories, from 1880 to 1900.

TABLE 42.—COMPARATIVE STATEMENT OF NEWSPAPERS AND PERIODICALS, NUMBER OF PUBLICATIONS

	STATES AND TERRITORIES.	Year.	Total number.	PERIOD OF ISSUE. Daily. Total.	Daily. Morning.	Daily. Evening.	Triweekly.	Semi-weekly.	Weekly.	Monthly.	Quarterly.	All other classes.
1	United States	1900	18,226	2,226	595	1,631	62	637	12,979	1,817	237	268
		1890	14,901	1,610	559	1,051	34	194	10,814	1,734	225	290
		[2]1880	[3] 11,314	971	438	533	73	133	8,633	1,167	116	221
2	Alabama	1900	175	19	8	11	1	2	143	4		6
		1890	136	14	8	6		1	108	9	2	2
		1880	125	6	3	3	1		109	7		2
3	Arizona	1900	43	10	4	6			32	1		
		1890	29	8	6	2			21			
		1880	17	6	3	3			11			
4	Arkansas	1900	236	20	4	16	1	4	199	8	1	3
		1890	164	14	4	10			142	7		1
		1880	117	6	2	4		1	104	2		4
5	California	1900	622	117	47	70	1	22	397	71	6	8
		1890	455	87	42	45	2	11	311	37	1	6
		1880	361	58	30	28	2	11	250	32	2	6
6	Colorado	1900	248	42	13	29	1	3	179	19	1	3
		1890	186	23	11	12	1	3	163	6		
		1880	87	19	12	7		1	63	4		
7	Connecticut	1900	155	44	13	31		22	74	9	2	4
		1890	156	34	12	22		2	95	20	1	4
		1880	139	17	7	10		2	99	15	2	4
8	Delaware	1900	30	6	2	4		1	21	2		
		1890	32	5	2	3			23	4		
		1880	26	5	2	3			20	1		
9	District of Columbia	1900	69	8	3	5		1	31	22	2	5
		1890	17	4	2	2			11	2		
		1880	44	5	3	2			23	15	1	
10	Florida	1900	97	11	4	7	1	1	76	8		
		1890	97	12	4	8	2		80	1		2
		1880	45	3	3			2	40			
11	Georgia	1900	265	27	15	12		9	205	17	1	6
		1890	230	19	11	8		1	177	29	1	3
		1880	200	16	11	5	4	3	163	11		3
12	Idaho	1900	72	5	3	2		5	59	1		2
		1890	33	3	2	1		2	28			
		1880	10				1	2	7			
13	Illinois	1900	1,548	197	44	163	4	72	1,000	219	23	33
		1890	1,241	121	44	77	2	20	858	182	29	29
		1880	1,017	74	30	44	6	17	758	118	21	23
14	Indiana	1900	841	156	26	130		41	561	64	10	9
		1890	620	92	17	75		2	448	61	6	11
		1880	467	40	12	28	3	1	390	27		6
15	Indian Territory	1900	64	6	1	5			66	2		
		1890	9	1	1				8			
		[6]1880										
16	Iowa	1900	1,045	65	16	49	7	58	831	64	8	12
		1890	703	46	18	28	2	14	593	39	4	5
		1880	569	30	12	18	1	3	500	31	1	3
17	Kansas	1900	684	53	7	46	1	3	563	61	5	8
		1890	693	43	12	31		3	621	22	1	3
		1880	347	20	8	12		1	310	15		1
18	Kentucky	1900	282	27	10	17	1	24	190	32	3	6
		1890	218	25	12	13	1	7	165	13		7
		1880	205	11	7	4	2	7	160	23		2
19	Louisiana	1900	160	23	8	15	2	6	112	15		2
		1890	129	12	6	6		1	99	13	1	3
		1880	112	13	8	5	1	1	94	2		1
20	Maine	1900	177	15	5	10		5	100	45	8	4
		1890	146	16	5	10		1	88	36	2	4
		1880	123	12	4	8	1		90	18	1	1
21	Maryland	1900	166	18	8	10		2	127	15	1	3
		1890	124	11	9	2			102	6	2	3
		1880	143	15	10	5			111	12	1	4
22	Massachusetts	1900	486	98	25	73		7	273	85	15	8
		1890	568	56	12	44		7	336	123	31	15
		1880	427	39	16	23	1	13	279	80	7	8
23	Michigan	1900	698	70	14	56	5	23	522	65	5	8
		1890	689	62	12	40	1	5	472	49	1	9
		1880	464	33	13	20	3	3	397	19	1	8
24	Minnesota	1900	622	44	12	32	1	9	493	60	2	13
		1890	392	30	11	19		1	311	42	2	6
		1880	223	10	4	6	1		205	6		1

[1] Includes 173 Sunday publications, not connected with daily newspapers.
[2] Includes publications for Dakota and Indian Territory.
[3] Includes 1,182 publications not reporting operations, as they can not be excluded from the classification.

BY PERIOD OF ISSUE AND CHARACTER OF PUBLICATION, BY STATES AND TERRITORIES, 1880 TO 1900.

CHARACTER OF PUBLICATION.															
News, politics, and family reading.	Religion.	Agriculture, horticulture, dairying, and stock raising.	Commerce finance, insurance, and railroads.	Trade journals.	General literature, including magazines.	Sunday newspapers.	Medicine and surgery.	Law.	Science and mechanics.	Fraternal organizations.	Education and history.	Society, art, music, and fashion.	College and school periodicals.	Miscellaneous.	
14,867	952	307	190	520	239	72	111	62	66	200	120	88	139	293	1
11,326	1,025	263	239	432	291	143	123	47	83	216	119	152	137	[1] 305	
8,863	553	173	[4] 363	(4)	189	(4)	114	45	68	149	[4] 248	72	(4)	[5] 477	
160	7	2	4				1							1	2
110	14	4		1	1	2	1		2	1					
114	5	2						1			3				
41		1											1		3
26		3													
17															
214	6	1			1	3	1			6	2	1		1	4
150	6	1					1		1	3			2		
106	5	2			1		1		1					1	
467	40	17	12	21	10	2	4	4	3	13	6	2	2	19	5
356	15	11	10	22	7	3	3	1	2	6	3	2		14	
270	12	7	27		4		3	3	3	7	6	3		16	
199	4	9	3	7		1	1	2	2	6	2	1	1	10	6
174	3	2	1	1		1			1	1		1		1	
78	2	1	1						2	1	1			1	
130	6	2	4	1		3	2			4	3				7
119	11	5	1	3	5	3	1		1	1	2		3	1	
110	3	4			2		1		1	5	11			2	
28										1	1				8
24	2	1				1						1	1	2	
24	1										1				
32	4	1	3	2	5	2	1	1	5	2	1	1	2	7	9
10	1					1		3						2	
20			2		2		1	2	1	3	2			11	
86	7	2			2										10
83	4	4	1	3								1		1	
41		2	1		1										
236	10	2	1	5	2		4	1					1	3	11
185	13	2	2	3	2	1	5		2	1	5	2	5	2	
177	7	4			2		3			1		1		5	
69		1		1						1					12
32				1											
10															
1,141	85	35	17	101	28	4	12	8	9	18	17	24	10	39	13
862	102	30	27	72	18	5	12	5	17	18	7	19	3	44	
736	49	15	66		9		8	5	5	13	19	7		85	
730	36	16	3	14	3	5	4			13	3	1	8	5	14
508	27	20	5	13	1	10	6		1	9	2	2	7	9	
422	13	7	3				2		2	6	9			3	
62	1										1			1	15
7	1														
942	39	14	2	4	2	1		1	1	13	5	3	9	9	16
630	26	7	5	1	3					9	4	2	8	8	
519	15	4			2			1	1	7	15	1		4	
608	16	16	2	6	2					11	6	1	7	9	17
647	9	8	1	1			1			5	4	4	6	7	
322	4	5			2		1			3	3			7	
220	22	8		10		1	3	1		3	1		8	5	18
177	15	4	2	6	1	4	1	1		1	1		3	2	
162	13	6	4		3		4			2	5			6	
134	6	4	1	3	3				1	1		1	3	3	19
86	10	5	6	2		1	2			2			3	12	
96	7	1	1				1			1	1			4	
128	9	1	4	1	21		1		1	3	1		4	3	20
97	6	6			21	2				4	4	3	3	1	
91	9	4	1		8				2	2	3			3	
130	12	3	2	6	1		1	2	4					5	21
106	5	2	1	2	1	1	2			1		1	1	1	
105	10	5	5		3		2	1	1	3	4			4	
312	48	6	8	27	27	8	2		5	7	8	7	5	16	22
326	77	14	12	18	27	5	2	1	11	15	13	12	8	27	
281	30	6	19		20		2	2	5	6	15	10		31	
615	23	7	3	18	8	1	5	1	1	5	4		3	4	23
495	36	8	2	3	6	7	4		1	9	4	2	6	6	
413	11	5	3		1		7		2	5	9	3		5	
516	20	11	5	21	6		4	4	2	12	6	1	5	9	24
316	19	5	5	6	8	4	1	2	3	5	3	3	5	7	
207	3	3	2							2	2			4	

[4] In 1880 "trade journals" were included with "commerce, finance, insurance, and railroads," "Sunday newspapers" with "miscellaneous," and "college and school periodicals" with "education and history."

[5] Includes 217 children's publications and Sunday school papers.

[6] Indian Territory and Oklahoma reported as Indian Territory in 1880.

TABLE 42.—COMPARATIVE STATEMENT OF NEWSPAPERS AND PERIODICALS, NUMBER OF PUBLICATIONS BY

	STATES AND TERRITORIES.	Year.	Total number.	PERIOD OF ISSUE. Daily. Total.	Daily. Morning.	Daily. Evening.	Triweekly.	Semi-weekly.	Weekly.	Monthly.	Quarterly.	All other classes.
25	Mississippi	1900	178	13	3	10	1	2	156	4		2
		1890	119	6	2	4	1		102	7		3
		1880	123	5	3	2	5	1	109	3		
26	Missouri	1900	940	92	24	68	1	14	695	101	14	23
		1890	707	81	27	54	2	7	516	73	9	19
		1880	530	43	22	21	8	2	415	50	1	11
27	Montana	1900	89	11	5	6		4	70	3	1	
		1890	52	9	3	6	1	1	37	3		1
		1880	18	4	4				14			
28	Nebraska	1900	538	32	7	25	1	16	454	28	3	4
		1890	446	31	6	25		2	395	11		7
		1880	189	15	5	10		1	165	7		1
29	Nevada	1900	35	9	3	6	1	3	21	1		
		1890	15	6	3	3			9			
		1880	37	14	5	9			22	1		
30	New Hampshire	1900	88	14	2	12	2		67	5		
		1890	111	16	3	13		2	83	10		
		1880	87	10	2	8			66	7		4
31	New Jersey	1900	298	49	7	42		2	225	17	4	1
		1890	263	47	15	32	2	1	186	21	3	3
		1880	215	27	8	19	1	6	163	13	2	3
32	New Mexico	1900	42	3		3			35	1	1	2
		1890	34	4	1	3			29			1
		1880	18	3	2	1			15			
33	New York	1900	1,477	207	63	144	8	52	872	272	35	31
		1890	1,627	162	64	98	4	31	927	395	49	59
		1880	1,411	115	46	69	5	24	892	282	40	53
34	North Carolina	1900	200	26	8	18		15	142	10	1	6
		1890	135	20	9	11		3	102	5	3	2
		1880	142	13	7	6	2	3	113	7		4
35	North Dakota	1900	139	9	4	5		2	126	2		
		1890	87	7	3	4		2	74	4		
		[1]1880										
36	Ohio	1900	1,039	170	24	146	8	53	692	90	15	11
		1890	932	121	27	94	7	19	635	106	25	19
		1880	774	56	22	34	8	4	584	90	11	21
37	Oklahoma	1900	110	9	2	7		1	96	3		1
		1890	21	6	3	3			14	1		
		[2]1880										
38	Oregon	1900	188	21	9	12		14	124	27		2
		1890	126	16	7	9		1	100	8		1
		1880	74	7	4	3			59	6	1	1
39	Pennsylvania	1900	1,365	196	52	144	5	47	883	178	42	14
		1890	1,271	143	45	98	3	13	771	266	37	38
		1880	973	98	42	56	4	3	674	159	16	19
40	Rhode Island	1900	40	12	3	9	1	3	21	2	1	
		1890	54	9	3	6		1	30	13	1	
		1880	44	8	2	6		1	31	3		1
41	South Carolina	1900	117	7	3	4	1	15	83	10		1
		1890	84	6	4	2	1	2	73		1	1
		1880	81	4	3	1	3	1	69	3	1	
42	South Dakota	1900	218	16	4	12		1	189	9		3
		1890	174	19	7	12		3	141	10		1
		[1]1880										
43	Tennessee	1900	251	16	9	7		6	187	28	10	4
		1890	219	18	8	10		2	169	20	6	4
		1880	193	12	7	5		2	154	16	2	7
44	Texas	1900	722	83	22	61		22	579	33	1	4
		1890	437	42	13	29	1	6	367	19	1	1
		1880	280	30	14	16	1	2	231	14		2
45	Utah	1900	72	6	2	4	1	7	49	4	2	3
		1890	28	9	4	5		7	6	4		2
		1880	22	5	2	3		4	8	4		1
46	Vermont	1900	79	9	2	7		2	53	10	1	4
		1890	70	5	2	3			58	7		
		1880	82	5	2	3			72	3	1	1
47	Virginia	1900	204	37	15	22	3	6	126	23	6	3
		1890	185	21	11	10	1	6	134	18	3	2
		1880	194	20	15	5	5	6	124	33	3	3
48	Washington	1900	199	15	8	7	1	3	154	21	2	3
		1890	144	18	6	12			118	7		1
		1880	29	4	4				23	2		

[1] North Dakota and South Dakota reported as Dakota in 1880.

PERIOD OF ISSUE AND CHARACTER OF PUBLICATION, BY STATES AND TERRITORIES, 1880 TO 1900—Continued.

CHARACTER OF PUBLICATION.

News, politics, and family reading.	Religion.	Agriculture, horticulture, dairying, and stock raising.	Commerce, finance, insurance, and railroads.	Trade journals.	General literature, including magazines.	Sunday newspapers.	Medicine and surgery.	Law.	Science and mechanics.	Fraternal organizations.	Education and history.	Society, art, music, and fashion.	College and school periodicals.	Miscellaneous.	
169	5	1	...	...	...	...	...	...	...	...	...	...	2	1	25
105	7	3	...	...	1	...	...	...	...	1	2	...	...	...	
115	4	3	...	...	...	...	...	...	...	...	1	...	...	...	
739	45	22	11	36	12	2	18	7	7	7	5	5	8	16	26
526	58	15	20	30	5	2	11	4	4	5	6	7	3	11	
425	28	7	17	...	5	...	8	3	2	9	11	2	...	13	
79	2	5	...	...	...	...	...	...	...	1	...	...	...	2	27
45	2	3	...	1	...	...	...	...	...	...	...	...	...	1	
17	...	1	...	...	...	...	...	...	...	...	...	...	...	...	
481	14	9	2	9	3	...	...	1	1	7	...	1	3	7	28
414	3	8	2	5	2	1	1	...	...	2	1	2	3	2	
178	2	3	1	...	2	...	...	...	...	...	2	...	...	1	
34	...	...	...	...	...	...	...	...	...	1	...	...	...	...	29
15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
35	...	...	...	...	...	...	...	...	2	...	...	...	...	...	
80	2	2	...	1	1	...	...	...	...	...	...	...	...	2	30
97	5	...	...	1	5	...	...	...	...	1	...	1	...	1	
74	3	1	...	...	5	...	...	...	...	1	1	1	...	1	
274	6	1	1	5	1	...	...	...	...	1	2	1	1	5	31
218	10	1	...	1	5	5	...	2	1	9	2	3	3	3	
194	3	1	2	...	3	...	1	1	1	4	4	...	...	1	
36	4	1	...	...	...	...	...	...	...	...	...	...	1	...	32
32	1	...	...	...	...	1	...	...	...	...	...	...	...	...	
17	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
1,004	79	25	56	111	51	8	19	9	15	12	16	18	5	49	33
862	155	23	81	147	98	24	27	12	24	34	26	52	11	51	
816	97	29	125	...	77	...	38	6	28	16	35	28	...	116	
168	22	4	2	1	...	2	...	...	...	...	...	...	1	...	34
114	12	3	1	...	...	...	1	...	...	...	...	...	2	2	
118	12	4	2	...	2	...	1	...	...	2	1	...	...	...	
138	...	...	...	...	...	...	...	...	...	...	...	...	1	...	35
81	1	1	...	...	...	...	...	...	...	1	1	...	1	1	
880	55	8	10	29	9	3	5	6	1	7	3	5	9	9	36
694	101	8	8	14	15	18	9	3	2	16	6	6	11	21	
576	57	12	24	...	2	...	11	4	4	12	19	7	...	46	
106	2	...	...	...	1	...	1	...	...	...	...	...	...	...	37
20	1	...	...	...	...	...	...	...	...	...	...	...	...	...	
137	11	7	3	7	2	...	1	1	...	10	3	1	2	3	38
108	6	2	2	1	...	1	...	...	...	1	1	...	1	3	
60	5	1	2	...	2	...	1	...	...	...	2	...	...	1	
1,008	164	14	20	45	22	15	11	6	7	12	4	9	6	22	39
784	175	15	28	50	35	20	23	12	8	35	13	19	15	39	
675	75	13	41	...	18	...	13	13	3	15	23	5	...	79	
30	3	1	...	3	1	...	...	...	...	...	...	...	1	1	40
33	4	...	2	2	3	3	...	...	...	3	1	...	3	...	
39	...	...	...	...	...	...	...	...	...	3	2	...	...	...	
100	9	3	...	1	...	...	...	...	...	...	...	...	4	...	41
75	7	1	...	...	...	1	...	...	...	2	1	...	...	...	
68	10	...	...	...	...	...	...	...	...	...	...	...	...	...	
203	...	3	1	2	1	...	...	...	1	3	4	...	3	...	42
162	4	1	...	1	1	...	...	...	...	...	2	...	...	...	
198	32	5	...	3	1	...	3	...	...	3	2	...	3	1	43
169	26	2	3	3	1	1	3	...	1	1	1	1	5	2	
147	14	...	4	...	5	...	3	...	...	4	9	...	...	7	
648	25	12	...	9	1	6	1	1	...	...	3	2	6	8	44
382	8	9	1	6	3	5	3	...	...	3	1	2	3	11	
254	14	2	2	...	2	...	...	1	...	2	1	1	...	1	
55	6	3	...	...	...	...	...	3	...	2	...	...	2	1	45
17	3	2	...	2	3	...	...	...	...	...	...	...	...	1	
15	4	1	...	...	...	...	...	...	...	...	...	...	...	2	
63	3	4	...	1	2	...	1	...	...	...	...	...	3	2	46
61	3	...	...	1	3	...	1	...	...	...	1	...	...	...	
74	3	2	...	...	1	...	...	...	...	...	2	...	...	...	
153	32	4	...	3	...	2	2	1	...	1	1	...	5	...	47
144	17	4	4	1	1	...	2	1	...	2	1	2	4	2	
135	11	6	3	...	2	...	2	2	1	4	15	2	...	11	
152	8	5	9	1	2	...	1	1	...	9	3	1	3	4	48
127	2	3	4	2	...	1	...	...	...	...	1	...	1	3	
28	1	...	...	...	...	...	...	...	...	...	...	...	...	...	

[2] Indian Territory and Oklahoma reported as Indian Territory in 1880.

TABLE 42.—COMPARATIVE STATEMENT OF NEWSPAPERS AND PERIODICALS, NUMBER OF PUBLICATIONS BY

	STATES AND TERRITORIES.	Year.	Total number.	PERIOD OF ISSUE.									
				Daily.			Triweekly.	Semi-weekly.	Weekly.	Monthly.	Quarterly.	All other classes.
				Total.	Morning.	Evening.						
49	West Virginia	1900	176	19	6	13	...	4	141	11	...	1
		1890	112	9	4	5	...	1	95	5	...	2
		1880	109	2	2	...	1	2	96	6	1	1
50	Wisconsin	1900	595	60	15	45	1	21	463	42	5	3
		1890	456	47	14	33	...	3	373	20	3	10
		1880	340	21	9	12	3	2	283	20	...	11
51	Wyoming	1900	42	4	1	3	1	2	32	3	...	...
		1890	25	5	2	3	...	...	20	...	...	...
		1880	11	3	2	1	...	...	8	...	...	...

PERIOD OF ISSUE AND CHARACTER OF PUBLICATION, BY STATES AND TERRITORIES, 1880 TO 1900—Continued.

CHARACTER OF PUBLICATION.															
News, politics, and family reading.	Religion.	Agriculture, horticulture, dairying, and stock raising.	Commerce, finance, insurance, and railroads.	Trade journals.	General literature, including magazines.	Sunday newspapers.	Medicine and surgery.	Law.	Science and mechanics.	Fraternal organizations.	Education and history.	Society, art, music, and fashion.	College and school periodicals.	Miscellaneous.	
165	5	3	...	...	...	...	...	...	...	2	...	...	1	...	
99	[illegible]	1	...	3	1	2	...	...	...	3	...	...	1	...	49
100	3	...	...	...	1	...	...	...	...	1	2	...	...	2	
527	17	5	1	5	7	3	2	1	...	3	7	2	3	12	
392	10	16	2	3	8	7	...	...	1	8	1	2	3	3	50
301	7	4	5	...	2	...	...	...	1	7	8	1	...	4	
40	...	1	...	...	1	...	...	...	...	...	...	...	...	...	
24	...	1	...	...	...	...	...	...	...	...	...	...	...	...	51
11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	

RELATION OF WEEKLY AND DAILY NEWSPAPERS TO POPULATION.

From Table 42 may be derived a comparison of the relation of weekly and daily newspapers to population, by states and territories, as follows:

TABLE 43.—COMPARISON OF THE NUMBER OF INHABITANTS TO EACH WEEKLY AND DAILY PUBLICATION, BY STATES AND TERRITORIES, 1890 AND 1900.

STATES AND TERRITORIES.	POPULATION.		WEEKLY PUBLICATIONS.				DAILY PUBLICATIONS.			
			Number.		Population to each.		Number.		Population to each.	
	1900	1890	1900	1890	1900	1890	1900	1890	1900	1890
United States	....	....	....	....	....	....	....	....	....	....
Alabama	1,828,697	1,513,017	143	108	12,788	14,009	19	14	96,247	108,073
Arizona	122,931	59,620	32	21	3,842	2,839	10	8	12,293	7,452
Arkansas	1,311,564	1,128,179	199	142	6,591	7,945	20	14	65,578	80,584
California	1,485,053	1,208,130	397	311	3,741	3,885	117	87	12,693	13,887
Colorado	539,700	412,198	179	153	3,015	2,694	42	23	12,850	17,922
Connecticut	908,420	746,258	74	95	12,276	7,855	44	34	20,646	21,949
Delaware	184,735	168,493	21	23	8,797	7,320	6	5	30,789	33,699
District of Columbia	278,718	230,392	31	11	8,991	20,945	8	4	34,840	57,598
Florida	528,542	391,422	76	80	6,955	4,893	11	12	48,049	32,618
Georgia	2,216,331	1,837,353	205	177	10,811	10,381	27	19	82,086	96,703
Idaho	161,772	84,385	59	28	2,742	3,014	5	3	32,354	28,128
Illinois	4,821,550	3,826,351	1,000	858	4,822	4,460	197	121	24,475	31,623
Indiana	2,516,462	2,192,404	561	448	4,486	4,894	156	92	16,131	23,830
Indian Territory	392,060	....	56	8	7,001	....	6	1	65,343	....
Iowa	2,231,853	1,911,896	831	593	2,686	3,224	65	46	34,336	41,563
Kansas	1,470,495	1,427,096	563	621	2,612	2,298	53	43	27,745	33,188
Kentucky	2,147,174	1,858,635	190	165	11,301	11,264	27	25	79,525	74,345
Louisiana	1,381,625	1,118,587	112	99	12,336	11,299	23	12	60,071	93,216
Maine	694,466	661,086	100	88	6,945	7,512	15	15	46,298	44,072
Maryland	1,188,044	1,042,390	127	102	9,355	10,220	18	11	66,002	94,763
Massachusetts	2,805,346	2,238,943	273	336	10,276	6,664	98	56	28,626	39,981
Michigan	2,420,982	2,093,889	522	472	4,638	4,436	70	52	34,585	40,267
Minnesota	1,751,394	1,301,826	493	311	3,553	4,186	44	30	39,804	43,394
Mississippi	1,551,270	1,289,600	156	102	9,944	12,643	13	6	119,328	214,933
Missouri	3,106,665	2,679,184	695	516	4,470	5,192	92	81	33,768	33,076
Montana	243,329	132,159	70	37	3,476	3,572	11	9	22,121	14,684
Nebraska	1,066,300	1,058,910	454	395	2,349	2,681	32	31	33,322	34,158
Nevada	42,335	45,761	21	9	2,016	5,086	9	6	4,704	7,627
New Hampshire	411,588	376,530	67	83	6,143	4,537	14	16	29,399	23,533
New Jersey	1,883,669	1,444,933	225	186	8,372	7,768	49	47	38,442	30,743
New Mexico	195,310	153,593	35	29	5,580	5,296	3	4	65,103	38,398
New York	7,268,894	5,997,853	872	927	8,336	6,470	207	162	35,115	37,024
North Carolina	1,893,810	1,617,947	142	102	13,337	15,862	26	20	72,839	80,897
North Dakota	319,146	182,719	126	74	2,533	2,469	9	7	35,461	26,103
Ohio	4,157,545	3,672,316	692	635	6,008	5,783	170	121	24,456	30,350
Oklahoma	398,331	61,834	96	14	4,149	4,417	9	6	44,259	10,306
Oregon	413,536	313,767	124	100	3,335	3,138	21	16	19,692	19,610
Pennsylvania	6,302,115	5,258,014	883	771	7,137	6,820	196	143	32,154	36,769
Rhode Island	428,556	345,506	21	30	20,407	11,517	12	9	35,713	38,390
South Carolina	1,340,316	1,151,149	83	73	16,148	15,769	7	6	191,474	191,858
South Dakota	401,570	328,808	189	141	2,125	2,332	16	19	25,098	17,306
Tennessee	2,020,616	1,767,518	187	169	10,805	10,459	16	18	126,288	98,195
Texas	3,048,710	2,235,523	579	367	5,265	6,091	83	42	36,731	53,227
Utah	276,749	207,905	49	6	5,648	34,651	6	9	46,125	23,101
Vermont	343,641	332,422	53	58	6,484	5,731	9	5	38,182	66,484
Virginia	1,854,184	1,655,980	126	134	14,716	12,358	37	21	50,113	78,856
Washington	518,103	349,390	154	118	3,364	2,961	15	18	34,540	19,411
West Virginia	958,800	762,794	141	95	6,800	8,029	19	9	50,463	84,755
Wisconsin	2,069,042	1,686,880	463	373	4,469	4,522	60	47	34,484	35,891
Wyoming	92,531	60,705	32	20	2,892	3,035	4	5	23,133	12,141

Upon rearranging the states and territories in the order of increasing number of inhabitants to each publication in 1900, the following comparisons result:

TABLE 44.—*States and territories arranged in order of number of inhabitants to each weekly publication, 1900.*

Nevada	2,016	New Hampshire	6,143
South Dakota	2,124	Vermont	6,484
Nebraska	2,349	Arkansas	6,591
North Dakota	2,533	West Virginia	6,800
Kansas	2,612	Maine	6,945
Iowa	2,686	Florida	6,954
Idaho	2,742	Indian Territory	7,001
Wyoming	2,892	Pennsylvania	7,137
Colorado	3,015	New York	8,336
Oregon	3,335	New Jersey	8,372
Washington	3,364	Delaware	8,797
Montana	3,476	District of Columbia	8,991
Minnesota	3,553	Maryland	9,355
California	3,741	Mississippi	9,944
Arizona	3,842	Massachusetts	10,276
Oklahoma	4,149	Tennessee	10,805
Wisconsin	4,469	Georgia	10,811
Missouri	4,470	Kentucky	11,301
Indiana	4,486	Connecticut	12,276
Michigan	4,638	Louisiana	12,336
Illinois	4,822	Alabama	12,788
Texas	5,265	North Carolina	13,337
New Mexico	5,580	Virginia	14,716
Utah	5,648	South Carolina	16,148
Ohio	6,008	Rhode Island	20,407

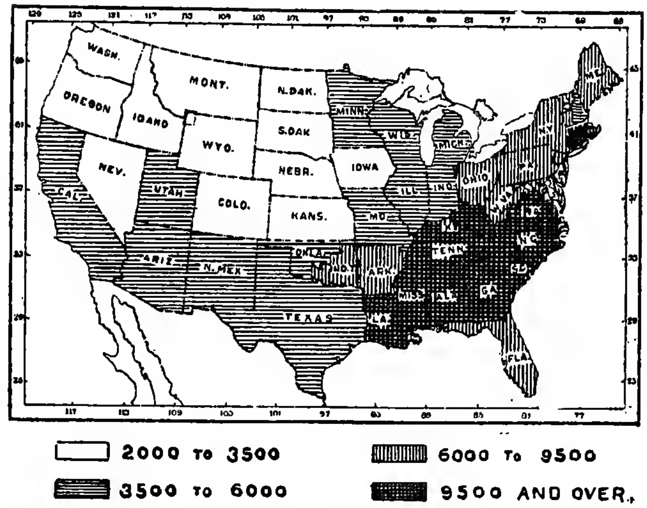
TABLE 45.—*States and territories arranged in order of number of inhabitants to each daily publication, 1900.*

Nevada	4,704	New York	35,115
Arizona	12,293	North Dakota	35,461
California	12,693	Rhode Island	35,713
Colorado	12,850	Texas	36,731
Indiana	16,131	Vermont	38,182
Oregon	19,692	New Jersey	38,442
Connecticut	20,646	Minnesota	39,804
Montana	22,121	Oklahoma	44,259
Wyoming	23,133	Utah	46,125
Ohio	24,456	Maine	46,298
Illinois	24,475	Florida	48,049
South Dakota	25,098	Virginia	50,113
Kansas	27,745	West Virginia	50,463
Massachusetts	28,626	Louisiana	60,071
New Hampshire	29,399	New Mexico	65,103
Delaware	30,789	Indian Territory	65,343
Pennsylvania	32,154	Arkansas	65,578
Idaho	32,354	Maryland	66,002
Nebraska	33,322	North Carolina	72,839
Missouri	33,768	Kentucky	79,525
Iowa	34,336	Georgia	82,086
Wisconsin	34,484	Alabama	96,247
Washington	34,540	Mississippi	119,328
Michigan	34,585	Tennessee	126,288
District of Columbia	34,840	South Carolina	191,474

From the rearrangement of states and territories given in Tables 44 and 45, it will be observed that in 1900 the proportion of inhabitants to each weekly publication was far more uniform than that to each daily. The range of number of inhabitants to each weekly publication is shown to be between 2,016, for Nevada, and 20,407, for Rhode Island.

On dividing the entire list of states and territories, arranged by rank according to the number of inhabitants to each weekly publication, into four groups, it appears that the first group is composed of the states and territories having from 2,000 to 3,500 inhabitants to each weekly publication; the second, from 3,500 to 6,000; the third, from 6,000 to 9,500; and the fourth, from 9,500 upward. The geographic relations of the states and territories composing these groups are clearly illustrated in cartogram 2, in which the United States is divided into irregular but practically contiguous sections. The smallest numbers of inhabitants to each weekly publication are shown in the middle West and Northwest. The next class forms an irregular section beginning with California, and extending, with practically no break, through Texas, Oklahoma, and Missouri to Lake Michigan and Minnesota. It is clear that the inhabitants of the states shown in this class depend less

CARTOGRAM 2.—*Number of inhabitants to each weekly publication, by states and territories, 1900.*



upon weekly publications than do those of the preceding class. The third class appears principally in the group of populous states beginning with Ohio and extending northeast to Maine. The fourth class is composed of Massachusetts, Rhode Island, Connecticut, Kentucky, Tennessee, and all the Southern states except Florida.

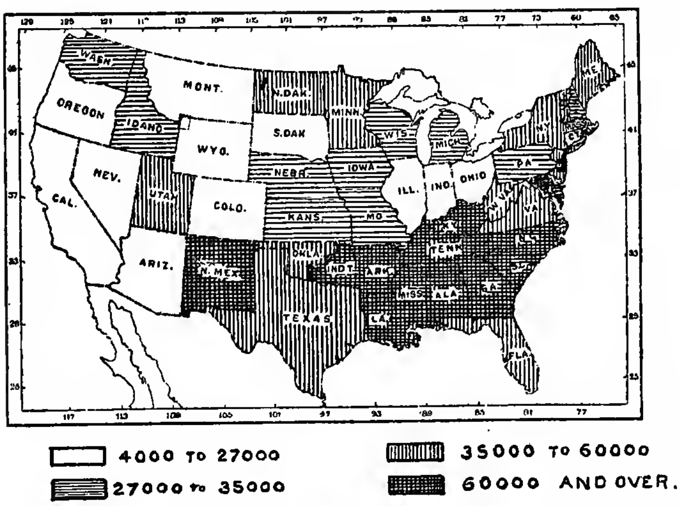
It is evident that the high ratio of inhabitants to weekly periodicals indicates either a low percentage of publications, in general, to number of inhabitants, or else the substitution, for weekly newspapers, of publications issued more frequently. In the case of the three New England states above mentioned it appears, by reference, in the comparative table, to the column relating to the number of inhabitants to each daily publication, that Massachusetts and Connecticut are shown in the two classes having the largest proportion of daily publications to inhabitants. In the case of Rhode Island, 81.2 per cent of the population resides in cities of over 8,000 inhabitants. Considering this exceptional rate and the small area, there is little probability of success in the publication of weekly newspapers in Rhode Island. The proportion of dailies to population is higher than that of weeklies, but proximity to New York and to the large cities of Massachusetts and Connecticut, has led to considerable dependence on those centers for daily newspapers, thus producing a comparatively low rank for dailies also.

By referring to page 68 it will be observed that the sections which are the most liberal patrons of the "patent insides" method of publishing weekly newspapers are the Eastern and Western North Central groups of states. Of the "patent insides" used in the United States, over 60 per cent were sent to these states. It will be noted by cartogram 2 that this section is the chief stronghold of the weekly.

When the number of inhabitants to each daily newspaper is made the basis of classification, the proportion varies from 4,704, for Nevada, to 191,474, for South Carolina. In the populous states the proportion of population to each daily publication varies from 20,000 to 40,000. On dividing the states and territories, as in the case of weekly publications, into 4 groups or classes, it appears that the proportion of population to each daily newspaper ranges, in the first class, from 4,000 to 27,000; in the second, from 27,000 to 35,000; in the third, from 35,000 to 60,000; and in the fourth, from 60,000 upward.

The conditions which surround the publication of daily newspapers are so complex—depending largely upon locality, character of the population, ambition of the community, proximity to large cities, and especially upon ability to be an active producer of circulation rather than a receiver of it from elsewhere—that it is not surprising to find that the comparison is less significant than that for weeklies. The proportions of inhabitants to daily publications are shown geographically in cartogram 3.

Cartogram 3.—*Number of inhabitants to each daily publication, by states and territories, 1900.*



In general, the far Western states, which showed high averages in the proportion of population to weekly publications, showed a similar proportion for daily publications. Obviously, this is due to the ambition and energy of isolated communities, which by reason of distance must produce their own daily publication or go without one.

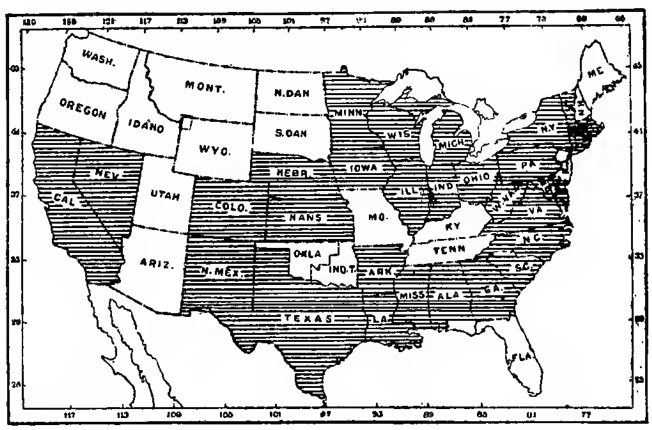
The region in which, with respect to population, both daily and weekly papers are least numerous, is in general the group of states east of the Mississippi and south of the Ohio and Potomac, where there is less than 1 daily to every 60,000 people, and less than 1 weekly to every 9,500. The region in which they are most numerous is in general the states of the Western division, in most of which there is more than 1 daily to every 35,000 people, and more than 1 weekly to every 3,500. In other words, publications of this character are most numerous in the western and northwestern parts of the country, and least numerous in the southeastern part.

The fact that the New England states with largest population are in the highest or next to the highest class in number of inhabitants to each daily newspaper, but rank low in number of inhabitants to each weekly publication suggests that in that densely peopled region, with highly developed facilities for rapid distribution to a numerous public, the daily has in some measure supplanted the weekly.

During the last decade the number of inhabitants to each weekly publication increased in 26 out of 49 states and territories, from which fact it appears that in more than half the states and territories the increase in the number of weekly publications failed to keep pace with the increase in population.

In the case of the daily newspaper the changes wrought during the decade from 1890 to 1900 are more striking. Out of 49 states and territories it appears that in 31 the proportion of inhabitants to each daily publication decreased, while in the other 18 the increase in number of publications failed to keep pace with the increase in population. The marked advance of the daily in proportion to population, shown in a majority of the states, is represented in cartogram 4.

Cartogram 4.—*States ana territories in which there was a gain in number of daily newspapers in proportion to population.*



It will be observed that those states and territories which showed a gain in the number of inhabitants to each daily newspaper were, for the most part, those containing large cities, which acted as purveyors of news to adjacent states or territories. Massachusetts, for example, supplied portions of New England; New York and Pennsylvania supplied New Jersey; Ohio supplied Kentucky; the large cities of Minnesota formed centers of distribution for North Dakota and South Dakota; and on the Pacific coast California was the center for publications of the daily class. All the states bordering upon the Great Lakes, and 15 out of 21 seaboard states, showed an increase in the proportionate number of daily newspapers to inhabitants. In this group are found all but 9 of the states and territories showing an increase in the number of daily publications to inhabitants. In general, the states in which the daily lost ground during the decade ending in 1900 were those in the far Northwest, and in that section were recorded the most marked gains made by the weekly.

DISTRIBUTION, BY GEOGRAPHIC DIVISIONS, OF CIRCULATION, NUMBER OF ESTABLISHMENTS, CAPITAL, AND VALUE OF PRODUCTS.

The consideration of the geographic distribution of circulation, number of establishments, capital, and value of products which follows, employs the following grouping of the states and territories by minor geographic divisions:

NORTH ATLANTIC DIVISION.

New England.—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

Southern North Atlantic.—New York, New Jersey, Pennsylvania.

SOUTH ATLANTIC DIVISION.

Northern South Atlantic.—Delaware, Maryland, District of Columbia, Virginia, West Virginia.

Southern South Atlantic.—North Carolina, South Carolina, Georgia, Florida.

NORTH CENTRAL DIVISION.

Eastern North Central.—Ohio, Indiana Illinois, Michigan, Wisconsin.

Western North Central.—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas.

SOUTH CENTRAL DIVISION.

Eastern South Central.—Kentucky, Tennessee, Alabama, Mississippi.

Western South Central.—Louisiana, Arkansas, Indian Territory, Oklahoma, Texas.

WESTERN DIVISION.

Rocky Mountain.—Montana, Idaho, Wyoming, Colorado, New Mexico.

Basin and Plateau.—Arizona, Utah, Nevada.

Pacific.—Washington, Oregon, California.

Circulation.—The preponderance of certain states in circulation, before noted, is again indicated upon examining aggregate circulation by geographic divisions.

TABLE 46.—*Aggregate circulation per issue of all classes of publications, by main geographic divisions, with per cent which circulation in each division forms of total, 1890 and 1900.*

DIVISION.	AGGREGATE CIRCULATION FOR ALL CLASSES.		PER CENT OF TOTAL.		Per cent of increase, 1890 to 1900.
	1900	1890	1900	1890	
United States	114,299,334	69,138,934	100.0	100.0	65.3
North Atlantic	65,577,439	37,208,013	57.4	53.9	76.2
South Atlantic	3,551,594	2,385,414	3.1	3.5	48.9
North Central	35,747,654	23,742,919	31.3	34.3	50.6
South Central	6,417,164	3,765,571	5.6	5.4	70.4
Western	3,005,483	2,037,017	2.6	2.9	47.5

The North Atlantic and North Central divisions combined possessed 88.2 per cent of the aggregate circulation per issue in 1890, and 88.7 per cent in 1900. The North Atlantic division advanced 3.5 per cent, while the North Central declined 3 per cent, during the decade.

In Table 47 the circulation per issue of all classes, and of dailies, weeklies, and monthlies, in 1890 and 1900, with the per cent of increase, is shown by minor geographic divisions, together with the per cent of the total circulation for the United States, in 1890 and in 1900, reported for each division.

TABLE 47.—*Aggregate circulation per issue of all classes, by minor geographic divisions, with per cent which circulation for each division forms of total, 1890 and 1900.*

DIVISION.	Per cent which population of each division forms of total, 1900.	AGGREGATE CIRCULATION OF ALL CLASSES.			PER CENT WHICH CIRCULATION IN EACH DIVISION FORMS OF TOTAL.	
		1900	1890	Per cent of increase.	1900	1890
United States	100.0	114,299,334	69,138,934	65.3	100.0	100.0
New England	7.4	13,661,873	8,217,762	66.2	12.0	11.9
Southern North Atlantic	20.3	51,915,566	28,990,251	79.1	45.4	41.9
Northern South Atlantic	5.9	2,439,895	1,245,185	95.9	2.1	1.8
Southern South Atlantic	7.9	1,111,699	1,140,229	[1]2.5	1.0	1.6
Eastern North Central	21.0	23,806,433	17,395,722	36.9	20.8	25.2
Western North Central	13.6	11,941,221	6,347,197	88.1	10.4	9.2
Eastern South Central	9.9	4,629,210	2,532,807	82.8	4.0	3.7
Western South Central	8.6	1,787,954	1,232,764	45.0	1.6	1.8
Rocky Mountain	1.6	762,263	367,446	107.4	0.7	0.5
Basin and Plateau	0.6	175,486	104,839	67.4	0.2	0.1
Pacific	3.2	2,067,734	1,564,732	32.1	1.8	2.3

[1] Decrease.

A.—DAILIES.

DIVISION.	Per cent which population of each division forms of total, 1900.	AGGREGATE DAILY CIRCULATION.			PER CENT WHICH CIRCULATION IN EACH DIVISION FORMS OF TOTAL.	
		1900	1890	Per cent of increase.	1900	1890
United States	100.0	15,102,156	8,387,188	80.1	100.0	100.0
New England	7.4	1,587,435	721,131	120.1	10.5	8.6
Southern North Atlantic	20.3	6,037,626	3,521,361	71.5	40.0	42.0
Northern South Atlantic	5.9	518,624	289,892	78.9	3.4	3.5
Southern South Atlantic	7.9	194,249	127,386	52.5	1.3	1.5
Eastern North Central	21.0	3,603,936	1,760,818	104.7	23.9	21.0
Western North Central	13.6	1,590,598	909,086	75.0	10.5	10.8
Eastern South Central	9.9	395,335	257,595	53.5	2.6	3.1
Western South Central	8.6	310,756	185,590	67.4	2.1	2.2
Rocky Mountain	1.6	211,400	98,774	114.0	1.4	1.2
Basin and Plateau	0.6	40,845	34,435	18.6	0.3	0.4
Pacific	3.2	611,357	481,120	27.1	4.0	5.7

Table 47.—*Aggregate circulation per issue of all classes, by minor geographic divisions, with per cent which circulation for each division forms of total, 1890 and 1900*—Continued.

B.—WEEKLIES.

DIVISION.	Per cent which population of each division forms of total, 1900.	AGGREGATE WEEKLY CIRCULATION. 1900	AGGREGATE WEEKLY CIRCULATION. 1890	AGGREGATE WEEKLY CIRCULATION. Per cent of increase.	PER CENT WHICH CIRCULATION IN EACH DIVISION FORMS OF TOTAL. 1900	PER CENT WHICH CIRCULATION IN EACH DIVISION FORMS OF TOTAL. 1890
United States	100.0	39,852,052	28,954,515	37.6	100.0	100.0
New England	7.4	2,746,803	2,576,922	6.6	6.9	8.9
Southern North Atlantic	20.3	16,666,074	9,762,282	70.7	41.8	33.7
Northern South Atlantic	5.9	1,125,941	803,818	40.1	2.8	2.8
Southern South Atlantic	7.9	706,017	767,091	[1] 8.0	1 8	2.6
Eastern North Central	21.0	8,660,185	7,634,925	13.4	21.7	26.4
Western North Central	13.6	5,438,513	3,875,605	40.3	13.6	13.4
Eastern South Central	9.9	1,859,468	1,466,273	26.8	4.7	5.1
Western South Central	8.6	1,203,723	909,521	32.3	3.0	3.1
Rocky Mountain	1.6	429,736	229,522	87.2	1.1	0.8
Basin and Plateau	0.6	68,945	31,129	121.5	0.2	0.1
Pacific	3.2	946,647	897,427	5.5	2.4	3.1

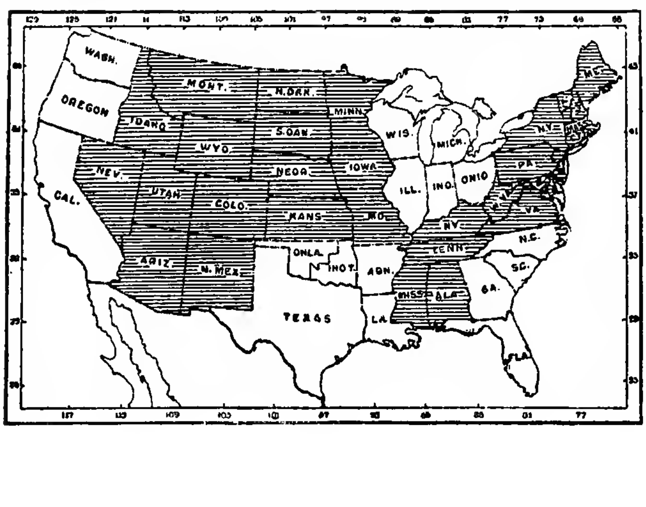
[1] Decrease.

C.—MONTHLIES.

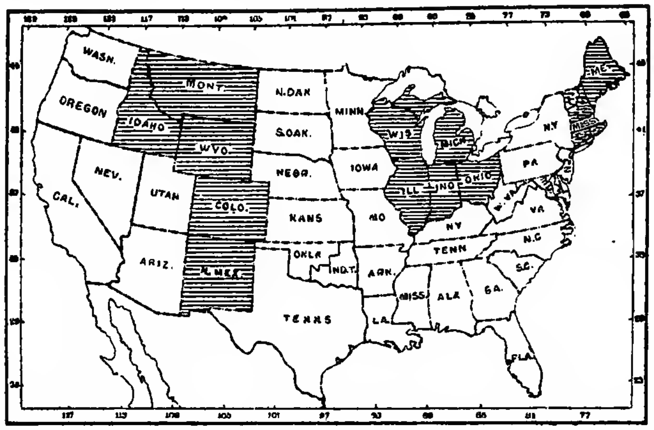
DIVISION.	Per cent which population of each division forms of total, 1900.	AGGREGATE MONTHLY CIRCULATION. 1900	AGGREGATE MONTHLY CIRCULATION. 1890	AGGREGATE MONTHLY CIRCULATION. Per cent of increase.	PER CENT WHICH CIRCULATION IN EACH DIVISION FORMS OF TOTAL. 1900	PER CENT WHICH CIRCULATION IN EACH DIVISION FORMS OF TOTAL. 1890
United States	100.0	39,519,877	19,624,038	101.3	100.0	100.0
New England	7.4	8,466,732	3,614,681	134.2	21.4	18.4
Southern North Atlantic	20.3	20,202,791	10,790,513	87.2	51.1	55.0
Northern South Atlantic	5.9	556,740	103,865	436.0	1.3	0.5
Southern South Atlantic	7.9	99,575	189,877	[1] 47.6	0.3	1.0
Eastern North Central	21.0	6,382,698	3,385,130	88.6	16.2	17.2
Western North Central	13.6	2,751,055	1,089,516	152.5	7.0	5.6
Eastern South Central	9.9	546,010	142,749	282.5	1.4	0.7
Western South Central	8.6	100,100	105,233	[1] 4.9	0.3	0.5
Rocky Mountain	1.6	88,422	31,100	184.4	0.2	0.2
Basin and Plateau	0.6	14,506	12,000	20.9	[2]	0.1
Pacific	3.2	311,248	159,375	95.3	0.8	0.8

[1] Decrease. [2] Less than one-tenth of 1 per cent.

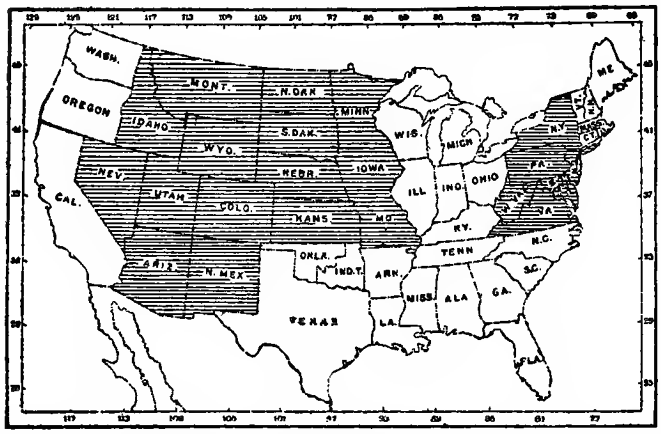
Cartogram 5.—*Minor geographic divisions in which the rate of increase in circulation per issue of all classes was more rapid than the rate of increase for the United States, 1900.*



Cartogram 6.—*Minor geographic divisions in which the rate of increase in circulation per issue of dailies was more rapid than the rate of increase for the United States, 1900.*



Cartogram 7.—*Minor geographic divisions in which the rate of increase in circulation per issue of weeklies was more rapid than the rate of increase for the United States, 1900.*



Cartogram 8.—*Minor geographic divisions in which the rate of increase in circulation per issue of monthlies was more rapid than the rate of increase for the United States, 1900.*

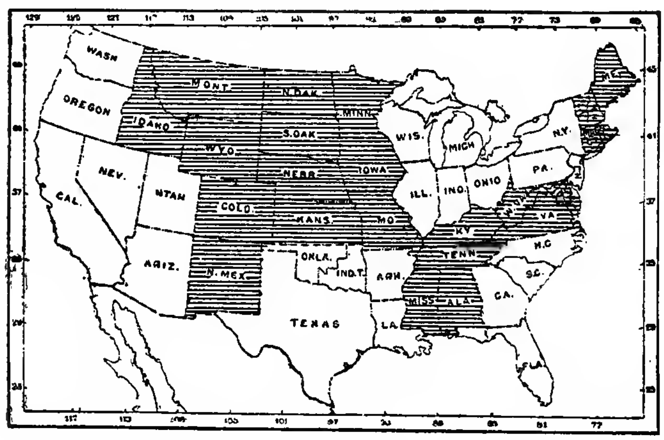


Table 47, in connection with cartograms 5, 6, 7, and 8, shows that in circulation of all classes there was a large increase in each division except the Southern South Atlantic. The most striking advance in the proportion of the total circulation reported was in the Southern North Atlantic group—New York, Pennsylvania, and New Jersey. The Western North Central group—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas—also showed a decided advance. In daily circulation all divisions showed a large increase, though but three showed a greater proportion of the total circulation of daily newspapers for the United States than in 1890; of these the New England states and the Eastern North Central group—Ohio, Indiana, Illinois, Michigan, and Wisconsin—showed the most decided advance. In the circulation of weekly newspapers and periodicals the Southern South Atlantic group showed a slight decrease, while the remaining groups all showed a moderate increase. The most striking advance in the proportion of the total circulation of weekly publications reported was in the Southern North Atlantic group. In monthly circulation a decrease was shown in the Southern South Atlantic and Western South Central groups. In the other divisions a large increase was shown. The greatest advance in the proportion of the total circulation of monthly publications reported was shown for New England and the Western North Central group.

In Table 48 is presented a comparison of the aggregate number of copies issued during the census years 1890 and 1900, by main geographic divisions, with the per cent which the number of copies for each division forms of the total. The proportions in 1900 agree substantially with those for the circulation per issue of all publications for the same geographic divisions, the greatest difference being 6.6 per cent in the North Atlantic division.

TABLE 48.—*Aggregate number of copies issued during the census year, by main geographic divisions, with per cent which number for each division forms of total, 1890 and 1900.*

DIVISION.	AGGREGATE NUMBER OF COPIES ISSUED DURING THE CENSUS YEAR.		PER CENT WHICH NUMBER OF COPIES FOR EACH DIVISION FORMS OF TOTAL.		Per cent of increase, 1890 to 1900.
	1900	1890	1900	1890	
United States	8,168,148,749	4,681,113,530	100.0	100.0	74.5
North Atlantic	4,150,978,811	2,305,659,459	50.8	49.3	80.0
South Atlantic	361,278,033	221,901,227	4.4	4.7	62.8
North Central	2,810,281,262	1,604,549,714	34.4	34.3	75.1
South Central	449,933,789	281,679,126	5.5	6.0	59.7
Western	395,676,854	267,333,004	4.9	5.7	48.0

Table 49 is of interest principally as showing the relation between the distribution of aggregate circulation per issue and that of the aggregate number of copies issued during the census year.

TABLE 49.—CIRCULATION OF NEWSPAPERS AND PERIODICALS CLASSIFIED

	STATES AND TERRITORIES.	Total number of publications.	AGGREGATE CIRCULATION PER ISSUE.								
			All classes.	Daily.		Triweekly.	Semi-weekly.	Weekly.	Monthly.	Quarterly.	All other classes.
				Including Sunday.	Except Sunday.						
1	United States	18,226	114,299,334	8,645,536	6,456,620	228,610	2,832,868	39,852,052	39,519,897	11,217,422	5,546,329
2	Alabama	175	230,079	30,450	18,195	700	4,340	155,244	6,800	....	14,350
3	Arizona	43	34,054	7,856	3,600	....	....	22,392	206	....	....
4	Arkansas	236	262,903	34,340	3,800	1,000	11,285	187,578	18,900	5,000	1,000
5	California	622	1,448,656	367,280	108,316	480	23,342	618,146	194,792	112,500	23,800
6	Colorado	248	521,213	125,477	31,539	500	2,000	285,425	72,947	1,250	2,075
7	Connecticut	155	457,622	39,400	169,415	....	29,325	155,507	44,375	1,800	17,800
8	Delaware	30	85,900	34,277	....	....	1,700	43,773	6,150	....	....
9	District of Columbia	69	820,835	69,606	31,242	....	1,000	304,037	354,050	2,760	58,140
10	Florida	97	112,302	27,907	....	1,000	5,000	66,295	12,100	....	....
11	Georgia	265	549,493	55,841	47,031	....	33,941	331,905	67,425	1,000	12,350
12	Idaho	72	48,795	3,000	2,100	....	4,645	36,300	1,500	....	1,250
13	Illinois	1,548	10,429,368	500,673	948,414	5,338	170,720	3,866,983	3,072,932	1,683,434	180,874
14	Indiana	841	2,108,805	96,599	248,805	....	77,185	858,424	715,292	77,700	34,800
15	Indian Territory	64	50,141	2,100	1,250	....	....	45,891	900	....	....
16	Iowa	1,045	1,884,875	125,473	92,116	19,224	168,672	1,105,666	301,205	27,529	44,990
17	Kansas	684	1,144,320	36,619	68,729	800	20,040	653,507	321,050	21,800	21,775
18	Kentucky	282	1,099,172	77,124	87,500	1,800	125,575	425,323	262,450	6,500	112,900
19	Louisiana	160	300,072	88,900	18,090	2,400	32,698	137,434	14,750	....	5,800
20	Maine	177	6,434,065	14,298	45,540	....	17,728	220,759	6,120,490	7,050	8,200
21	Maryland	166	679,867	39,172	208,380	....	17,360	316,505	93,250	3,000	2,200
22	Massachusetts	486	6,199,127	581,097	549,723	....	32,350	2,066,369	2,257,142	363,096	349,350
23	Michigan	698	2,374,403	224,798	146,050	7,975	192,098	752,032	984,025	50,400	17,025
24	Minnesota	622	1,949,630	144,119	156,147	5,000	95,660	908,478	452,329	4,550	183,347
25	Mississippi	178	168,942	5,586	10,762	502	1,080	142,702	6,610	....	1,700
26	Missouri	940	5,495,802	718,004	97,488	200	329,153	1,862,856	1,378,586	895,050	219,465
27	Montana	89	127,148	28,922	13,242	....	9,380	62,109	6,495	7,000	....
28	Nebraska	538	1,095,538	92,615	29,799	1,200	53,008	650,349	255,935	2,950	9,682
29	Nevada	35	18,153	....	5,226	160	1,750	10,517	500	....	....
30	New Hampshire	88	211,819	....	42,419	5,250	....	158,900	5,250	....	....
31	New Jersey	298	3,009,104	6,545	216,688	....	1,900	367,021	28,950	136,500	2,251,500
32	New Mexico	42	32,420	....	3,820	....	....	25,000	500	800	2,300
33	New York	1,477	37,626,095	3,006,426	890,541	146,175	460,867	12,607,099	16,927,062	2,276,625	1,311,300
34	North Carolina	200	287,916	18,150	26,470	....	24,490	197,706	12,050	700	8,350
35	North Dakota	139	138,890	10,600	7,421	....	7,100	106,219	7,550	....	....
36	Ohio	1,039	7,467,358	494,512	730,203	13,300	211,161	2,411,172	1,420,501	1,795,609	390,900
37	Oklahoma	110	120,077	14,674	....	....	800	99,953	4,150	....	600
38	Oregon	188	311,950	42,433	8,758	....	14,810	166,511	75,038	....	4,400
39	Pennsylvania	1,365	11,280,367	987,931	929,495	8,206	282,142	3,691,954	3,246,779	1,991,819	142,041
40	Rhode Island	40	170,694	72,200	46,644	100	6,754	37,671	4,225	3,000	....
41	South Carolina	117	161,988	13,600	5,250	200	23,327	110,111	8,000	....	1,500
42	South Dakota	218	232,166	6,000	10,463	....	1,600	151,438	34,400	....	28,265
43	Tennessee	251	3,131,017	58,168	107,550	....	7,700	1,136,199	270,150	1,540,900	10,350
44	Texas	722	1,054,761	96,989	50,618	....	101,392	732,867	61,400	1,250	10,250
45	Utah	72	123,279	15,538	8,625	2,000	30,630	36,036	13,800	150	16,500
46	Vermont	79	188,646	....	26,699	....	8,400	107,597	35,250	300	10,400
47	Virginia	204	627,280	67,995	24,375	3,100	13,030	291,690	96,890	120,500	9,700
48	Washington	199	307,128	35,250	49,320	500	7,850	161,990	41,418	5,300	6,500
49	West Virginia	176	226,013	26,200	17,377	....	4,900	169,936	6,400	....	1,200
50	Wisconsin	695	1,426,499	164,592	109,290	1,000	161,995	771,574	189,948	69,600	18,500
61	Wyoming	42	32,687	1,200	2,100	500	985	20,902	7,000	....	....

ACCORDING TO PERIOD OF ISSUE, BY STATES AND TERRITORIES: 1900.

AGGREGATE NUMBER OF COPIES ISSUED DURING THE CENSUS YEAR.									
All classes.	Daily.		Triweekly.	Semiweekly.	Weekly.	Monthly.	Quarterly.	All other classes.	
	Including Sunday.	Except Sunday.							
8,168,148,749	3,155,620,640	2,020,922,060	35,663,160	294,618,272	2,072,306,704	474,238,764	44,869,688	69,909,461	1
25,758,633	11,114,250	5,695,035	109,200	451,360	8,072,688	81,600	....	234,500	2
5,161,096	2,867,440	1,126,800	....	....	1,164,384	2,472	....	....	3
25,077,996	12,534,100	1,189,400	156,000	1,173,640	9,754,056	226,800	20,000	24,000	4
205,789,752	134,057,200	33,902,908	74,880	2,427,568	32,143,592	2,337,504	450,000	396,100	5
71,702,076	45,799,106	9,871,707	78,000	208,000	14,842,100	875,364	5,000	22,800	6
79,366,409	14,381,000	53,026,895	....	3,049,800	8,086,364	632,600	7,200	282,650	7
15,037,901	12,511,105	....	....	176,800	2,276,196	73,800	....	....	8
56,720,860	25,406,190	9,778,746	....	104,000	15,809,924	4,248,600	11,040	1,362,360	9
14,454,595	10,186,055	....	156,000	520,000	3,447,340	145,200	....	....	10
57,001,092	20,381,965	14,720,703	....	3,529,864	17,259,060	809,100	4,000	296,400	11
4,170,980	1,095,000	657,300	....	483,080	1,887,600	18,000	....	30,000	12
746,880,247	182,745,645	296,853,582	832,728	17,754,880	201,083,116	36,875,184	6,733,736	4,001,376	13
175,432,092	35,258,635	77,875,965	....	8,027,240	44,638,048	8,583,504	310,800	737,900	14
3,554,882	766,500	391,250	....	....	2,386,332	10,800	....	....	15
158,895,153	45,797,645	28,832,308	2,998,944	17,541,888	57,494,632	3,614,460	110,116	2,505,160	16
75,387,961	13,365,935	21,512,177	124,800	2,084,160	33,982,364	3,852,600	87,200	378,725	17
96,862,156	28,150,260	27,387,500	280,800	13,059,800	22,116,796	3,149,400	26,000	2,691,600	18
49,348,430	32,448,500	5,662,170	374,400	3,400,592	7,146,568	177,000	....	139,200	19
106,420,850	6,218,770	14,254,020	....	1,843,712	11,479,468	73,445,880	28,200	150,800	20
98,959,220	14,297,780	65,222,940	....	1,805,440	16,458,260	1,119,000	12,000	43,800	21
581,739,780	212,100,405	172,063,299	....	3,364,400	107,451,188	27,085,704	1,452,384	8,222,400	22
200,457,376	82,051,270	45,713,650	1,244,100	19,978,192	39,105,664	11,808,300	201,600	354,600	23
169,257,418	52,603,435	48,874,011	780,000	9,948,640	47,240,856	5,427,948	18,200	4,364,328	24
13,398,752	2,038,890	3,368,506	78,312	112,320	7,420,504	79,320	....	300,900	25
446,832,760	260,246,460	30,513,744	31,200	34,231,912	96,868,512	16,543,032	3,580,200	4,817,700	26
19,012,404	10,556,530	4,144,746	....	975,520	3,229,668	77,940	28,000	....	27
85,959,730	33,804,475	9,327,087	187,200	5,512,832	33,818,148	3,071,220	11,800	226,968	28
2,395,582	....	1,635,738	24,960	182,000	646,884	6,000	....	....	29
22,421,947	....	13,277,147	819,000	....	8,262,800	63,000	....	....	30
103,924,361	2,388,925	67,823,344	....	197,600	19,085,092	347,400	546,000	13,536,000	31
3,020,460	....	1,195,660	....	....	1,300,000	6,000	3,200	516,600	32
2,324,952,983	1,097,345,490	278,739,333	22,803,300	47,930,168	655,569,148	203,124,744	9,106,600	10,334,300	33
28,081,732	6,624,750	8,285,110	....	2,646,960	10,280,712	144,600	2,800	196,800	34
12,544,161	3,869,000	2,322,773	....	738,400	6,523,388	90,600	....	....	35
591,526,155	180,496,880	228,553,539	2,074,800	21,960,744	125,380,944	17,046,012	7,182,436	8,830,800	36
10,698,566	5,356,010	....	....	83,200	5,197,556	49,800	....	12,000	37
29,434,167	15,488,045	2,741,254	....	1,540,240	8,658,572	900,456	....	105,600	38
923,178,870	360,594,815	290,931,935	1,280,136	29,342,768	191,981,608	38,961,348	7,967,276	2,118,984	39
43,692,180	26,353,000	14,599,572	15,600	702,416	1,958,892	50,700	12,000	....	40
15,355,730	4,964,000	1,643,250	31,200	2,426,008	5,725,772	96,000	....	469,500	41
14,597,255	2,190,000	3,274,919	....	166,400	7,874,776	412,800	....	678,360	42
124,423,368	21,231,320	33,663,150	....	800,800	59,082,348	3,241,800	6,163,600	240,350	43
100,811,006	35,400,985	15,841,869	....	10,544,768	38,109,084	736,800	5,000	172,500	44
14,304,587	5,671,370	2,699,625	312,000	3,185,520	1,873,872	165,600	600	396,000	45
15,281,431	....	8,356,787	....	873,600	5,595,044	423,000	1,200	31,800	46
51,213,030	24,818,175	7,629,375	483,600	1,355,120	15,167,880	1,162,680	482,000	114,200	47
38,239,106	12,866,250	15,437,160	78,000	816,400	8,423,480	497,016	21,200	99,600	48
24,453,873	9,563,000	5,439,001	....	509,600	8,836,672	76,800	....	28,800	49
132,510,954	38,176,080	34,207,770	156,000	16,847,480	40,121,848	2,279,376	278,400	444,000	50
2,446,644	438,000	657,300	78,000	102,440	1,086,904	84,000	....	....	51

Number of establishments.—It has already appeared that the circulation of newspapers and periodicals is largely centralized in certain states. Table 50 indicates that if the industry be measured by number of establishments, rather than by output, no such centralization exists.

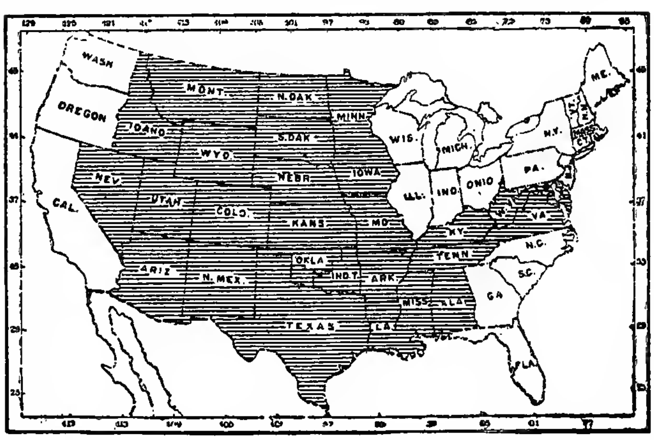
TABLE 50.—*Number of establishments, by minor geographic divisions, with per cent which number in each forms of total, 1890 and 1900.*

DIVISION.	NUMBER OF ESTABLISHMENTS.		PER CENT WHICH NUMBER IN EACH DIVISION FORMS OF TOTAL.		Per cent of increase, 1890 to 1900.
	1900	1890	1900	1890	
United States	15,305	12,362	100.0	100.0	23.8
New England	800	815	5.2	6.6	[1]1.8
Southern North Atlantic	2,509	2,479	16.4	20.1	1.2
Northern South Atlantic	536	412	3.5	3.3	30.1
Southern South Atlantic	582	483	3.8	3.9	20.5
Eastern North Central	3,820	3,110	25.0	25.2	22.8
Western North Central	3,700	2,846	24.2	23.0	30.0
Eastern South Central	786	597	5.1	4.8	31.7
Western South Central	1,161	674	7.6	5.5	72.3
Rocky Mountain	429	281	2.8	2.3	52.7
Basin and Plateau	123	53	0.8	0.4	132.1
Pacific	859	848	5.6	6.9	1.3

[1] Decrease.

From Table 50 it appears that of the total number of establishments in 1900, New England—already shown to be an important factor in the publishing industry—possessed only 5.2 per cent, and that the Southern North Atlantic states—a group immensely influential in the production of periodicals—showed only 16.4 per cent. Thus, these two groups combined represented but 21.6 per cent of the total number of establishments. The changes in relative importance from 1890 to 1900 were not marked; 5 divisions showed declines, and in but 2 was the advance sufficiently great to be worthy of notice. Cartogram 9 presents those

CARTOGRAM 9.—*Minor geographic divisions in which the rate of increase in the number of establishments was greater than the rate of increase for the United States, 1900.*



minor geographic divisions showing a per cent of increase in number of establishments exceeding the per cent of increase for the United States. From this cartogram it appears that in all of the states bordering on the Atlantic and Pacific oceans, except Delaware, Maryland, and Virginia, and in all of the states bordering on the Great Lakes, except Minnesota, the per cent of increase in number of establishments is less than that for the United States. The states showing these relatively low percentages of increase contain most of the large cities, and are the ones in which consolidation of establishments is most likely to occur.

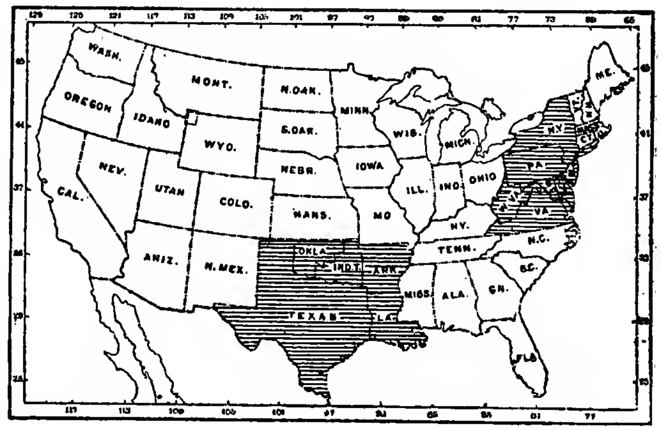
Capital.—The distribution of capital by minor geographic divisions is shown, in Table 51 and by reference to cartogram 10, to vary in a marked degree from the distribution of the number of establishments.

TABLE 51.—*Capital, by minor geographic divisions, with per cent which capital in each forms of total, 1890 and 1900.*

DIVISION.	CAPITAL.		PER CENT WHICH CAPITAL IN EACH DIVISION FORMS OF TOTAL CAPITAL.		Per cent of increase, 1890 to 1900.
	1900	1890	1900	1890	
United States	$192,443,708	$126,269,885	100.0	100.0	52.4
New England	16,800,780	11,827,874	8.7	9.4	42.0
Southern North Atlantic	83,648,876	48,159,589	43.5	38.1	73.7
Northern South Atlantic	7,159,175	3,358,169	3.7	2.7	113.2
Southern South Atlantic	3,332,721	2,580,365	1.7	2.0	29.2
Eastern North Central	36,885,321	26,041,005	19.2	20.6	41.6
Western North Central	22,957,056	17,301,266	11.9	13.7	32.7
Eastern South Central	6,332,991	5,070,293	3.3	4.0	24.9
Western South Central	4,764,265	3,056,304	2.5	2.4	55.9
Rocky Mountain	3,055,318	2,129,833	1.6	1.7	43.5
Basin and Plateau	958,226	710,986	0.5	0.6	34.8
Pacific	6,548,979	6,034,201	3.4	4.8	8.5

In 8 out of the 11 divisions the per cent which the capital invested formed of the total capital was less in

CARTOGRAM 10.—*Minor geographic divisions in which the rate of increase in capital was more rapid than the rate of increase for the United States, 1900.*



1900 than in 1890. The only marked advance was made in the Southern North Atlantic group—New York, Pennsylvania, and New Jersey—which increased its lead at the expense of nearly all of the other divisions. In other words, during the decade just ended, the centralization of this industry, as measured by capital invested therein, has made most rapid progress in the Southern North Atlantic group, and this in spite of the fact that in each division the absolute increase in capital was large. The very high per cent of increase for the United States was of course due, to some extent, to the enormous advance shown in the group mentioned. The per cent of increase for the remainder of the United States was only 39.3 per cent.

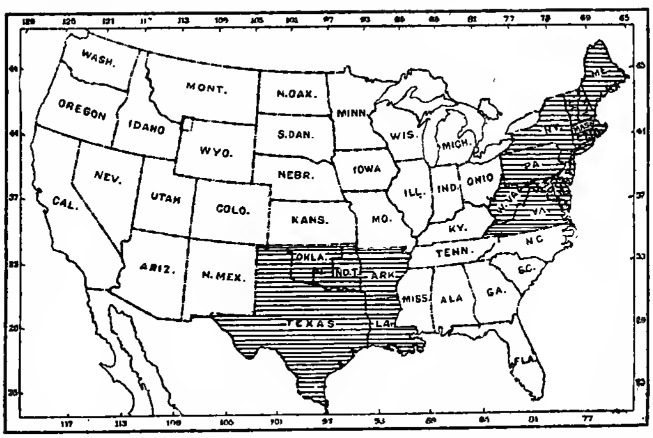
Value of newspaper and periodical products.—In Table 52 is presented, by geographic divisions the combined value of advertising, and subscriptions and sales. These figures show greater uniformity in relative importance than any other figures for this industry. The advance is greatest in New England, and there it is but 1.5 per cent; in 3 divisions it is fractional; 1 presents the same proportion as in 1890; and 6 show declines, all of which are insignificant. In every division except the Southern South Atlantic there was an increase in the value of such products.

TABLE 52.—*Value of products, by minor geographic divisions, with per cent which value of products for each forms of total, 1890 and 1900.*

DIVISION.	VALUE OF PRODUCTS.		PER CENT WHICH VALUE OF PRODUCTS IN EACH DIVISION FORMS OF TOTAL.		Per cent of increase, 1890 to 1900.
	1900	1890	1900	1890	
United States	$175,789,610	$143,586,547	100.0	100.0	24.0
New England	18,549,042	13,039,163	10.6	9.1	42.2
Southern North Atlantic	70,244,534	56,457,695	40.0	39.3	24.4
Northern South Atlantic	5,612,432	4,253,464	3.2	3.0	31.9
Southern South Atlantic	2,867,574	2,893,545	1.6	2.0	[1] 0.9
Eastern North Central	36,663,239	30,298,789	20.9	21.1	21.0
Western North Central	20,386,232	17,297,463	11.6	12.0	17.9
Eastern South Central	4,634,427	4,288,391	2.6	3.0	8.1
Western South Central	5,059,191	4,019,041	2.9	2.8	25.9
Rocky Mountain	3,248,759	2,650,786	1.8	1.8	22.6
Basin and Plateau	719,283	691,493	0.4	0.5	4.0
Pacific	7,805,897	7,696,717	4.4	5.4	1.4

[1] Decrease.

CARTOGRAM 11.—*Minor geographic divisions in which the rate of increase in value of product was more rapid than the rate of increase for the United States, 1900.*



In cartogram 11 are indicated the minor geographic divisions showing a per cent of increase in value of products greater than the per cent for the United States.

It will be observed, from cartograms 9, 10, and 11, that the Western South Central group has exceeded the percentage for the United States in all three particulars—number of establishments, capital, and value of products—doubtless because of the influence of Texas.

Consideration of the proportions which each minor geographic division contributed to the totals for number of establishments, capital, and value of products, shows that 8 divisions ranked higher in number of establishments than in capital or value of products; that 1, the Southern North Atlantic, ranked highest in capital; and 1, New England, ranked highest in value of products. It is shown by Table 53 that the North Atlantic division, comprising New England, New York, New Jersey, and Pennsylvania, although having only 21.6 per cent of all establishments, possessed 52.2 per cent of all the capital, and produced 50.6 per cent of the total value of products; that 6 divisions possessed substantially the same proportion of each item, and that 3 possessed a decidedly greater proportion of the total number of establishments than of capital or value of products.

TABLE 53.—*Per cent of number of establishments, capital, and value of products in each minor geographic division, 1900.*

DIVISION.	Number of establishments.	Capital.	Value of products.
United States	100.0	100.0	100.0
New England	5.2	8.7	10.6
Southern North Atlantic	16.4	43.5	40.0
Northern South Atlantic	3.5	3.7	3.2
Southern South Atlantic	3.8	1.7	1.6
Eastern North Central	25.0	19.2	20.9
Western North Central	24.2	11.9	11.6
Eastern South Central	5.1	3.3	2.6
Western South Central	7.6	2.5	2.9
Rocky Mountain	2.8	1.6	1.8
Basin and Plateau	0.8	0.5	0.4
Pacific	5.6	3.4	4.4

The detailed statistics for newspapers and periodicals are given in Table 58, which appears at the end of this report

BOOK AND JOB PRINTING.

Table 54 presents the number of establishments, capital, value of products, and wage statistics for this branch of the industry in 1890 and 1900, for cities containing 20,000 inhabitants and over.

TABLE 54.—SUMMARY OF BOOK AND JOB PRINTING FOR CITIES HAVING A POPULATION OF 20,000 OR OVER, 1900.

CITIES.	Population.	Number of establishments.	Capital.	Salaried officials, clerks, etc.		Wage-earners.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
New York, N. Y	3,437,202	996	$19,107,954	1,552	$1,689,166	12,857	$7,730,447	$4,404,740	$7,206,921	$26,484,933
Chicago, Ill	1,698,575	594	12,540,430	1,816	1,750,818	9,531	4,674,796	2,947,234	4,955,114	18,536,364
Philadelphia, Pa	1,293,697	401	11,539,833	844	775,094	5,327	2,508,317	1,626,292	2,948,999	10,066,740
St. Louis, Mo	575,238	173	3,560,128	524	481,141	2,329	1,129,757	648,828	2,016,560	4,420,147
Boston, Mass	560,892	280	5,870,499	708	582,807	3,077	1,663,282	1,723,336	1,752,274	8,183,215
Baltimore, Md	508,957	142	1,285,980	148	133,600	1,178	505,903	196,111	690,446	2,037,037
Cleveland, Ohio	381,768	69	1,107,419	150	141,306	981	496,319	117,084	700,052	1,787,106
Buffalo, N. Y	352,387	87	1,517,303	101	92,661	1,071	522,369	137,789	475,302	1,455,933
San Francisco, Cal	342,782	105	1,370,577	104	109,514	1,183	667,566	137,002	656,344	2,022,649
Cincinnati, Ohio	325,902	115	1,630,554	127	127,762	1,617	784,122	177,234	866,618	2,513,458
Pittsburg, Pa	321,616	67	100,015	90	75,076	886	434,481	116,728	513,223	1,396,292
New Orleans, La	287,104	51	507,670	61	57,218	452	183,062	48,889	150,577	573,987
Detroit, Mich	285,704	91	927,233	426	165,476	831	394,301	128,950	383,633	1,417,275
Milwaukee, Wis	285,315	58	746,478	59	57,924	562	225,622	65,785	242,234	750,896
Washington, D. C	278,718	76	3,139,046	164	211,277	4,101	3,236,730	113,580	1,367,668	5,107,905
Newark, N. J	246,070	54	524,712	104	89,403	493	203,380	37,570	185,153	674,321
Jersey City, N. J	206,433	18	454,023	27	29,004	442	175,166	22,195	206,977	488,795
Louisville, Ky	204,731	45	631,577	60	60,257	601	235,635	59,249	319,998	854,547
Minneapolis Minn	202,718	73	474,357	63	57,296	548	253,200	68,706	209,474	770,839
Providence, R. I	175,597	47	421,297	48	53,539	446	201,182	52,091	250,706	667,328
Indianapolis, Ind	169,164	47	911,693	159	119,842	746	351,393	472,194	385,885	1,536,652
Kansas City, Mo	163,752	63	720,010	166	114,805	804	419,784	102,835	333,089	1,187,253
St. Paul, Minn	163,065	47	577,999	195	127,902	395	188,808	163,324	289,164	923,909
Rochester, N. Y	162,608	52	496,819	47	23,828	362	130,402	80,006	137,846	524,296
Denver, Colo	133,859	52	604,486	56	59,274	390	251,561	92,676	183,266	808,895
Toledo, Ohio	131,822	24	248,690	36	23,257	208	96,746	30,551	100,109	337,239
Allegheny, Pa	129,896	16	79,566	7	4,728	87	40,394	10,800	42,482	129,289
Columbus, Ohio	125,560	22	172,060	29	22,082	206	97,045	17,874	91,188	282,915
Worcester, Mass	118,421	31	195,851	7	13,018	148	84,552	35,514	84,629	271,625
Syracuse, N. Y	108,374	29	346,280	24	17,672	212	94,890	26,816	136,567	336,384
New Haven, Conn	108,027	35	513,982	47	31,474	285	127,832	132,459	184,999	583,889
Paterson, N. J	105,171	12	45,796	...	...	29	11,756	6,821	11,147	43,465
Fall River, Mass	104,863	9	50,938	2	1,018	37	18,669	5,110	22,815	66,584
St. Joseph, Mo	102,979	9	169,150	20	14,420	240	121,529	12,374	96,359	302,060
Omaha, Nebr	102,556	38	459,714	59	55,737	395	196,739	65,326	228,717	668,567
Los Angeles, Cal	102,479	47	182,626	18	18,168	230	114,143	30,807	106,470	391,370
Memphis, Tenn	102,320	17	225,750	15	23,529	215	92,370	16,589	118,849	354,647
Scranton, Pa	102,026	13	74,898	3	1,280	50	22,715	5,715	21,464	66,717
Lowell, Mass	94,969	16	64,932	8	2,811	53	28,692	7,873	29,435	85,790
Albany, N. Y	94,151	29	1,253,446	77	68,202	685	347,876	181,168	332,316	1,244,810
Cambridge, Mass	91,886	17	961,932	84	54,371	873	468,527	97,649	455,284	1,242,492
Portland, Oreg	90,426	32	285,972	25	26,515	140	76,758	25,945	105,600	315,506
Atlanta, Ga	89,872	17	365,085	31	28,160	409	150,562	26,613	143,149	405,964
Grand Rapids, Mich	87,565	22	[1] 199,437	20	21,530	244	88,739	26,651	84,609	278,431
Dayton, Ohio	85,333	18	277,477	59	39,899	186	85,500	55,415	173,335	431,840
Richmond, Va	85,050	18	1,048,768	64	55,223	291	142,035	95,913	147,009	538,682
Nashville, Tenn	80,866	18	595,143	55	57,616	371	186,294	34,893	224,391	613,439
Seattle, Wash	80,671	22	164,738	23	20,149	161	98,230	23,231	81,969	285,688
Hartford, Conn	79,850	38	1,028,315	49	55,293	442	236,111	151,533	252,420	876,854
Reading, Pa	78,961	17	121,607	...	...	63	27,485	7,062	35,020	99,447
Wilmington, Del	76,508	12	134,875	12	8,644	85	39,589	7,475	27,905	106,245
Camden, N. J	75,935	14	68,357	5	2,866	37	13,696	3,544	19,195	58,252
Trenton, N. J	73,307	10	155,838	6	4,016	75	38,401	7,127	31,422	109,744
Bridgeport, Conn	70,996	11	72,672	10	8,180	56	24,902	6,318	25,036	87,282
Lynn, Mass	68,513	14	104,141	8	6,050	83	41,751	7,381	44,829	141,452
Oakland, Cal	66,960	16	47,295	5	3,800	43	17,839	5,200	19,454	69,009
Lawrence, Mass	62,559	6	20,470	1	750	14	5,626	1,673	8,719	22,199
New Bedford, Mass	62,442	8	29,613	4	1,928	26	11,658	2,279	15,456	46,550
Des Moines, Iowa	62,139	22	313,060	40	36,164	357	156,160	27,516	170,413	463,934
Springfield, Mass	62,059	22	565,986	121	120,686	189	103,890	214,166	132,963	750,710
Somerville, Mass	61,643	5	7,200	...	...	3	2,514	820	2,882	12,765
Troy, N. Y	60,651	14	128,073	10	6,630	84	39,045	10,612	26,556	127,467
Hoboken, N. J	59,364	10	26,740	...	...	20	11,669	2,249	13,341	44,799
Evansville, Ind	59,007	7	81,627	10	7,721	94	34,666	7,064	44,147	109,815
Manchester, N. H	56,987	13	29,125	...	...	30	14,100	2,951	11,439	38,639
Utica, N. Y	56,383	16	123,000	16	8,958	116	49,458	14,295	59,608	179,169
Peoria, Ill	56,100	12	143,340	14	12,016	169	72,666	9,244	88,758	226,576
Charleston, S. C	55,807	7	182,417	22	15,990	121	49,542	11,145	72,390	203,032
Savannah, Ga	54,244	5	72,320	3	3,696	75	32,961	6,896	34,800	91,430
Salt Lake City, Utah	53,531	10	117,273	16	14,082	96	44,689	13,082	52,795	144,644
San Antonio, Tex	53,321	11	123,757	11	13,390	191	107,548	8,665	90,116	290,900
Duluth, Minn	52,969	10	82,262	9	7,317	93	49,193	10,376	31,057	133,614
Erie, Pa	52,733	10	106,512	2	624	71	33,652	3,644	28,180	108,904
Elizabeth, N. J	52,130	5	291,350	15	17,885	195	98,150	18,096	92,844	312,766
Wilkesbarre, Pa	51,721	11	147,857	8	5,604	80	40,594	6,031	31,554	103,182
Kansas City, Kans	51,418	5	12,400	...	...	12	5,443	1,171	6,170	18,300
Harrisburg, Pa	50,167	14	219,921	9	8,009	198	89,891	24,047	67,336	210,155
Portland, Me	50,145	22	188,830	20	14,884	159	78,727	19,711	79,218	244,789
Yonkers, N. Y	47,931	6	10,060	...	...	9	4,452	1,493	3,437	14,500
Norfolk, Va	46,624	15	75,618	7	4,010	73	32,884	11,693	33,242	108,331
Waterbury, Conn	45,859	7	58,077	13	7,834	37	20,655	6,681	23,551	65,202
Holyoke, Mass	45,712	12	139,844	29	27,642	158	62,716	31,553	80,087	237,646
Fort Wayne, Ind	45,115	4	80,432	8	8,492	59	23,435	3,762	54,550	88,380
Youngstown, Ohio	44,885	4	44,685	5	4,700	16	8,180	3,996	6,761	44,160
Houston, Tex	44,633	16	153,783	14	9,860	103	53,781	16,143	48,815	157,059

[1] By clerical error this figure is given as $1,062,667 in Vol. VIII, Manufactures, Part II, p. 430.

TABLE 54.—SUMMARY OF BOOK AND JOB PRINTING FOR CITIES HAVING A POPULATION OF 20,000 OR OVER, 1900—Continued.

CITIES.	Population.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
Covington, Ky	42,938	6	$16,325	....	....	13	$5,527	$1,682	$7,178	$19,145
Akron, Ohio	42,728	13	2,195,040	111	$98,611	903	431,763	375,444	535,907	1,821,296
Dallas, Tex	42,638	20	207,207	21	16,080	146	78,226	27,870	74,247	284,178
Saginaw, Mich	42,345	11	106,717	2	1,100	57	23,527	6,237	27,096	81,078
Lancaster, Pa	41,459	9	149,110	3	3,500	71	31,265	5,914	17,546	73,075
Lincoln, Nebr	40,169	10	94,270	10	7,610	109	42,935	11,197	58,883	143,920
Brockton, Mass	40,063	9	100,140	8	6,750	78	44,707	13,427	71,243	180,390
Binghamton, N. Y	39,647	11	32,400	1	1,000	18	6,656	2,030	9,195	28,582
Augusta, Ga	39,441	6	82,600	2	2,560	212	25,427	3,595	19,186	70,132
Pawtucket, R. I	39,231	8	151,100	18	13,500	89	35,354	7,303	74,810	154,550
Wheeling, W. Va	38,878	6	21,721	1	960	22	7,280	1,669	10,958	24,767
Mobile, Ala	38,469	9	54,205	....	....	66	24,948	4,941	20,949	71,730
Birmingham, Ala	38,415	5	87,643	14	14,544	99	52,685	6,094	63,410	148,699
Little Rock, Ark	38,307	5	80,510	11	10,332	59	35,810	6,945	47,230	129,000
Springfield, Ohio	38,253	8	87,140	6	6,250	106	44,591	4,606	61,571	130,239
Galveston, Tex	37,789	7	48,725	7	6,810	36	16,510	3,954	8,189	44,225
Tacoma, Wash	37,714	12	56,053	3	3,380	48	22,916	5,185	17,886	73,487
Haverhill, Mass	37,175	12	44,625	4	2,680	49	26,251	3,644	14,457	71,550
Spokane, Wash	36,848	11	86,961	9	10,630	72	49,122	8,956	28,989	128,541
Terre Haute, Ind	36,673	9	54,960	19	7,900	85	32,301	7,601	34,138	114,660
Dubuque, Iowa	36,297	5	44,883	5	3,280	46	21,906	3,606	22,127	70,396
Quincy, Ill	36,252	12	103,004	11	10,876	122	41,958	6,598	61,631	135,461
South Bend, Ind	35,999	7	30,800	2	1,561	39	15,878	3,423	19,315	55,561
Salem, Mass	35,956	7	23,300	3	900	32	12,057	3,966	13,707	41,330
Johnstown, Pa	35,936	5	14,500	....	....	16	3,327	1,128	7,117	19,497
Elmira, N. Y	35,672	11	44,635	2	660	27	8,344	2,335	19,662	43,876
Allentown, Pa	35,416	8	66,048	3	1,118	30	11,303	5,116	15,195	44,885
Davenport, Iowa	35,254	11	104,828	12	12,508	87	39,376	11,654	40,683	133,673
Springfield, Ill	34,159	9	124,625	14	11,030	118	50,647	10,646	34,076	129,602
Chelsea, Mass	34,072	6	17,545	....	....	21	8,022	2,011	5,678	23,296
Chester, Pa	33,988	4	14,250	....	....	5	1,800	746	3,548	16,900
York, Pa	33,708	11	39,040	....	....	14	6,195	1,370	8,949	27,675
Malden, Mass	33,664	7	21,845	....	....	23	9,966	3,191	8,447	28,957
Topeka, Kans	33,608	13	372,594	24	23,140	204	109,550	30,578	152,178	369,181
Newton, Mass	33,587	3	8,940	....	....	17	8,300	525	3,844	18,100
Sioux City, Iowa	33,111	9	179,421	12	12,420	78	28,143	15,119	40,532	118,232
Knoxville, Tenn	32,637	6	79,690	7	7,450	108	37,493	5,459	32,535	110,301
Schenectady, N. Y	31,682	6	31,150	1	150	6	3,518	2,483	3,706	13,250
Fitchburg, Mass	31,531	6	13,275	....	....	11	6,770	1,254	5,893	19,338
Rockford, Ill	31,051	7	53,533	5	4,835	66	25,246	3,956	26,942	72,356
Canton, Ohio	30,667	7	31,875	....	....	23	10,329	1,544	7,111	26,382
Butte, Mont	30,470	3	5,625	1	1,500	2	1,096	627	1,651	6,800
Montgomery, Ala	30,346	6	39,401	2	2,400	56	14,287	3,258	16,066	48,929
Auburn, N. Y	30,345	6	23,350	1	300	21	6,338	1,361	8,099	25,325
Chattanooga, Tenn	30,154	10	51,060	19	13,250	100	37,310	5,645	48,064	129,425
Joliet, Ill	29,353	5	14,438	3	1,680	14	4,092	1,550	5,903	16,466
Sacramento, Cal	29,282	5	62,062	3	3,000	27	22,247	5,083	12,721	54,391
Racine, Wis	29,102	3	16,200	1	672	21	8,500	1,071	9,116	22,550
La Crosse, Wis	28,895	4	10,550	1	400	8	2,600	964	4,768	12,250
Williamsport, Pa	28,757	6	29,955	2	1,830	27	12,186	2,043	19,160	44,277
Jacksonville, Fla	28,429	9	96,392	6	5,050	86	36,962	5,613	25,850	95,342
Newcastle, Pa	28,339	3	18,950	1	150	8	3,150	887	5,172	17,929
Oshkosh, Wis	28,284	6	30,067	....	....	31	12,003	2,837	12,289	33,326
Woonsocket, R. I	28,204	4	36,850	2	1,050	25	12,180	1,864	13,024	33,880
Pueblo, Colo	28,157	4	24,000	3	3,520	21	11,354	2,241	13,359	42,100
Bay City, Mich	27,628	6	37,950	5	3,484	26	12,155	3,712	10,858	42,917
Fort Worth, Tex	26,688	7	60,793	11	10,339	50	23,993	9,380	29,087	85,224
Lexington, Ky	26,369	10	41,550	7	2,168	54	18,531	4,523	23,469	63,300
New Britain, Conn	25,998	3	18,734	2	1,214	13	5,759	1,277	7,044	19,817
Council Bluffs, Iowa	25,802	4	10,950	....	....	11	4,854	1,226	4,240	15,560
Cedar Rapids, Iowa	25,650	6	42,614	3	3,028	54	21,898	4,417	23,563	71,803
Jackson, Mich	25,180	3	14,286	....	....	15	7,997	1,091	5,677	21,935
Wichita, Kans	24,671	10	68,817	7	5,915	54	25,537	4,958	39,846	96,237
Kingston, N. Y	24,535	4	9,200	....	....	7	2,554	436	1,738	9,400
Kalamazoo, Mich	24,404	10	203,239	26	14,114	158	55,738	15,125	75,055	194,448
Meriden, Conn	24,296	5	69,659	8	6,364	38	20,243	1,871	14,114	51,955
North Adams, Mass	24,200	4	24,460	1	600	24	12,182	1,865	5,590	25,868
Aurora, Ill	24,147	4	22,150	....	....	31	11,200	1,428	13,199	38,200
Poughkeepsie, N. Y	24,029	7	61,360	2	2,100	60	25,496	3,809	16,057	75,449
Hamilton, Ohio	23,914	3	11,535	....	....	15	4,806	1,074	7,475	20,950
Cohoes, N. Y	23,910	3	35,985	....	....	29	12,480	1,322	8,797	35,242
Nashua, N. H	23,898	4	8,100	....	....	9	3,525	863	3,743	13,000
Lewiston, Me	23,761	7	26,227	....	....	18	8,574	1,722	6,657	22,960
Zanesville, Ohio	23,538	6	9,700	....	....	10	3,106	1,040	2,821	19,940
Waltham, Mass	23,481	6	14,625	....	....	10	5,162	1,400	9,195	25,421
Bloomington, Ill	23,286	7	90,400	18	15,516	122	44,830	5,744	61,946	147,383
Macon, Ga	23,272	6	32,225	4	2,400	35	11,523	3,967	14,535	43,350
Springfield, Mo	23,267	8	27,150	....	....	17	6,846	5,030	10,063	41,600
Burlington, Iowa	23,201	5	63,362	20	14,694	60	16,791	4,645	22,243	71,100
West Hoboken, N. J	23,094	3	4,415	....	....	2	1,710	935	1,909	7,534

TABLE 54.—SUMMARY OF BOOK AND JOB PRINTING FOR CITIES HAVING A POPULATION OF 20,000 OR OVER, 1900—Continued.

CITIES.	Population.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
Jamestown, N. Y	22,892	8	$25,080			15	$6,166	$1,796	$10,100	$30,648
Clinton, Iowa	22,698	3	25,300	3	$4,475	15	4,968	1,022	7,327	21,820
Elgin, Ill	22,433	3	98,546	6	4,000	39	15,329	22,742	30,536	87,100
Austin, Tex	22,258	5	82,200			94	60,275	6,006	29,854	115,880
Oswego, N. Y	22,199	5	98,188	8	2,782	36	16,750	3,286	16,693	46,117
Bangor, Me	21,850	9	46,875	1	364	39	15,283	3,215	20,612	59,208
Petersburg, Va	21,810	4	35,590	2	1,200	27	6,160	1,761	17,352	43,486
Pittsfield, Mass	21,766	4	7,964			6	1,926	1,443	1,297	8,620
Lima, Ohio	21,723	3	8,200			4	1,186	1,153	4,535	12,450
Watertown, N. Y	21,696	3	88,704	7	6,229	54	15,616	2,491	23,192	55,370
San Jose, Cal	21,500	15	98,895	4	5,020	50	22,482	8,073	20,869	77,500
Roanoke, Va	21,495	3	94,694	9	6,608	74	32,439	7,428	40,958	96,064
Columbia, S. C	21,108	6	17,190	5	3,100	61	20,550	1,808	9,173	44,580
Wilmington, N. C	20,976	6	15,970			17	4,004	1,335	6,663	20,150
Muncie, Ind	20,942	6	18,315	5	2,200	32	12,236	2,387	19,143	48,567
Amsterdam, N. Y	20,929	3	7,300			9	3,068	609	2,662	12,400
Decatur, Ill	20,754	5	19,075	6	2,209	16	6,696	2,303	9,244	27,310
Leavenworth, Kans	20,735	4	62,675	5	4,800	38	19,250	7,314	23,776	70,500
Waco, Tex	20,686	10	42,665			47	23,855	4,887	17,354	59,208
New Albany, Ind	20,628	4	2,275			3	535	482	1,937	5,645
Anderson, Ind	20,178	5	8,800	8	1,600	7	3,100	1,815	10,472	28,300
New Brunswick, N. J	20,006	5	26,100			18	8,550	1,707	9,031	25,778
All other cities[1]		31	131,431	7	4,328	119	60,599	10,051	50,623	175,992

[1] Includes Bayonne, N. J., 2; Easton, Pa., 2; East St. Louis, Ill., 2; Everett, Mass., 1; Gloucester, Mass., 2; Joplin, Mo., 2; McKeesport, Pa., 2; Muskegon, Mich., 2; Newburg, N. Y., 2; Newport, Ky., 2; Norristown, Pa., 1; Orange, N. J., 2; Passaic, N. J., 1; Quincy, Mass., 2; Sheboygan, Wis., 1; South Omaha, Nebr., 1; Superior, Wis., 2; Taunton, Mass., 2.

In 1900, cities of 20,000 inhabitants and over contained 79.0 per cent of the separate job printing establishments of the country, with 95.8 per cent of the capital invested in such establishments, and 97.7 per cent of the value of products.

Table 55 compares the totals for cities of 20,000 and over with those for all other localities.

TABLE 55.—*Number of establishments, capital, and total and average value of products shown for cities of 20,000 or more inhabitants, and for other localities, 1890 and 1900.*

LOCALITY.	Year.	Number of establishments.	Capital.	Value of products.	Average value of products per establishment.
Cities of 20,000 or over	1900	5,466	$92,850,506	$118,943,242	$21,761
	1890	3,491	64,053,816	90,034,844	25,791
Other localities	1900	1,454	4,045,672	2,855,854	1,964
	1890	607	3,092,629	3,505,987	5,776

Between 1890 and 1900 the number of establishments in cities increased 56.6 per cent, but the value of products increased only 32.1 per cent, showing a decrease in the average value of products per establishment.

While the per cent of increase, between 1890 and 1900, in number of establishments outside of the cities was very large, in the value of products a decrease was shown, resulting in a much lower value of products per establishment in 1900 than in 1890. To some extent this change may be due to a more careful enumeration in 1900, by which were included certain small establishments that escaped notice in 1890.

Table 54 shows wide variations in number of establishments, capital, and value of products, in relation both to one another and to population. Large job printing establishments are often attracted to a given city by special causes quite distinct from population, as in the case of a state capital, in which a large amount of official printing is required. Of this class Albany, N. Y., Richmond, Va., and Hartford, Conn., are examples.

II. PROGRESS IN THE PRINTING AND PUBLISHING INDUSTRY.

When judged by modern ideas of progress, the art of printing was nearly stationary for four hundred years. Printing has been the most generous contributor to human progress, the handmaiden of all the arts and industries, and perhaps the most powerful factor in making the Nineteenth century the leader of all centuries in genius and invention; but it has been reserved for the last two decades to record the most substantial advances in the many and exacting details connected with the satisfactory production of a printed page. The invention of the 10-cylinder press, by Robert Hoe, in 1853, was declared by the lords of the privy council of England to be "one of the greatest steps ever made in printing." But in the far more difficult field of machine composition, inventors made no appreciable progress during the greater portion of the Nineteenth century; as late as 1880 the extended report of the Tenth Census upon this industry, after presenting evidence of the activity and progress of the period, declared: "While all these improvements have been following each other in the printing and delivery of newspapers, the ingenuity of man has not yet invented a substitute for the setting of type by hand, the method of composition remaining precisely the same as it was when printing was first invented."[1]

The first step toward the solution of this problem was taken in 1886, by Ottmar Mergenthaler, who invented the linotype machine, which shortly afterwards came into general use, and has been followed by several ingenious and successful inventions similar in purpose. Although only beginning to be felt, the effect of these inventions is already significant, and in them doubtless may be found the cause of many of the abrupt changes which are shown on contrasting the figures given for 1890 and 1900 in the tables for newspapers and periodicals. These remarkable inventions can not fail to affect more and more the future progress of the industry.

Types have no existence in the product of the linotype machine; the unit is the line, which is known as a "slug." By pressing keys the operator assembles brass matrices, and upon the completion of a line these are pressed forward against a bar of molten type metal, casting the line, or slug, in condition for printing. By continuation of this process the matrices return automatically to their receptacles.

Other inventors also attacked the problem of mechanical composition, and there have been placed upon the market the Lanston monotype, a combination of a keyboard by which a strip of paper is punched, and a machine casting individual types from matrices indicated by the passage of compressed air through the holes in the punched paper strip; the Goodson graphotype, also a combination of two machines, operated by electricity, and casting individual types; and the Scudder monoline, a Canadian machine somewhat like the linotype, except that the matrices are located upon a disk. The monoline machine has not been placed upon the American market.

Mechanical composition and distribution of foundry type are accomplished successfully by the Dow, Simplex, Empire, and other machines.

The question of wages has been somewhat affected by the introduction of these radical departures in composition. In 1850 a compositor in New York city received $1.50 per day, or $9 per week. Ordinary job compositors now receive $18, and operators upon machines receive considerably more. It is the opinion of many large employers of labor in this industry, that the invention of labor-saving machines has merely served to increase the demand for labor in new channels, so that the number of wage-earners employed has actually increased rather than diminished. The introduction of machine composition has been of decided benefit to the employee, offering a new field of employment at high wages. This fact is illustrated by the experience of the Typographical Union of New York city, in 1900, when called upon hastily to supply 150 men for a special piece of work in connection with city printing. Every effort was made to secure them, but in that great center of population and labor it was impossible to obtain, at short notice, more than 100 men fitted for the work.

[1]Tenth Census: The Newspaper and Periodical Press, by S. N. D. North, page 102.

During the decade type founding made marked progress in several of its branches. The Benton punch cutter and the Barth type-casting machine enabled the founder to dispense with much of the laborious and expensive detail connected with his calling, and to reduce materially the cost of type to the printer. To some extent the use of these machines offset the inroads which the use of machine composition made into the business of the type founder, and permitted him to increase greatly the output of special faces and artistic display type.

In the measurement of type bodies a revolution was effected. A uniform series of sizes, known as the "point system," was introduced about 1890, supplanting everywhere the earlier method, by which each foundry used a different size of "body." This radical change permitted the use of the type of one foundry with that of any other, and meant as much to the printer as the change from local to national currency meant to the nation.

In stereotyping, a device known as the autoplate was invented in 1900, by means of which the time required for casting plates was considerably reduced, and in electrotyping the value and efficiency of the foundry were enormously increased by the use of a strong current of electricity to hasten the deposit of copper, so that the time required by the process may now be controlled by the electrotyper to suit his customer.

The greatest advances in press building since 1880 have been made in perfecting presses. These machines are now constructed of such enormous size and with such great capacity that it is possible to obtain, at short notice, a newspaper press which will produce 100,000 impressions per hour, printed in 12 colors. The greatest advance in printing presses, however, was the construction of perfecting presses capable of producing the finest type and cut work as rapidly as though printing newspapers. Such machines, which were an impossibility in 1880, and an experiment in 1890, are now in general use, and are necessary to the production of the large number of inexpensive magazines and newspaper special supplements, profusely illustrated, which have become an important feature of current literature.

The great advance in the direction of printing in colors from plates, by means of which the printer has invaded the business of the lithographer, created a demand which the press maker met with a machine capable of printing the three primary colors and producing several more by combination at one impression, so that a complete picture in many colors may be the product of one impression.

In the field of illustration the decade has witnessed advances second only to the invention and commercial success of composing machines. The art of steel engraving, carried to great perfection about the middle of the century, has become practically a lost art, and by 1900 wood engraving was neglected and unprofitable, being replaced by the "line cut" and the "half tone."

These two classes of illustration are obtained by a combination of photography and etching. In producing the line cut the drawing is photographed and the negative printed upon a zinc plate. The lines of the photograph are then protected and acid is permitted to eat away the exposed portions, producing a relief. The mechanical details of the half tone resemble to some extent those of the line cut, but the process is much more delicate, and the element of individual skill plays a more important part. The relief upon the plate is secured by small dots obtained by photographing the drawing through two glass plates which have been closely ruled. The negative is then printed upon a copper plate, which is subsequently etched.

The effect of the extraordinary activity in invention and improvement, sketched above as characteristic of this great industry since 1880, has been twofold: To the printer himself it has been injurious rather than helpful; to the public it has been of incalculable advantage—a potent factor in elevating the standards of good taste.

It has already been pointed out that by the introduction of labor-saving devices in this industry, the wage-earner has doubtless benefited both in employment and in higher wages. As a matter of fact, the employing printer and not the wage-earner, suffered from new inventions and improvements in machinery. The type founder and the press maker secure protection from the ills of competition by consolidation, but no such relief is afforded to the printer. Indeed, from the nature of his calling, no effective combination could be organized. Extraordinary activity in mechanical invention and improvement, added to increasing competition, forced the printer to sacrifice to the interests of his business a large share of his narrow margin of profit. It is unlikely that there is any other industry in which there is so small a financial return for so much labor and uncertainty. Printers have seldom grown rich from their calling; their recompense has been generally in the character of their product. So far as wealth from his occupation is concerned, the printer of to-day, like his predecessor of centuries ago, lives entirely in the future.

Of far greater consequence, however, is the consideration of the quality of the product. There has been a remarkable advance, since 1880, in artistic composition and in artistic results in all classes of printing. The styles of printing employed during the last two or three decades may be divided into three general periods. The first period was that in which a great number of type faces were employed in all display work and title pages, apparently with the idea that several kinds of shaded and display type were necessary for effective presentation. This style of composition was accompanied by elaborate ornamentation, such as rule work, scroll work, impossible cranes, birds, frogs, and conventional designs. Such work was not artistic in any sense, and could be regarded as interesting and commendable only from the standpoint of ingenuity.

The second period was marked by the imitation of alleged ancient designs and type faces. In the Seventeenth century printing was placed under very great restrictions in England. In consequence of this, a large number of small printing shops sprang up in obscure places, being generally known as "holes." These shops often used secondhand and worn-out dresses of type, and, operating secretly, produced pamphlets and small books of a very poor grade. Where ornamentation or special letters were necessary, the printer himself cut them, generally in crude and barbarous fashion. Thus there was a distinct decline in the printing of that period, due to the product of this multitude of interdicted shops. Certain artists of the present day, coming across this class of work, endeavored to imitate what was not really a subject for imitation, for it did not represent the best work of the period. Advertisers seized upon these oddities with avidity, and for a time there was a considerable movement toward such extreme results; but this fashion appears to be already on the wane. It obtained little foothold on the title pages or in the ornamentation of standard books.[1]

The third period was one of better taste, the simplest types being used in the preparation of titles and display. At no period in the history of the industry has more beautiful work been produced in the combination of types and paper than during the decade which has just ended. Indeed, in the progress of this industry paper is a factor which should not be overlooked.

In 1862 the kind of news paper ordinarily used was made of cotton rags. It was imperfect, poor in color, and manufactured in the crudest manner. The price was 24 cents per pound. In 1900 stock of the same quality could not have been marketed for 2 cents per pound. The extensive use of wood pulp, and the great variety of qualities, weights, and surfaces made possible by increased skill and by improved paper-making machinery, are factors which must not be neglected in any careful survey of the advance of printing.

The volume of advertising circulars and pamphlet literature was never before so large or of such mechanical excellence as during the last decade. The educational effect upon the public at large of presenting in the most attractive and artistic form the ordinary details concerning commercial wares, can not be overestimated.

The underlying cause of this advance, however, is the fact that the untiring search for improvement

[1] Theodore L. DeVinne, to the writer.

has not been confined to the printing industry; other lines of commercial activity, scoring their triumphs, turned to the printer for exploitation by combinations of types, cuts, and paper so original and artistic as to compel attention and merit preservation. To this demand the printer was quick to respond. He became in many cases a designer, and firms were organized, with and without plants, to make a specialty of designing artistic combinations of types and material. This class of designing printers was practically a product of the last decade.

Leaping beyond the narrow limits of the modest and ugly circulars, leaflets, and handbills of two generations ago, the business community thus educated itself, through the activity of the period, to demand, for advertising purposes, the most beautiful products of the press.

In the realm of bookmaking no striking changes were recorded, but the advance in good taste and in artistic beauty of product was a marked characteristic of this branch of the industry. Fashions in bindings changed annually, but a widening range of materials and patterns, more daring use of designs and inks, and the invention and general use of automatic binding machinery supplemented improvements in printing, permitting lower prices for books and promoting phenomenal sales. It is a significant coincidence that the decade which witnessed extraordinary advance in all details of mechanical production in this industry, should be characterized also by the most noteworthy advance in the good taste and appreciation of the general public.

In connection with daily newspapers the beneficial results of the use of composing machines and of improvements in plate making, in presses, and in methods of illustration, are so obvious that they need not be discussed in detail. Many of the advances in mechanical construction, which already have been sketched, profoundly affected this class of publications.

The growth of the Sunday edition of the daily newspaper is worthy of notice. In 1900, 7 morning daily newspapers in New York published Sunday editions, aggregating nearly 400 pages. These enormous publications were composed of sections of 8, 12, or 16 pages devoted to news, literature, advertising, and comic illustrations in colors. The last-mentioned feature—made possible by the advance in color printing on perfecting presses—though carried to extremes, showed no sign of reaction.

There was no radical change in the gathering of news or in the management and scope of daily papers. One characteristic of the decade, however, was the great increase in the quantity of news published. Partly because of the ambitious and progressive spirit of the period, and partly because of the lavish expenditures of capital made by reorganized or newly established publications in order to break into the patronage of prosperous competitors and secure a foothold, the dailies of the great cities became the purveyors of the news of the world to an extent never before attempted. In many cases—especially in New York city, where the daily newspapers are of national repute—it was freely admitted that this expenditure was carried beyond the bounds of business prudence.

In 1886 the *New York World* reported the battle of Majuba Hill in six lines, but so rapid was the extension of news gathering that, fourteen years later, events in the same quarter of the globe were reported to the great American dailies by cable as fully as though close at hand. The destruction of St. Pierre, Martinique, in 1902, by an eruption of Mont Pelee, may be mentioned as an illustration of this tendency. Cablegrams concerning that great disaster reached American newspapers by way of Brazil, the Azores, and Great Britain, costing the recipients from $2 to $4 per word, with fees for precedence.

To some extent this outlay for increased news service has been met by organizing groups of newspapers in different cities to receive and publish duplicates of expensive cables or dispatches, but in few cases has this arrangement lifted more than half the burden. During the greater part of the decade the most stirring current events occurred on the other side of the globe; the war between China and Japan, the conquest of the Philippines, the war in South Africa, and the campaign of the Allies in the Far East required in turn costly presentation, while the operations of the Spanish War off Cuba, followed with wonderful efficiency by the American newspapers, involved immense expenditure. Many of the larger dailies maintained special yacht service between the scene of the conflict and Jamaica or Key West.

Upon the public the effect of such extensive news gathering was very marked; there was a decided increase in human interest; the world became a great neighborhood.

In the revenues of newspapers, however, there was no corresponding increase to offset the drain of increased expenditures for news.

The recent public sale of the Philadelphia Record, which may be regarded as representative of large and prosperous publications, adds confirmation to the foregoing statements. An accurate analysis of the business of the Record for most of the decade under consideration shows the following:

TABLE 56.—SUMMARY OF RECEIPTS AND EXPENDITURES OF THE PHILADELPHIA RECORD, WITH INCOME PER COLUMN FROM ADVERTISING: 1893 TO 1900.[1]

YEAR.	RECEIPTS.			EXPENDITURES.				PER CENT OF TOTAL EXPENDITURES.			Income per column from advertising.
	Total.	Advertising.	Subscriptions, sales, and miscellaneous.	Total.	News-gathering and wages.	Paper.	All other.	News-gathering and wages.	Paper.	All other.	
1893	$815,474	$487,360	$328,114	$617,542	$302,907	$227,489	$87,146	49.1	36.8	14.1	$59
1894	797,285	477,225	320,060	571,344	265,366	231,547	74,431	46.4	40.5	13.0	62
1895	848,478	552,587	295,892	598,369	281,303	239,266	77,800	47.0	40.0	13.0	60
1896	964,904	630,751	334,153	661,429	305,948	275,520	79,961	46.3	41.7	12.1	60
1897	885,934	594,337	291,597	668,328	332,325	266,195	69,808	49.7	39.8	10.4	59
1898	980,742	645,426	335,316	757,908	389,878	292,287	75,743	51.4	38.6	10.0	58
1899	1,073,917	722,205	351,712	769,019	411,931	291,693	65,395	53.6	37.9	8.5	57
1900	1,209,445	855,810	353,635	921,561	490,352	352,137	79,072	53.2	38.2	8.6	55

[1] Prospectus of the sale of the Philadelphia Record, Exhibit 1.

It will be observed from this summary that the proportion of expenditure for news gathering rose from 46.4 per cent in 1894 to 53.2 per cent in 1900, a difference of 6.8 per cent, and the earning power of a column of advertising fell from $62 to $55, a difference of $7 per column, or more than 10 per cent.

In connection with increase in expenditures it should be noted that toward the close of the decade there appeared a perceptible hardening in the price of paper. Urgency of demand had made such inroads into the supply of lumber available for wood pulp, that it was clear that unless more liberal laws were enacted the price of paper was likely to rise rather than become lower.

Because of competition, many newspapers cut the price of their issue to 1 cent per copy, and in spite of increasing circulation, there was thus an actual decrease in revenue from sales.

In the meantime, advertising, the other source of newspaper income, showed no marked increase. The department store, though a liberal advertiser, did not compensate for the multitude of smaller retailers whom it supplanted. Taking advantage of the concentration effected in advertising, as elsewhere, the department store advertising agent offered contracts for as much as a thousand columns at a time, and these huge figures extorted from the publisher the lowest possible price.

By 1900 it had become customary for large advertisers to form combinations; it is said that the patronage of fewer than twenty advertisers forms more than half the total quantity of advertising appearing in the daily newspapers of New York city. The only new source of income in the field of advertising was found in newcomers—principally tobaccos, whiskies, cereals, and books. Of these interests the publisher, formerly the most conservative advertiser, became the most daring. The professional advertising agent might be termed another cause of loss to the daily paper, to the amount of the commissions exacted. Between the opposing perplexities of competition and combinations of the advertisers there has been a decline in the advertising earning power of leading newspapers.

After passing 300,000 circulation, the value of advertising becomes a race between the receipts from that source and the cost of white paper. The advertising in one of the New York evening papers with circulation much exceeding 300,000 was recently declared to entail a cost of 21 cents per line for white paper. Evidently the publisher who secures a circulation of huge proportions confronts the necessity of securing from his advertising patrons a return of the cost of the paper space which they occupy, with a margin of profit. For reasons already noted, the profit is in many cases uncertain, and, as the decade drew to a close, for certain newspapers in the great cities a new problem arose.

The population had become so vast, and means of communication with surrounding territory so easy, that systematic search for circulation had been rewarded by enormous sales, the penalty for which was reduction or complete wiping out of profit on advertising. The circulation ball, once in motion, is not easy to stop, and the serious nature of this problem appeared when the cost of white paper occupied threatened to exceed the return from the advertiser. At the close of the decade such a possibility confronted several American daily newspapers. Overcirculation necessitated also an increase in capital invested in plant, with the added burden of interest which it represented. It may be said, therefore, that at the close of the decade from 1890 to 1900 the daily newspaper was more of a public institution than ever before, because it sacrificed an increased share of its revenue for the public benefit, obtaining no compensating financial return from either purchaser or advertiser. This was a condition very much to the advantage of the public, but one which tended to periods of reduced dividends in those establishments appearing to be most prosperous. Daily publications suffered from the rage for enlarged business and narrow profits so characteristic of all industries during the decade, but the relief which other callings found in combinations was not open to the publishers of daily newspapers, because the inequalities of circulation forever make combinations of newspapers impossible. Prosperity for the daily newspaper clearly lies in a middle course, if conditions permit, with respect to both news and circulation.

The changes which occurred in weekly publications during the last decade were not such as to merit more than passing consideration.

In weekly publications of general circulation devoted primarily to news, a distinct decline set in, doubtless as a result of circumstances which have been referred to in connection with the tables. Many such publications were discontinued; for example, the *New York Times* and the *New York Sun* abandoned the weekly editions long published by those papers, and the widely-known *New York Weekly Tribune* was saved from the same fate only by being made an agricultural paper. It should be mentioned, also, as indicating the tendency of the period, that the semiweekly *Tribune* was made a triweekly.

Notable additions to the class of important weeklies, devoted to literary subjects or illustrated matter, and possessing large national circulation, were the *Saturday Evening Post*, of Philadelphia, and *Collier's Weekly*, of New York. Other publications, devoted to the subjects mentioned, and national in scope, maintained a prosperous circulation.

In the field of monthly magazines the most notable change which occurred during the decade was the creation of the 10-cent magazine. The leading publications in this class were *Munsey's Magazine*, established as a 25-cent publication in October, 1891, and reduced to 10 cents in October, 1893; and *McClure's Magazine*, established as a 15-cent magazine in June, 1893, and reduced to 10 cents in July, 1895. The *Cosmopolitan*, which had long existed as a 25-cent publication, varied its price to 12½ cents and 15 cents, reducing to 10 cents in 1895.

The immediate effect of the reduction in price of *Munsey's Magazine* to 10 cents was to increase the circulation to such an extent that it was difficult to supply the orders, and the production of the first edition at the reduced rate was stopped in order to begin work upon the next issue. In the case of *McClure's Magazine*, reduction to 10 cents caused the circulation to double, and before the end of the first year it had reached about 150,000.

When the reduction of price to 10 cents was made, it was generally regarded as a foolhardy proceeding. The opposition of the news companies made it necessary to handle independently the distribution of *Munsey's Magazine*. It was not realized by many well-informed publishers that the time was ripe for such a change. Improvements in mechanical production had progressed so far that it was at length possible for a daring manager to produce an excellent magazine at a trifling cost per copy. Moreover, the public, accustomed to cuts in prices in other directions, were in a frame of mind to welcome such a change. It should be remarked that advances in machine composition and in making illustrations, while of much importance, represented but a part of the initial cost, and were, moreover, a fixed figure, regardless of the size of the edition. These items, therefore, were not of much consequence in producing a great number of copies. The principal factors were the improvements in presses and in machines for stitching and covering, which greatly reduced the cost per copy.

Publications of this class may be regarded as a variation of the old-established and more expensive magazine. They at once supplied an evident want, and have attained to an enormous aggregate circulation. Possessing different characteristics, they reached a different class of readers, circulating not only in the United States, but in Canada as well.

Munsey's Magazine is noted for the large number of illustrations employed, and for the use of material that deals with people and timely topics, avoiding descriptions. This magazine averages 160 pages of reading matter and 80 pages of advertising, or a total of about 240 pages and cover.

The leading characteristic of *McClure's Magazine*, in addition to articles by well-known writers, is the presentation of subjects of current interest, completely worked out in all their details as soon as the topic has actually been completed. In character of material used, the *Cosmopolitan* follows a little more closely the policy of the older magazines. In all magazines of this class, except the *Argosy*, illustrations are freely used. There is unquestionably an evolution of daily newspapers, through their Sunday publications, toward the field occupied by the inexpensive magazine, which, before the completion of another decade, may have some decisive result. Meantime the importance of the inexpensive magazine, and its educating force in the community, must be given due weight. The combined circulation of the monthlies published by F. A. Munsey, the *Ladies' Home Journal*, *McClure's Magazine*, and the *Cosmopolitan*, in 1900, was 2,483,000 copies per issue.

TYPE FOUNDING.

There has been no material change during the past two decades in the manner of designing types, but the process of executing the design is different from that formerly employed.

For the laborious and delicate task of punch cutting, a machine known as the Benton punch cutter came into general use about 1885. This consists of a light framework a little over 5 feet high, occupying a floor space of 22 by 28 inches. About three feet from the floor a table is set in the machine. The preparation of a model for the Benton punch cutter begins with a pencil sketch, on paper, of letters 12 inches high. The drawing is reproduced by a pantograph, in the form of a model letter 3 inches high, with raised outline. An electrotype of this letter is then prepared, and is fixed firmly upon the platform or table of the machine, beneath a tracing needle or index. To the head plate of this index are attached the four rods holding the cutting mechanism, which is at the top of the machine, and consists of a rapidly revolving borer, fixed in a stationary position and in a movable framework, in which is set the bar of steel or other metal which is to be cut. The leverage of the machine is capable of various adjustments, so that from the same model letter any body of type, from 2-point to 72-point, can be cut with equal facility and exactness.

The operator moves the index over the model letter on the platform, bearing down upon the lower parts and pressing against the sides of parts in high relief. The direction given to the index, at the will of the operator, upon the outlines of the model letter, is faithfully repeated by the tools cutting the punch. The cutting tools, of which two or three kinds are used in succession, are made with the utmost care. Being very highly tempered and being operated at very high speed, by steam power, they cut into the steel along the lines indicated by the movement of the guide over the model letter. The punches which are produced by this machine are finished in all points, requiring no hand work. Besides being produced more rapidly than those made by hand, these punches are more accurate, the counters are deeper, and the bevels are truer and always of uniform slope. This machine may be arranged to reproduce model letters in either direct or reverse order.

Where the punch is to be employed in making matrices by the driving process, as is necessary for small characters, hard steel is used. The matrices for the larger characters are made from soft metal by the electrolysis process.

The automatic type-casting machine was invented by Mr. Henry Barth, of Cincinnati, and patented in 1886. The machine is now in general use in type foundries, both in the United States and in England, and has been largely instrumental in reducing the price of type. It delivers completely cast type, perfect in all respects and ready for use. In the office of the *London Times* a new dress of type is cast daily by an automatic type-casting machine, which, though seemingly deliberate in its operation, casts 1,000 types a minute. The old dress of the *Times* goes daily into the melting pot, and a new one takes its place. In that office this system is preferred to the use of the linotype or other composing machine.

The first practical attempt at uniformity in type bodies was made in France, by the type founder Fournier, in 1737. His system, which was quite complicated, did not come into general use, but after his death it was improved by Didot, a type founder of Paris. The systems of Fournier and Didot are still followed to some extent by French type founders.

In America the first practical attempt to establish correct proportions between different types was made by George Bruce, a New York type founder, in 1822, but his method was not adopted by other American founders. After the Chicago fire a firm of type founders in that city—Marder, Luse & Co.—planned a system of bodies based on 6 picas to the inch. Later they took as their standard the pica made by the MacKellar, Smiths & Jordan Company, as the one which the majority of American founders and printers would prefer, and regraded the other sizes according to the methods of Fournier. In 1878 they placed on sale type made on what they called the American system of interchangeable type bodies.

At a meeting of the American Type Founders' Association, in 1886, a committee was appointed to examine into and report upon the new system. There was some objection to the pica as a standard, but the majority of founders finally agreed to accept it as the basis of the point system. The twelfth part of a pica, called a point, was taken as a unit, and all bodies of type were placed on multiples of this point and called by numerical names: pica became 12-point; long primer, 10-point; brevier, 8-point; nonpareil, 6-point, etc.

The American system follows the system of Fournier and Didot, except in the unit of measure employed. The following statement shows the names of the principal bodies or sizes of type in use in England and in America, with the names of these sizes under the point system: .

Names of type bodies.[1]

American.		English.
New name.	Old name.	
60-point	Five-line pica	Five-line pica.
48-point	Canon, or four-line	Canon, or four-line.
44-point	Meridian	Two-line double pica.
40-point	Double paragon	
36-point	Double great primer	Two-line great primer.
32-point	Four-line brevier	
30-point	Five-line nonpareil	
28-point	Double english	Two-line english,
24-point	Double pica	Two-line pica.
22-point	Double small pica	Double pica.
20-point	Paragon	Paragon.
18-point	Great primer	Great primer.
16-point	Columbian	Two-line brevier.
14-point	English	English.
12-point	Pica	Pica.
11-point	Small pica	Small pica.
10-point	Long primer	Long primer.
9-point	Bourgeois	Bourgeois.
8-point	Brevier	Brevier.
7-point	Minion	Minion.
$6\frac{1}{2}$-point	Minionette	Emerald.
6-point	Nonpareil	Nonpareil.
$5\frac{1}{2}$-point	Agate	Ruby.
5-point	Pearl	Pearl.
$4\frac{1}{2}$-point	Diamond	Diamond.
4-point	Brilliant	Brilliant.
$3\frac{1}{2}$-point		
3-point	Excelsior	Minikin.

[1] From Theodore L. DeVinne's Practice of Typography; Plain Printing Types, page 54.

In the autumn of 1892 the American Type Founders' Company was established. The majority of the type foundries of the United States became branches of this organization, which now practically controls this branch of the industry.

COMPOSING AND TYPESETTING MACHINES.

The Mergenthaler Linotype.—The linotype machine, invented by Ottmar Mergenthaler, of Baltimore, Md., became commercially successful during the early part of the decade. This machine is less than 5 feet square, and weighs about 2,000 pounds. It consists of a bank of keys connected with a magazine containing about 1,500 brass matrices—small plates about an inch high and half an inch wide, the thickness varying with the type character. On one edge is the die from which is cast the letter, and at the upper end are a series of nicks or teeth for distributing purposes, every character possessing a different combination. Each magazine contains a number of matrices for each letter, and all the usual characters required by a complete font of type, together with spaces, quads, etc., of varying thicknesses. In addition there are also flat, elongated, wedge-shaped spaces which are inserted between words and employed for justifying each line as it is cast. The magazine containing the matrices is an inclined receptacle 2 feet 6 inches high, the top being about 6 feet from the floor. Within this magazine are channels in which the matrices for the different letters are stored, and through which they pass. The machine is so adjusted that as the keyboard is manipulated the matrices are selected in the order in which they are to appear in the slug or casting. When a key is depressed, the matrix to which it corresponds emerges from its channel, is caught upon an inclined traveling belt, and is then carried to the assembler, or stick. As each word is completed, a stroke of the space key inserts the wedge-shaped space used between each two words. When the line is completed the operator can correct errors by extracting matrices or substituting others for those which are in the line. The wedge-shaped spaces are now pushed up through the line, securing instantaneous and complete justification. The completed line is then transferred automatically to the front of a mold extending through a mold wheel at the left. Behind the mold is a melting pot, heated by gas or gasoline, and containing molten metal. Within the pot is a pump plunger leading to a perforated mouth arranged to close the rear of the mold. When the matrix line is in position the automatic operation of the plunger forces the metal into the mold and against the line of matrix letters, where it instantly solidifies in the form of a slug. The mold wheel then makes a partial revolution, bringing the mold in front of a blade which pushes the slug into a receiving galley, ready for the proof press.

In order to insure accuracy in height and thickness of the slugs, knives are arranged to act upon them during their progress to the galley. The slugs thus prepared are type-high, and when arranged in order look exactly like a type-high, metal-backed stereotyped plate cut into slices one line deep.

Having served their purpose in front of the mold, the matrices are returned to the magazine to be utilized in new combinations. The distribution is accomplished automatically. The line is lifted from the mold by a long arm, and shifted laterally until the teeth at the tops of the matrices engage the teeth of a bar which is lowered to receive them. This bar then rises, lifting the matrices to the distributor at the top of the machine, but leaving the wedge-shaped spaces behind to be shifted to their magazine, which is to the left of the matrix magazine, and about on a line with its foot. The matrices, having been lifted to the top of their magazine, are pushed along a distributor bar by continually-moving longitudinal screws beneath. The distributor bar, which is made in a single piece, is fixed horizontally over the upper end of the magazine, and is supplied with longitudinal ribs or teeth adapted to engage the teeth of the matrices and to hold the latter in suspension as they are carried along the bar. The teeth of the bar are cut away to produce a different number or arrangement over each of the channels. Each matrix remains engaged and travels over the mouths of the channels until it arrives at the point where its teeth bear such relation to those of the bar that it is permitted to disengage itself and fall into its own channel. It is thus clear that the operation of the machine permits the composition of one line, the casting of a second, and the distribution of a third to be carried on simultaneously. The casting operation can also be arranged to work independently of the rest of the machine. It is said that this machine is capable of a speed greater than that at which the most skillful expert can operate the keys. The average product of a good operator is 4,000 ems per hour. Many operators, however, can produce from 5,000 to 6,000 per hour, and a speed of 13,000 is on record. There are three styles of mold—the first from 30 ems to 19 ems pica, the second for any measure between 24 and 13 ems pica, and the third for measures from 14 ems to 5 ems pica, inclusive. Each magazine contains matrices for any face of type, and the usual range of type faces is now from ruby to pica, or 12-point, though some matrices have been made for 14-point. Various faces of letters, and the alphabets of different languages, can be supplied with this machine. There are also combinations such as casting a 6-point face on a 7-point body, or a 7-point face on an 8-point body, in order to secure the effect of leading. The machines are equipped to permit an exchange of matrices or molds, and they can now be adapted to produce any practical face or any desired body, provided the line does not exceed 5 inches in width.

The Linotype company makes all the matrices required for its machines, employing the Benton punch cutter extensively in the preparation of the characters. Until 1899 it was impossible to employ in this machine more than one face of type at a time—the use of italics, for example, was impossible with body letters; but in the year mentioned one of the officers of the linotype company invented a two-letter matrix. The principal letter is a body character, and is placed above the other, which is italic, small capital, or bold face. To utilize the two-letter device, a special finger key is provided, which moves a small slide into or out of the assembler.

When the slide is drawn forward, the matrices entering the assembler assume the customary height and are delivered to the mold in position to produce the upper or body characters. If italics or small capitals are desired, it is necessary only to draw out the lower end of the finger key, causing the slide to move inward, so that the matrices added to the line will be arrested and sustained at a higher level than the others, causing their lower or secondary characters to be presented in casting position. By the operation of the finger key the line may be made to consist wholly of body face, italics, or small capitals, or of any combination of these faces required. The field of operation of the linotype machine has been much extended by the introduction of the two-letter device. It is stated that about 8,000 machines are in use in the United States, perhaps half that number in Great Britain, and a large number in Germany, France, and other parts of Europe. About one thousand new machines are put in operation each year. They are now in general use in the large newspaper offices in the United States. In addition to greatly cheapening the cost of composition, they possess the added advantage of supplying what is in effect a new font of type with every issue, the slugs being returned to the melting pot after each use. Another advantage is the ease with which the slugs can be handled. As they represent lines instead of individual letters, they can be manipulated with great rapidity.

The Scudder Monoline.—The Scudder monoline machine manufactures a solid line of type, or type bar. It is automatic in all of its functions, and is operated by one man, by the manipulation of a keyboard. The different parts of the working mechanism are attached to a solid, three-legged cast frame, and are in full view and within easy reach of the operator. The machine is 3 feet 6 inches high, 4 feet long, and 3 feet 6 inches wide, occupying about as much floor space as a printer's three-quarter case frame.

The principle governing the operations of the monoline is much the same as for the linotype, the main difference being in the construction of the matrix bars; those for the linotype carry a single intaglio, while the monoline uses matrix bars, each having 12 characters indented on the front edge. These matrix bars, of which there are 500, are stored one behind another in a magazine about the size of an ordinary photographic camera. As the keys are struck on the keyboard the matrices and spacers descend into the assembling box, traveling a distance of about four inches, and the bars are dropped more or less, according to the position of the letter to be brought in line to be cast. When the line has been completed to approximately its full length, the operator strikes a lever at the right of the keyboard and begins the composition of the second line, while at the same time the machine automatically justifies the first line, carries it to the casting pot, delivers it upon the galley, and returns the matrices and spacers to their respective receptacles in the magazine. The machine will not cast a line which has not been properly justified. After being once brought into use, a matrix bar or spacer is not employed again until all others of the same kind stored in the magazine have been used in turn.

The Lanston Monotype Machine.—The Lanston monotype machine was invented by Tolbert Lanston, in 1886, but was not placed upon the market until the latter part of the last decade. The principle upon which it is constructed differs radically from that of the linotype. The monotype produces single types cast in the order of their use, and set in automatically justified lines. It consists of two machines—a perforating device operated by a keyboard, and a casting machine. The keyboard differs from that of the typewriter only in the much greater number of characters, of which there are 225, comprising a complete font, including italics and small capitals. The keys are arranged in 15 columns of 15 rows each, with 2 extra rows at the top to secure justification. For each series of characters in the font a different color is used, so as to distinguish italic from roman, etc. The keyboard is between 3 and 4 feet from the floor and is supported by an iron bar upon a base 1 foot square. At the top of the machine is a roll of paper which unwinds from one spool and winds on another as the keys are struck, and also a paper scale for registering the body size of the type.

Before beginning his task, the keyboard operator sets an index of the number of ems required per line. Each stroke of a key perforates the paper ribbon in such a combination as to control the matrix of the proper letter in the casting machine, and causes the registering scale to charge to the line an amount equal to the body width of the type just selected. In this way a line of matter is progressively perforated and charged until, as the end is approached, the line scale shows that the next word or syllable can not go into that line, while another portion of the registering scale indicates the amount of unfilled space in the line just perforated if it should be cast with its spaces of normal body size. Still another portion of the scale has been keeping account of the number of spaces used between words of the line which may be varied in the process of justification. The machine thus mechanically notes for the operator the amount of space to be added and the number of space types among which the variation from the normal body width may be apportioned. At the completion of each line the operator, by merely noticing the figures shown by the pointer on the justifying scale, knows at once what additional holes to perforate in the record in order to secure perfect justification. When he has touched the justifying keys the registering scale recedes to zero, advancing again as the new line progresses. These operations are all automatic.

From the perforator the spool passes to the casting and setting machine, an intricate piece of mechanism about 4 feet high and slightly less in width, weighing about 1,200 pounds. On being placed in the casting machine the ribbon is unwound in reverse order, the operation of casting and setting proceeding in like manner. The control of the casting machine by the perforations in the ribbon is effected by the pressure of air passing through the holes as the ribbon moves over a rounded plate. Within this plate are 32 air tubes, and, as different perforations appear, different connections are made through these tubes with the working parts of the casting machine, a pressure of 8 pounds being maintained. The 225 matrices are contained in a die case measuring about 3 inches square. The matrix case shifts its position according to the combination of perforations passing over the air tubes. The perforations for justification regulate the casting of space types between words, causing the mold to be opened in the degree indicated by the justifying holes, in order that the space types may be cast of the proper size. Thus, from the record ribbon made at the keyboard, the casting machines cast type and insert mathematically correct spaces at constant speed, which may be kept up up to the limit of cooling metal. It is the work of only a few moments to remove one matrix case and substitute another. Moreover, the molds in which the bodies of the types are cast, also, may be exchanged at short notice. At one side of the casting machine is a melting pot, in which an automatic plunger forces the hot metal into a nozzle leading directly to the mold upon which the matrix rests. The metal is forced against the matrix, which is filled first, and then instantly occupies the body of the mold under pressure, insuring a good cast. When chilled the types are ejected through the mold into the carrier, which carries them to the line in the galley. As each line is completed, it is advanced automatically to make room for the next. The correction of matter set on the Lanston machine is the same as in hand composition; it is not necessary to recast a line, as in the slug machines. In the operation of the Lanston machine it is customary first to cast a font of type to be used in making alterations by hand.

It should be observed that the keyboard and casting machine have no connection whatever, and that each part can be operated independently. A keyboard operator can set matter as rapidly as he can read the copy and strike the keys, a speed of 5,000 ems per hour being regarded as a moderate average. The type-casting machine casts and produces, according to the body size, from 75 to 125 ems per minute, or from 4,000 to 5,000 per hour. It can be adjusted to cast type on bodies ranging from 5½-point to 12-point, with various faces.

The advantages claimed for this machine are perfect justification, the convenience of being able to operate the two parts separately, the employment of matter set from single types, and therefore easily and quickly corrected, and the ability to produce a font of type at every operation. Although they have not been long in practical operation, many of these machines are in commercial use.

The Goodson Graphotype.—The Goodson graphotype machine was first placed upon the market in 1899, by J. H. Goodson, and depends upon electricity for its successful operation. It is composed of two parts: a small table about the size of a typewriter desk, containing an ordinary typewriter, a perforating machine, and a small dial similar to a clock; and a caster and setter. The typewriter is in all respects unaffected as far as facility in writing is concerned. The operator is required, in addition to the execution of ordinary typewriting, to notice, when the end of the line is reached, the dial which controls the spacing, and to touch the key indicated by the dial, thus automatically spacing and justifying the line.

Each time a key is touched, not only is the proper letter written on paper, but an electrical communication is made with the perforator, which perforates a narrow paper ribbon in series of round holes so arranged that when the ribbon is placed in the casting and setting machine a similar electrical connection is made through this perforation, by indicating the letter or space to be cast and set. The advantage of a visible, typewritten sheet is obvious. It is accessible to the operator for reference, and it may be read by the proof reader instead of the first proof, as the type and the typewritten page are identical so far as the orthography is concerned. The ribbon, together with the corrected typewritten sheets, may be put away indefinitely for reprint or for possible use in the future, without expense for retaining metal. The same perforated ribbon and corrected first proof can be used in the casting machine to set from 5½ to 12 point type, the size or style of type required being determined at the caster, not the perforator.

The caster and setter resembles a sewing machine, being but little larger. It is operated automatically, and controlled by the perforated ribbon already mentioned. It casts and sets type continuously at a speed of 5,500 ems per hour, and has reached a speed of 8,000 ems per hour. The metal pot is more than a foot from the mold, making it possible to cool the types rapidly, thus overcoming a difficulty which has heretofore limited the efficiency of casting machines. It is possible, therefore, to maintain the maximum speed mentioned. The molten metal is conveyed to the mold by means of an electrically heated tube insuring uniform temperature for type casting. The mold is also water-jacketed, to counteract the heat which the small jet of metal gives out in casting type. By this means the mold is kept at a temperature at which the type is immediately chilled throughout an indefinite run, insuring a perfect and well-cut face. The type itself is in all respects equal to foundry type, and can be distributed into the case and reset with the same facility. The size or style of type and the measure can be changed as rapidly as this could be done by hand. It is claimed that the advantages of this machine for setting tabular matter are very great—that it can be set at the same speed as straight matter, the rules being put in by hand.

The Dow Composing Machine.—The Dow system of composition, patented November 28, 1899, requires the use of two machines—a composing machine, which sets individual foundry types and delivers them automatically justified on the galley; and a distributing machine.

The composing machine is a little over 6 feet high, weighs 2,000 pounds, and occupies about 17 feet of floor space. It is operated by means of a keyboard similar to that of a typewriter, but with 90 characters. The keys descend only three thirty-seconds of an inch, and are used simply to release certain parts, the driving power of the machine accomplishing the rest of the work. For greater ease in handling, the main type magazine is divided into two parts. In the type channels, which are 4 feet in length, the types lie with their faces in sight, resting on their sides in order that a large number may be placed in one channel. For further increase of capacity, additional channels are devoted to letters in frequent use.

At each touch of the keyboard a single type is pushed from the magazine and advanced to a type raceway in front of and parallel with the magazine. This raceway, which is in a continuous horizontal line, widens at one end, so that as the type enters and is pushed along by a rapidly reciprocating type driver it is stopped at the center by the narrowing of the raceway. From this position it is conveyed, by a blade operating in harmony with the type drivers, into an upright channel or "stick," each type forcing down the preceding one. To set a line of quads the operator simply keeps his finger on the quad key, and the quads are set in the stick at the rate of 10 per second until the line is filled. As the types enter the stick their faces are presented directly in view of the operator, who can read and correct them at will. A bell gives warning when a line is approaching completion, and a gauge at the side of the channel in which the line of type is formed, shows how much the line is short or how far the operator has overrun the standard measure he is setting. When the line is full the operator touches the line key, and then, without further attention on his part, and without delaying the composition of the next succeeding line, the stick of type turns halfway round and the line of characters is thrust by a blade to a point on the raceway called the "bridge," where the process of justification begins.

During the process of composition plain, type-high, rectangular bits of brass are used temporarily to separate the words; at the bridge each word is removed from the forward end of the line and carried to the galley, where the temporary space is extracted and returned to the setting case, the proper justifying space being substituted. The justification is accomplished by means of an automatic calculating device placed at the back of the machine. This calculator registers the shortage in the line and the number of spaces among which this must be divided, divides the shortage as equally as possible among the number of spaces indicated, and sets in motion another mechanism which ejects the required spaces and places them between the words as they pass in succession along the raceway to the galley.

Safety devices are provided to protect the machine from accident or carelessness. Should anything get into the raceway at the foot of the channels, the sliding shoe on the type driver unlatches from the driving mechanism, so that the reciprocating parts go on working, clear of stoppage. If by any chance the stick becomes choked, so that it can not turn at the proper time, the ejector blade is stopped, thus preventing injury to the stick. All movements of the machine are positive, there being no dependence whatever on gravity, centrifugal force, magnetism, air pressure, or the like, and the operative force used is only one-half horsepower.

When one of the sorts is exhausted, if it be one of the duplicated channels the next channel is brought into action by means of one of a series of levers over the keyboard; if the type sort be entirely exhausted it is replenished from the distributor. When the magazine requires refilling, it is let down by a hand crank, lifted out by the handles, and taken to the distributor.

The Dow distributor is entirely separate from the composing machine, but its mechanism is of the same positive character. The operation by which it distributes the various types in their respective channels is automatic, and allows a normal speed sufficient to supply three composing machines with type. For purposes of distribution the body of each type character has a special identifying nick. The distributor, which lies flat, consists of a central disk joined to a set of channels radiating like a fan. Upon the periphery of the disk are supported 36 type carriers, and as these are rotated past the galley channel on one side, each receives a single type, which is carried round until it is opposite the proper channel, when it is pushed out of the carrier into the channel, the distributor continuing its rotation.

The Simplex One-man Type Setter.—The simplex machine is a combination of the Cox typesetting machine and the Thorne machine. It performs the two operations of composition and distribution, either simultaneously or one at a time, as the operator chooses. It occupies less space than a printer's stand, weighs 800 pounds, and requires less than one-fourth horsepower to drive it. The body of the machine is formed of two cylinders about 1½ feet in diameter, one directly above the other. The lower, which is about 2 feet high, is stationary, but the upper, whose height is about 9 inches, rotates in the common axis. In each cylinder, extending vertically their full length, there are 90 parallel channels, slightly wider than the body of the type which the machine is made to set; those of the lower form a magazine into which type is distributed from the channels of the upper cylinder, to be stored for resetting.

Each key on the keyboard is connected by levers and wires with a small plunger at the bottom of its particular channel. When the key is depressed the plunger is moved forward and ejects one type on to the flat surface of a rapidly moving disk encircling the bottom of the cylinder. The type is conveyed quickly to the right-hand side of the machine, collisions of type on the way being prevented by the scimitar-shaped guards between each two channels, which prevent the types from interfering with one another and guide them as they start on their run on the disk. A switch deflects the type from the disk to a flat traveling belt which runs parallel with the disk at this point, and which conveys the type to the "separator"—two rolls with just enough space between to permit the passage of a single type, so that if the operator has played two types which are traveling side by side they are separated before proceeding farther. The types are now guided, one by one, to the packer, where they run on a cam, are lifted, and are then carried forward to proper position. Types succeed each other in the packer with 3-em space between the words, until a continuous line is formed extending across the back of the keyboard, with the face in view. At this point the operator, who is on a seat attached to the body of the machine, swings himself to a place at the left, where the justifying mechanism is situated, separates from the long line about enough matter to fill a line of the width of the column being set, and justifies and corrects it by hand; he then touches a thumb lever beside the galley, releasing a pawl which engages with a ratchet on a rotating wheel under the keyboard. In one revolution of this wheel, the rule which stands behind the type line is drawn down below it, while a line pusher comes up in front of the line and carries it into the galley which rests on a support behind the rule. For "leading" matter automatically there is a receptacle—which the operator can easily keep supplied with leads—out of which, by the action of a small lever, a lead can be delivered behind each line as the line pusher carries it into the galley; if more than one lead is desired, the thumb lever is held out until the needed number of leads has been supplied.

The distributing mechanism is at the rear of the upper cylinder. The galley of dead type to be distributed is placed sidewise (the lines of type being vertical) on a bracket, upon a solid upright fastened to the body of the machine. In each channel of the distributing cylinder there is a weight which rests on top of the column of type. When an empty channel, in its revolution, reaches the loading point, its weight, being low, trips a trigger attached to the releasing mechanism and the vertical lifter and plunger cam shaft is started, making a complete revolution. The lifter arm carries up the weight, thus leaving the channel clear while the "plunger" is moved forward and a line is pushed from the galley into the channel. After one line has been extracted from the galley, a spring moves the column forward so that the next line is in position to be loaded into the distributing cylinder. As the shaft continues its revolution, the lifter arm is dropped and the weight is lowered upon the line of type where it rests, aiding the force of gravity in making each type drop into its proper channel in the magazine cylinder. For this system of distribution each type character in a font is given a combination of nicks, and the channels are so grooved that they are closed to all type not fitted, by the combination of nicks, to pass.

All the channels in the upper cylinder are filled in turn. The cylinder revolves with a step-by-step motion, each of its channels being brought in turn over each channel in the stationary magazine cylinder below and held rigidly a moment to permit the dropping of each type as it comes to its proper channel.

In the practical operation of this machine it is not necessary to keep the distributor working without interruption, since it supplies type faster than the operator can set it up. With every channel in the upper cylinder empty, the replenishing can be dône in three-quarters of a minute.

The sorts in the different channels distribute in about the proportion required by the operator, but provision is made for removing quickly any sorts which distribute faster than is required, and for replenishing the supply of sorts which do not distribute rapidly enough.

STEREOTYPING AND ELECTROTYPING.

The process of duplicating type surfaces by stereotyping has remained practically unchanged since its application to the requirements of newspapers in 1861. This process has been a necessary adjunct to the perfecting press, which prints from curved stereotype or electrotype plates. Advances in this form of press construction created a necessity for the rapid casting of stereotypes, and for many recent models, the duplication of pages. This demand led to considerable improvement in the direction of rapidity of production and ease of handling in stereotype plate casting.

The most notable improvements in the stereotyping process during the last two decades have been a matrix-rolling machine, constructed for making a specially prepared matrix, which is ready for the casting box when it leaves the press; improved drying tables; automatic casting boxes; combined sawers and trimmers; combined planers and shavers; improved machines for routing and beveling; and an improved half-tone beveling machine.

The autoplate, an invention of Henry A. Wise Wood, is a mechanical device for stereotyping. It is a solidly constructed mechanism, 4 feet high, 7 feet long, and 3 feet wide. The matrix is placed, face up, in a concave receiver, which slides forward into the casting box when the machine is set in motion. The bottom of the box rises and lifts the matrix close to a fluted cylinder, while at the same time a pump begins to draw molten metal from a caldron and force it into the casting chamber, under an elastic pressure, which follows the shrinkage of the plate with fresh metal. Sprays of water are used to cool rapidly the casting box and the cylinder. When the plate is completed the casting box falls, stripping off the matrix, and the plate is brought by the cylinder to the top of the machine, where a metal arm seizes it and carries it along toward the back, trimming and finishing it automatically on the way. Then the plate moves out upon a long arm, where a workman gives it the final preparation for the press.

The great advantage of the use of the autoplate over other methods of stereotyping is that much less time is required. At highest speed, hand work will produce but one plate per minute; the autoplate will produce three or four in the same time, and the quality of its work is pronounced superior to that of hand work. Another consideration of advantage to the printer is that fewer workmen are required to attend to the working of the autoplate than are necessary for hand work.

Stereotyping is still in general use in newspaper offices, because of speed. With respect to fineness and finish, electrotyping is far in advance of stereotyping, and is now used almost exclusively for book, magazine, and job printing.

In electrotyping the principal improvements are these: An important invention to stimulate the action of electro-deposition by the use of a dynamo; a black-leading machine which utilizes a blast of air; a combined metal kettle, wax-heating table, and case-filling table; a power wax-shaving machine; a hydraulic molding press; and improved saw and routing machines, including curved routing machines for use on both electrotype and stereotype plates. Process engraving, or the half tone, has developed new possibilities for the electrotyping process. The Muller patent half-softening hammers and punchers, and the Richards improved ruling machine, are inventions used in this work.

PRESSES.

Prior to 1870 printing presses were largely of two types: the platen or job press, in which the impression was made by direct pressure; and the cylinder press, consisting of a flat bed which held the type form in a horizontal position, and oscillated beneath a large revolving drum or cylinder carrying upon a segment of its surface the sheet to be printed.

Attempts had been made to construct a press which would permit the type to be placed upon a cylinder, utilizing the rotary principle that has been brought to a high degree of perfection in the modern web press. In 1846–47 Hoe & Co. produced a machine of this class. The type was locked on the surface of the cylinder, the curvature being assisted by V-shaped column rules. The sheets were fed separately to impression cylinders, and delivered by a sheet flier. This form of press was soon found incapable of meeting the demands of the larger newspapers.

The discovery, about this time, of the possibility of casting stereotype plates on a curve, from papier-maché matrices, was the key that opened the way to the ingenious and complicated printing presses of the period.

Job Presses.—The improvements in job presses consist largely in details relating to the various classes of work for which they are intended. In the general construction of this class of presses few radical changes have been made, and standard patterns long in use need not be described here. The most radical departure within the last few years has been the employment of the rotary principle, as exemplified in the Harris automatic press. In this press the printing surface is a curved electrotype plate, though separate types can be fitted into a type box adjusted to the printing cylinder. The press prints upon separate sheets which can be fed either by hand or by an automatic arrangement; the automatic feeder carries several thousand sheets of paper, which are fed from the bottom by an ingenious device permitting the renewal of the pile without stopping the press. The speed of this press is from 5,000 to 14,000 impressions per hour, according to the class of work.

The Kidder Press Company manufactures job presses which feed automatically from a roll.

Cylinder Presses.—Until the close of the last decade the cylinder press was the main reliance of publishers for larger work, such as books, posters, and all large forms. It was in general use also for papers of small circulation and for all high-class work. Improvement in perfecting presses has to some extent caused the displacement of the cylinder press, but it is still generally used.

There are four kinds of cylinder presses in use—the drum cylinder, the double cylinder, the stop cylinder, and the two-revolution cylinder. Of these, the last named is now regarded with the greatest favor.

The past twenty years have witnessed numerous improvements in the three styles of presses last mentioned. From the old, cumbersome drum cylinder, still in operation in many country newspaper offices, with a speed of 1,200 to 1,500 per hour, to the modern, rapid two-revolution press, with all its delicate adjustments and labor-saving devices, is a very great advance.

From the old-fashioned drum-cylinder press was evolved the double cylinder, a duplication of the cylinder, by which the capacity of the press was doubled. The cylinders were fed alternately. The stop-cylinder press was so named because the cylinder stops at a certain point in its revolution, thus permitting greater accuracy in feeding. Owing to the exactness with which the sheet was printed—technically called "register"—this press was used where fine grades of work, such as half-tone or color work, were required. It attained great popularity, but has been supplanted by the two-revolution press, because the latter possesses much greater speed and nearly equal accuracy. In this press the cylinder is smaller, and revolves twice at each impression, once in contact with the type and again in a slightly elevated position while the sheet is being released and the form returned to its former position.

In 1885 Robert Miehle made a number of improvements in the two-revolution press, which increased its capacity and brought it into more general use. Since then this type of press has been subject to continuous improvement. The Century two-revolution press is one of the most perfect machines of this class. The constant aim of improvements in this field has been to increase speed and accuracy, and to give the utmost facility in adjustment and operation. Among recent improvements in the two-revolution press are the substitution, for cam gears, of a crank movement of the bed; an adaptation of the stop-cylinder principle; and perfected methods of ink distribution.

Perfecting Presses.—In the web perfecting press occurred the most noteworthy development of the past two or three decades. While modern presses of this class possess remarkable capacity, they are the result of improvement, rather than a radical departure from the earlier form of rotary presses. Various mechanical problems, resulting from high speed, were met and solved; among these were the questions of combining the printed sheets, cutting, folding, and preventing the offsetting of ink. Although attempts were made before 1870, in this country as well as in England and France, to build presses embodying this principle, the machine constructed, in 1871, by Hoe & Co., of New York, may be said to be the first successful perfecting press. This press printed 15,000 papers per hour from one set of plates. In 1876 this firm brought out the rotary folder. The development of folding mechanisms has naturally kept pace with that of the press proper, until at the present time papers consisting of any even number of pages from 4 to 32 are turned out, cut, pasted, folded, and counted, in lots of 25 or 50, at rates of speed varying from 12,000 to 150,000 per hour.

The term "web perfecting" exactly describes the process employed; a roll, or "web," of paper passes into the press and is printed, or "perfected," on both sides before being cut and folded. The early form of rotary press was the "single." Then the length of the cylinder was doubled, thus doubling the capacity of the press—that is, printing a paper of the same size at twice the speed, or a paper double the size at the same speed, as the "single rotary." Then came the double-supplement press, with a set of single cylinders at one side, permitting the printing of 10-page and 12-page papers. The next step was to double the supplementary press, forming the quadruple press—a style in common use to-day—with a capacity of from 48,000 4-page papers to 12,000 24-page papers per hour. Instead of being arranged side by side, the presses were often constructed with the supplementary press on top, making a "double decker." The quadruple press was then converted into a sextuple press by the addition of a supplementary double press placed at one side. It was a simple matter to convert this into an octuple, a type of press now in use on such papers as the *New York Journal* and the *Chicago Tribune*. The octuple is sometimes constructed by piling four double presses one above another. One style of press, designed for the *New York Journal*, consists of two sextuples working side by side. This is a three-decker machine, equivalent to six double presses. In these presses each double-cylinder machine is fed from a separate roll of paper. The folding and cutting mechanism can be adjusted to assemble the pages in any desired combination within the limits of the press.

The illustrated colored supplements of the large city journals have been made possible by the adaptation of these presses to color printing, permitting the use of one, two, or three colors besides black. This principle has been carried still further in a rotary multicolor and half-tone machine, which prints in as many as eleven colors, and has a capacity 48,000 full-sized 8-page papers per hour.

Two general classes of the web press are made. In one, what is called the "angle bar" is utilized to turn the sheets in order to assemble them from the different webs. The other is designated the "straight line," the sheet being run through the press without being diverted from a straight course, and was invented by Joseph L. Firm, of Jersey City, N. J., who associated himself with the Goss Company, of Chicago, in 1890. By means of this invention greater accuracy in register was obtained, with less danger of tearing the running sheet in rapid work.

The Scott Company has produced an "all-size" rotary web press, by which pages of different sizes can be printed, the adjustment being graduated to quarter inches.

Another type of perfecting press is shown in the flat-bed "multipress" of the Campbell Company, and the Cox duplex press, in which the type beds are stationary, the cylinders rolling back and forth upon them. These are adapted to small country dailies.

Many variations in the perfecting press are made to order to satisfy individual requirements. Some of these even place colored covers upon their products and stitch or staple them. The colored supplements of newspapers are often printed in colors on one side and black on the other, and half-tones often occur on the same page in different colors. Music is printed on heavier paper and folded in with the supplement. All this is accomplished without marring the product. A space is often reserved also for a type column of late news, to avoid stereotyping another set of plates.

The presses of the Goss Company are fitted with an ingenious arrangement to prevent offsetting. Rollers made of molasses and glue pass over the freshly printed paper, absorbing the excess of ink, which is then transferred to a polished metal cylinder, from which it is removed by a cylindrical cotton wiper.

Toward the latter part of the last decade the product of the perfecting press was greatly improved, so that it became a competitor for the finer grades of magazine work, for which it is being utilized more and more.

Lithographic Presses.—Few changes of consequence were recorded in this branch of the industry during the decade. Aluminum plates have been employed with considerable success as a substitute for stones, but the notable feature in their employment is that they permit the use of the rotary principle. Special presses, constructed with great care to meet the exacting requirements of lithographic work, are manufactured for this process, and have attained some success.

PATENT BLANKETS AND MECHANICAL OVERLAYS.

There were many attempts to substitute mechanical processes for the laborious task of "making ready" by hand. Among the inventions of this class were the Savary, Dittman, De Vinne-Bierstadt, and Humphrey and Upham methods, all of which must be regarded, so far as general use is concerned, as still more or less in the experimental stage.

The Savary device is a blanket composed of a collection of very short wires. This blanket is mounted on a cylinder, and by equalizing the pressure serves to correct irregularities in the height of type and cuts. Another invention substituted a blanket of woven wire for that of pointed wires.

The Dittman process utilizes the expansion which occurs in wheat flour when dusted onto a fully inked impression.

The De Vinne-Bierstadt process utilizes the action of light upon gelatin in combination with other substances. A print taken on a thin sheet of transparent celluloid is dusted with plumbago to thicken the lines, and exposed in a photographer's printing frame over a film of gelatin. This film is afterwards swelled in those parts not made insoluble by the action of light, and from it a plaster of paris mold is made. From the latter a flexible reverse in gutta-percha is formed, and the gutta-percha, backed, becomes the overlay, being thickest in the darkest parts of the illustration.

The Humphrey and Upham process is of use only for duplicating overlays. This duplication is made by rubber or gutta-percha impressions of a reversed overlay.

ILLUSTRATING AND ENGRAVING.

The introduction of photoengraving, about the year 1875, marked a new era in the history of illustrating and engraving.

Wood and steel engraving were unable to fulfill the increasing demand of the public for large quantities of good, inexpensive pictorial work. Proper production of this work by hand was impossible, save by an artist of no mean ability. Accordingly, if illustration was cheap, it was poor; if good, it was expensive.

Half-tone Engraving and Zinc Etching.—The half-tone process is a method of making cuts suitable for use upon ordinary printing presses. The first step is the taking of a photograph on a wet sensitive plate, in front of which, in the camera, a fine screen is placed. These screens are an essential feature of the process, as they permit the accurate reproduction of the half tones in the object. They are made by mechanically cutting or scratching lines on two glass plates; these lines are then filled with some opaque substance, and the two plates are placed together, face to face, with the lines of one plate crossing those of the other. They are made in varying degrees of fineness, the lines ranging from 40 to 400 to the inch. The coarser screens are placed farther from the sensitive plate than the finer ones. The finer screens cut off about nine-tenths of the light; therefore, the negative is often exposed for eight or ten minutes.

After the negative is developed the film is stripped from the plate, reversed, and placed on another, called a turning glass, thus becoming a positive. This is placed in contact with a copper plate coated with a sensitized solution, and exposed to the light for about two minutes. After being developed, this plate is enameled and "burned in" over a flame. It is then etched with a solution of perchloride of iron. In this process the portions of the coated copper plate which have been exposed to the light in the printing process—in other words, the lines that were formed by the screen in the original negative—are etched away, producing a printing surface composed of dots which vary in size according to the lights and shadows of the object. Further processes pertain mainly to finishing and mounting. A certain amount of expert hand work is required for the finishing of the half-tone plate and its final preparation for the press. In this field many artists who were formerly engravers have found work.

Half tones are of three classes, considered according to the treatment of their background—the silhouette, the square-etched, and the vignette. The silhouette is an effect of sharply defined edges; the square-etched is an exact reproduction as to background, of the original picture; and the vignette is a production of softened, gradually-fading background, without definite termination.

Zinc etching is practically the same process, except that the copy must be a pen-and-ink or line drawing, and no screen is used. In the etching process, in place of perchloride of iron, muriatic acid is employed. This gives a plate which is cut deeper, but is less durable than the copper half-tone plate.

Three-color Process.—The attempt to print in colors from half-tone plates by means of photographic processes was partially solved by Frederick Ives, of Philadelphia, in 1888. Since that date the process has been improved with gratifying results. The principle upon which it is based is that by a combination of the three primary colors—red, yellow, and blue—almost any shade of color can be produced. Photographic plates that are specially sensitive to color are used. As in the half-tone process, a glass screen is placed in the camera. Three photographic negatives, each of which is to produce a separate printing plate, are made of the object. In each case a colored glass screen, excluding certain color rays of light, is used in front of the lens. In the production of the plate which is to print the blue ink, a red color screen is employed; to produce the plate for yellow ink, a blue-violet screen is used; and to produce the plate which is to print red ink, a green screen is used.

In printing from these plates great exactness, technically called "register," is required, in order that the colors may be laid on in proper place as the three impressions are consecutively made.

One serious problem which confronted the inventor was the difficulty experienced in so arranging the line screens that the diagonal lines would not form geometric patterns in the finished picture. This was solved by the discovery that by varying in certain ways the directions of the lines used for the three negatives, the pattern effect could be avoided.

Lithographic Color Printing.—A widespread but unsuccessful attempt was made, about 1880, to substitute zinc for stone in lithographic work. After this failure, zinc was generally abandoned as a factor in the lithographic problem, but one firm has continued to make experiments along this line with considerable success.

In 1898 the great superiority of aluminum over lithographic stone was demonstrated. Aluminum is far lighter, requires less space for storage, is cheaper, is almost noncorrosive, can be used in sheets upon rotary presses, can be used for longer runs without reproduction of the design, and after some manipulation possesses all the desirable qualities of stone.

The methods of manipulation are two. By the first, the surface of a sheet of fine-rolled aluminum is ground off, producing a porous surface. The second method is the formation of an aluminum surface by electrodeposition.

To prevent the ink from spreading over the limits of the design, phosphoric acid is used; this is removed from the plate by the application of nitric acid.

About four-fifths of present-day lithographic work is done on stone, but the number of printing machines constructed to use aluminum is rapidly increasing.

BOOKBINDING.

Recent advances in the bookbinding department of the printing and publishing business have been numerous, but not revolutionary.

Automatic feeding devices for folding machines, as well as for printing presses, are a product of the last decade. Of these there are many variations, but as the problem which they solve is comparatively simple they need not be described in detail. Three-fourths of the folding machines of the present day are supplied with automatic feeders. Folding machines have been greatly improved also by parallel-fold arrangements and by automatic pointing.

Many improvements have been made in wire-stitching machines. One of these machines will stitch anything from two sheets to a book 2 inches thick, and with several of them either round or flat wire may be used. There has been introduced recently a noteworthy combination folding and wire-stitching machine, which by a continuous and automatic operation takes the sheets from the feeders, and folds, gathers, collates, covers, and wire-stitches copies of magazines and pamphlets, delivering them ready for distribution.

Paper-cutting machines have been improved by the introduction of automatic clamps, indicators, and gauges.

The invention of a steam rounding and backing machine, increasing a capacity of from 500 to 1,000 books per day to a capacity of from 5,000 to 6,000 in the same time, should be noted. The latest case-making machine feeds itself from a roll of cloth which it automatically cuts into pieces of proper size for use. The cloth is first covered with glue by contact with a cylinder revolving in a pot of glue. It is then cut by the machine and nicked in corner sections; boards are supplied from a holder and a back lining from a roll, both receptacles forming parts of the machine. This process completed, the nearly finished product drops a little, the cloth is folded over the boards and back lining, and the binding, after passing through a case smoother, is delivered in a finished state. This automatic process is very satisfactory. Another interesting invention in this line is a machine for covering paper books and magazines, which has been known to cover 22,000 books in a day.

Among late inventions are a casting-in machine, for putting the body of a book into its cover, and a gathering machine.

During the next ten years the principal advance in bookbinding doubtless will be in those branches of the industry which are concerned with casting-in, gathering, smashing, folding, and sewing.

NEWS-GATHERING ORGANIZATIONS.

The only changes in news gathering since 1880 have been those of detail.

In 1880 the leading news-gathering association was the body then known as the Associated Press, which was furnishing news to 30 per cent of the dailies of the United States. This organization, composed of New York papers, gathered news for its own members on the cooperative plan, but exchanged news with other associations on terms that made the exchange practically a sale, a large cash bonus being asked from associations receiving their news.

These methods caused much dissatisfaction among the tributary associations. The claim was made that the parent organization, having absolute control of the news gathered, was selling it at a price covering the entire cost of collection, giving the news to its members practically for nothing.

The principal complaints came from the Western Associated Press, which in 1882 was paying a bonus amounting to $3,000 per month. The outcome of this controversy was an amalgamation of the Associated Press and the Western Associated Press into one organization, under the former title.

The next great conflict was that between the new Associated Press and the organization afterwards known as the United Press, which was founded in 1882. In 1884 the Associated Press and the United Press made a secret agreement for an exchange of services, by which a practical union of the two organizations was effected. It was claimed that the exchange was most unequal, the United Press getting the benefit of the wide field covered by the stronger organization, and giving poor and inadequate service in return. In 1891 the arrangement was discontinued; but in 1892 the eastern branch of the Associated Press—the original New York organization—transferred its affairs to the United Press, while the western branch—the former Western Associated Press—continued in business, with headquarters in Chicago, as the Associated Press. The new Associated Press, like the United Press and other proprietary bodies, followed the plan of selling its news to papers whose proprietors were not stockholders or members of the organization.

At the time of its organization the western association had contract relations with the eastern one. In 1893 the contract expired; the western association refused to renew it, and there followed a bitter war between the two associations, which was very disturbing and expensive to the newspapers of the country, some being compelled to receive news from both associations to insure a complete service. Strong efforts were made to bring about an agreement between the two organizations, but all failed because of fundamental differences in their plan of organization. In 1897 the United Press made an assignment, with large liabilities and no assets.

The victory of the Associated Press was not, however, the end of newspaper difficulties. This organization could not, under its regulations, admit to membership all the newspapers which were left without service by the failure of the United Press. Moreover, the associations which were organized to supply the needs of the papers not provided with a news service were declared to be antagonistic, and members of the Associated Press were forbidden to make contracts with them.

The *Chicago Inter-Ocean*, having received news from a bureau thus proscribed, and being threatened with suspension of the Associated Press service, applied for an injunction to restrain such action.

The circuit court and appellate court successively dismissed the bill, but the supreme court of the state (184 Illinois Reports, 438–455) reversed the previous decision on the ground that the corporation had a virtual monopoly of a commodity of vast importance to the public, had used its franchise in such a manner as to injure the public interests, and could not be allowed to deprive the public of the services of a newspaper.

This decision did not, however, break up the monopoly held by the Associated Press, but merely caused removal of that organization to New York state, where it was reincorporated on May 22, 1900, with practically all of its former 600 members and subscribers.

Under its new charter the Associated Press is simply a mutual and cooperative organization of newspaper proprietors. A distinction existing in the old organization between voting stockholders and ordinary members was abrogated in the new charter, and all newspaper owners who receive the news service of the Associated Press are now members of the organization on equal terms.

The certificate of membership designates in detail the name of the newspaper entitled to receive the news of the Associated Press, the language in which it is printed, its place of publication, whether it is a morning or an evening newspaper, and whether the member is to receive a day or a night report. A certificate of membership in the Associated Press is not transferable except in special cases.

Each and every member of the Associated Press is entitled to receive a service of news for the purpose of publication in the newspaper specified in his certificate of membership, and for that purpose only. Special regulations forbid, in detail, publishing news in any other newspaper than that specified, furnishing it in advance of publication to any person not a member, or anticipating the publication of documents of public concern confided to the corporation for use on a stipulated date, however the document may have been secured.

The Associated Press, as now organized, has four divisions—Eastern, Central, Southern, and Western—with headquarters at New York, Chicago, Washington, and San Francisco, respectively.

Domestic news is collected from all parts of these four divisions at the division offices, and exchanged between the several divisions, items being enlarged or condensed according to the territory in which they are to be circulated.

For gathering foreign news the Associated Press has contract relations with various news agencies, with which it exchanges news. Of these the most important are the Reuter agency, covering Great Britain and her colonies; the Agence Havas, covering France, Belgium, Switzerland, Portugal, and some parts of South America; and the Wolf agency, of Berlin, covering Germany, Hungary, Austria, and to some extent northern Europe and Russia. In the New York office of the Associated Press the Reuter agency has a representative who looks over the dispatches and sends abroad whatever American news may be of interest to Europeans. For Canadian news the Associated Press has exchange arrangements with the Canadian Pacific Railway, by which that company gathers all the news on its line and delivers it at Bangor, Buffalo, Detroit, and Seattle, receiving at those points the news of the United States, for use in Canada. Other agencies supplying news to the Associated Press are the Steffanie, covering Italy; the Nordischer Telegram Bureau, covering Russia; the Norsky Telegram Bureau, covering Norway; the Svenska Telegram Bureau, covering Sweden; and the Agence de Constantinople, covering Turkey.

While, as has been noted, each newspaper connected with the Associated Press contributes its quota of news to the general fund, the organization has regular correspondents of its own at places where it has no member. It also sends out its own reporters, when the occasion is of sufficient importance, to cover specific events, and employs special men to cover special classes of news—as, for instance, the Wall street market reports, and the arrival and departure of steamers at principal ports. It also has emergency men whose names are kept on file, and who can be called on at any time to gather news for the organization. At important points are stationed representatives whose duty it is to put the news into shape and file it for circulation throughout the country.

Besides the full reports delivered to large papers, the Associated Press distributes what are called "pony" reports—condensations of the full reports, sold at a cheaper rate. It also sells news to an organization known as the American Press Association, for distribution to papers not members of the Associated Press, with the proviso that the news thus sold is not to be printed for twelve hours after it has been sent over the wires to newspapers receiving the regular service of the Associated Press.

The Associated Press now has about 700 members, more than half of which are afternoon dailies, and serves, under the arrangement with the American Press Association described above, about 2,500 daily and weekly papers in addition. Most of the papers served are in the United States, but there are 50 or more in Canada, Mexico, Cuba, and Porto Rico. In its regular news service the Associated Press now uses 9,345 miles of leased wire by day and 20,467 miles by night.

The annual revenues derived from assessments levied on the newspapers served exceed $1,900,000, and the number of words daily received and transmitted at each of the more important offices is now over 50,000, or the equivalent of 35 columns of an average newspaper.

Among other news-gathering associations now in the field are the Publishers' Press, and the Scripps-McRae Press Association, which work together, the former operating principally in the eastern part of the country, the latter in the western.

The Publishers' Press was started April 8, 1897, the day after the failure of the United Press, to fill the gap left by that association. Unlike the Associated Press, it is not a cooperative organization, but a stock company whose business it is to buy news and sell it again; nor is it, like the Associated Press, under limitations as to the number of papers it may serve in one place. Again, unlike the Associated Press, the Publishers' Press does not receive news from the papers it serves, but has its own correspondents at the various centers where news can be collected. The foreign news of the Publishers' Press is gathered through a main office in London and branch offices in Paris, Berlin, Rome, and other European news centers.

The Publishers' Press controls several thousand miles of wire in the United States—one, which carries news to a Seattle paper, being 3,260 miles long.

Another news-gathering organization, which may be regarded as simply the news-gathering department of the *New York Sun*, is the Laffan News Bureau. This organization has regular correspondents at all news centers, foreign as well as domestic, maintaining, besides, "sleeping correspondents" who are paid in accordance with the news they send in; serves 30 or 40 newspapers in different parts of the country; and maintains, like the other bureaus, a system of leased wires.

Besides the regular press bureaus, some leading newspapers engage in the business of selling news. Among these are the *New York Herald*, the *Chicago Record*, and the Hearst papers. Such arrangements as these can hardly be said, however, to compete with the news service of the Associated Press, which is far in the lead of the news-gathering organizations of the United States.

Newspaper Syndicates.—An extension of the scope of the newspaper, during the last twenty years, to include subjects of more lasting interest, led to the creation and extension of the so-called "syndicate," which furnishes papers with miscellaneous reading matter, as the news-gathering association furnishes them with news. The syndicate was introduced about 1884, for the purchase and sale of stories, but has since extended its field to all sorts of reading matter. While the news-gathering associations are largely cooperativé, the syndicate is purely a proprietary affair, buying articles from authors and selling them outright to the different newspapers on their list of customers.

Some syndicate matter is sent out in matrix form, but most of it is supplied in the shape of galley proof, to be set up in the office of the newspaper purchasing it, in the general style of the paper.

Most of the syndicate material is prepared especially for the Sunday supplement or magazine part of a newspaper, but the syndicates will furnish almost any class of articles found in daily papers. In making sales, the syndicate has a fixed price for articles, and although it disposes of the same stories or other matter to a number of papers, only one in each city or field of publication may receive a given story or article.

The syndicate is enabled, by its sales of the same article to many customers, to purchase matter quite out of the reach of the individual newspaper, and to sell it on terms that each can afford. The scheme is found to be so advantageous that to-day practically all the newspapers of the country, except some in a few of the largest cities, use syndicate matter to a considerable extent.

Besides the firms engaged primarily in the syndicate business, certain leading metropolitan newspapers dispose of their own matter to papers published elsewhere.

In the last decade no important changes have taken place in the syndicate field. The material now supplied may be rather better in quality than that supplied at first, but the business arrangements and the extent of syndicate operations have remained about the same for several years.

THE COOPERATIVE PLAN OF PRINTING PAPERS.

There has been little development, for several decades, of the "patent insides" system described in the special report of the Tenth Census on the Newspaper and Periodical Press. The general advance in printing has led to some progress in methods, and the number of papers served has increased with the growth of the newspaper industry in general, but growth in this line has been relatively slow.

The following table shows, by states and territories arranged geographically, the number of newspapers printed on the cooperative plan:

TABLE 57.—*Newspapers printed on the cooperative plan, by states and territories: 1900.*

STATE OR TERRITORY.	Number of newspapers.
United States	7,749
North Atlantic division	728
New England	177
Maine	13
New Hampshire	30
Vermont	10
Massachusetts	90
Rhode Island	16
Connecticut	18
Southern North Atlantic	551
New York	196
New Jersey	79
Pennsylvania	376
South Atlantic division	511
Northern South Atlantic	185
Delaware	4
Maryland	49
District of Columbia	6
Virginia	62
West Virginia	64
Southern South Atlantic	326
North Carolina	81
South Carolina	51
Georgia	135
Florida	59
North Central division	4,725
Eastern North Central	2,110
Ohio	337
Indiana	358
Illinois	703
Michigan	365
Wisconsin	347
Western North Central	2,615
Minnesota	409
Iowa	619
Missouri	376
North Dakota	122
South Dakota	224
Nebraska	462
Kansas	403
South Central division	1,179
Eastern South Central	476
Kentucky	59
Tennessee	114
Alabama	134
Mississippi	169
Western South Central	703
Louisiana	94
Arkansas	143
Indian Territory	62
Oklahoma	153
Texas	251
Western division	606
Rocky Mountain	285
Montana	32
Idaho	40
Wyoming	20
Colorado	177
New Mexico	16
Basin and Plateau	43
Arizona	4
Utah	35
Nevada	4
Pacific	278
Washington	95
Oregon	65
California	118

It will be seen from this statement that over 60 per cent of the papers printed on the cooperative plan are found in the North Central division. The number in Illinois alone (the highest number for any single state) nearly equals the number shown for the entire North Atlantic division, and Iowa (next in rank) surpasses both the Western and South Atlantic divisions.

Many of the newspapers of this class are the only ones in their respective towns—this being the case with 60 per cent of those sent out by one concern. At the present time most of the newspapers printed in this way are weeklies, and these form about half of the total number of weeklies in the United States. Many semiweeklies and triweeklies, also, are issued in this way, and some dailies adopt the method. These dailies are printed at a distributing center, sent out by express in the morning, and finished at the local office in the afternoon.

Some concerns endeavor to avoid the sameness of appearance in "patent insides" by issuing the material in the form of stereotyped plates ready for printing, instead of in printed sheets. They first send out proof sheets, showing what articles they have on hand, and from these the local editor selects what he chooses. On receiving the plates he cuts them up as he likes, for arrangement in his page, even cutting off the headings and supplying headlines of his own, to secure greater individuality.

The American Press Association, of New York, organized about 1880, controls much of the business in plate matter, and has already been referred to as the association supplied by the Associated Press with telegraphic news for use twelve hours after the regular service. The news received by this association in the morning is set up in plate form, and distributed to some 2,500 dailies for use the same afternoon. This organization serves a large number of newspapers, including many dailies, with electrotype or stereotype plates of miscellaneous matter, and also sells type uniform with that used in making the plates, so that the papers supplied may be made to appear the same throughout.

There appears to be a growing tendency toward the use of plate matter in preference to the half-printed sheets. Country journals are beginning to demand telegraphic news, and this the plate-matter concerns can supply fresher than the "patent insides."

Newspaper Combinations.—By the close of the last decade there was noted a slight tendency toward consolidation, under one ownership or management, of newspapers published in different places. This plan has thus far been adopted only among certain large metropolitan dailies. Examples of common ownership of this general character are shown in the *Galveston News* and the *Dallas News*, essentially the same paper in both cities; the *New York Herald*, the *Evening Telegram* (New York), and the European edition of the *Herald*; the *New York Times* and the *Philadelphia Times;* the *Washington Times* and the *New York Daily News;* and the group of papers owned and published by William R. Hearst—the *San Francisco Examiner*, the *Journal and American* (formerly the *New York Journal*), the *Evening Journal* (New York), and the *Chicago American*. In small places the newspapers are in such close contact with the people they serve that it is a distinct advantage for the proprietor to be personally known to his subscribers, and to be identified exclusively with his locality. In small places not only the reading public but the advertisers seem to prefer newspapers owned and published in the place of circulation. Furthermore, it is only in large cities that the opportunities for economy through combination are great enough to warrant the attempt, practically the same results being secured more easily in country districts by making use of the syndicate and the "patent insides."

TABLE 58.—NEWSPAPERS AND PERIODICALS,

		United States.	Alabama.	Arizona.	Arkansas.	California.	Colorado.
1	Number of establishments	15,305	156	32	217	512	212
	Character of organization:						
2	Individual	9,686	109	22	154	328	118
3	Firm and limited partnership	3,016	29	3	44	91	34
4	Incorporated company	2,420	16	7	19	86	60
5	Miscellaneous	183	2	...	...	7	...
6	Established during the decade	5,881	73	18	11	207	100
7	Established during the census year	526	8	3	8	22	11
	Capital:						
8	Total	$192,443,708	$621,852	$186,573	$648,883	$4,440,602	$1,751,437
9	Land	$13,361,249	$13,945	$7,050	$13,510	$161,215	$51,155
10	Buildings	$19,497,604	$37,580	$12,475	$29,343	$239,835	$93,070
11	Machinery, tools, and implements	$77,362,342	$362,741	$118,602	$395,693	$2,464,724	$1,009,797
12	Cash and sundries	$82,222,513	$207,586	$48,446	$210,337	$1,574,828	$597,415
13	Proprietors and firm members	15,976	178	28	248	538	186
	Salaried officials, clerks, etc.:						
14	Total number	27,579	80	15	59	857	286
15	Total salaries	$27,015,791	$79,809	$17,727	$44,905	$840,650	$262,974
	Officers of corporations—						
16	Number	2,626	22	4	9	58	37
17	Salaries	$4,990,706	$41,220	$6,350	$10,600	$94,664	$56,130
	General superintendents, managers, clerks, and salesmen—						
18	Total number	24,963	58	11	50	799	249
19	Total salaries	$22,025,086	$38,589	$11,377	$34,305	$745,986	$206,844
	Men—						
20	Number	19,814	54	9	46	702	225
21	Salaries	$19,892,882	$37,140	$9,477	$33,146	$701,520	$195,378
	Women—						
22	Number	5,139	4	2	4	97	24
23	Salaries	$2,132,204	$1,449	$1,900	$1,160	$44,466	$11,466
	Wage-earners, including pieceworkers, and total wages:						
24	Greatest number employed at any one time during the year	107,123	641	160	748	3,173	1,508
25	Least number employed at any one time during the year	89,074	518	128	560	2,518	1,196
26	Average number	94,604	543	139	600	2,683	1,303
27	Wages	$50,333,051	$241,525	$73,640	$215,410	$1,804,619	$770,382
	Men, 16 years and over—						
28	Average number	73,653	459	109	384	2,158	1,168
29	Wages	$44,961,533	$229,549	$65,807	$179,932	$1,650,777	$730,362
	Women, 16 years and over—						
30	Average number	14,815	21	17	69	344	95
31	Wages	$4,628,221	$5,368	$6,685	$17,855	$128,979	$33,884
	Children, under 16 years—						
32	Average number	6,136	63	13	147	181	40
33	Wages	$743,297	$6,608	$1,148	$17,623	$24,863	$6,136
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
34	January	74,702	459	114	400	2,191	1,164
35	February	74,148	458	114	399	2,171	1,159
36	March	74,559	474	111	394	2,181	1,153
37	April	74,287	472	109	387	2,170	1,158
38	May	74,103	467	109	378	2,199	1,166
39	June	72,566	446	108	360	2,124	1,162
40	July	71,167	436	104	353	2,102	1,127
41	August	71,106	427	102	347	2,091	1,134
42	September	72,445	442	100	370	2,128	1,166
43	October	74,110	464	110	404	2,160	1,195
44	November	74,905	481	116	408	2,174	1,216
45	December	75,738	478	116	405	2,210	1,223
	Women, 16 years and over—						
46	January	15,218	20	18	72	353	89
47	February	15,250	19	17	72	351	88
48	March	15,375	20	17	69	344	93
49	April	15,196	21	16	71	348	94
50	May	14,944	21	17	72	344	105
51	June	14,471	20	17	68	336	93
52	July	13,827	20	17	63	331	94
53	August	14,019	21	16	67	327	94
54	September	14,296	22	16	70	338	97
55	October	14,865	28	18	69	349	97
56	November	15,068	22	18	67	352	99
57	December	15,251	23	18	67	354	98
	Children, under 16 years—						
58	January	6,264	69	13	157	187	43
59	February	6,256	67	13	156	185	42
60	March	6,272	68	13	156	188	41
61	April	6,281	66	13	156	189	39
62	May	6,245	63	13	161	185	42
63	June	6,042	59	13	142	178	38
64	July	6,934	59	13	132	170	38
65	August	5,888	61	13	133	168	36
66	September	5,978	63	13	135	174	40
67	October	6,112	59	13	142	179	36
68	November	6,141	56	9	146	178	39
69	December	6,219	61	13	149	187	41
	Compositors (included in wage-earners)—						
70	Men, 16 years and over	39,599	276	57	256	1,176	595
71	Women, 16 years and over	7,608	20	11	34	241	53
72	Children, under 16 years	2,104	10	...	118	16	4
	Compositors operating type-casting or typesetting machines—						
73	Men	4,946	37	9	5	199	88
74	Women	857	1	...	3	70	2
75	Type-casting and typesetting machines used, number	3,988	32	6	1	150	68
	Miscellaneous expenses:						
76	Total	$38,544,642	$84,881	$17,968	$79,261	$637,302	$323,599
77	Rent of works	$4,134,995	$16,498	$5,873	$19,725	$147,847	$53,555
78	Taxes	$961,248	$4,313	$1,814	$3,974	$26,246	$10,475
79	Newspaper and periodical postage	$4,260,681	$9,847	$1,199	$5,991	$80,624	$45,149
80	Rent of offices, interest, insurance, and all sundry expenses not hitherto included.	$18,121,131	$41,390	$9,082	$43,211	$255,452	$151,565
81	Contract work	$11,066,687	$12,833	...	$6,360	$127,133	$62,855

Connecticut.	Delaware.	District of Columbia.	Florida.	Georgia.	Idaho.	Illinois.	Indiana.	Indian Territory.	Iowa.	Kansas.	
116	26	60	86	233	66	1,259	638	58	910	595	1
57	12	21	68	135	47	764	432	36	593	436	2
15	2	14	17	48	14	232	123	15	243	130	3
44	12	21	11	48	5	249	71	7	72	23	4
....	....	4	....	2	....	14	12	....	2	6	5
29	6	31	40	95	39	510	220	48	350	211	6
2	2	8	4	14	4	48	11	9	35	17	7
$2,289,658	$275,298	$2,233,897	$400,221	$1,852,813	$280,804	$12,259,569	$4,792,139	$115,003	$4,708,049	$1,920,536	8
$199,600	$20,650	$290,300	$11,110	$113,635	$22,865	$893,231	$207,450	$3,920	$239,560	$63,700	9
$309,243	$30,550	$576,812	$28,250	$166,112	$25,376	$1,524,023	$558,068	$7,356	$405,976	$222,375	10
$1,098,895	$153,705	$843,029	$252,538	$1,249,133	$154,123	$4,847,496	$2,670,216	$78,326	$2,451,255	$1,131,989	11
$681,920	$70,393	$523,756	$108,323	$324,933	$78,441	$4,994,820	$1,356,405	$25,403	$1,606,268	$502,572	12
85	15	51	99	234	73	1,239	680	69	1,083	701	13
238	45	301	55	196	17	2,894	665	5	623	169	14
$235,655	$29,656	$289,566	$49,096	$177,325	$11,600	$2,420,322	$616,036	$1,900	$398,966	$107,369	15
63	6	32	4	32	6	285	110	4	69	24	16
$83,892	$7,100	$94,040	$7,100	$49,123	$3,300	$488,489	$176,298	$1,300	$88,872	$23,329	17
175	40	269	61	164	11	2,609	655	1	454	145	18
$151,763	$22,556	$195,526	$41,996	$128,202	$8,300	$1,931,833	$438,738	$600	$310,093	$84,040	19
147	37	198	43	145	11	1,841	431	1	370	120	20
$136,261	$20,996	$172,285	$39,691	$120,930	$8,300	$1,639,983	$384,987	$600	$275,967	$76,310	21
28	3	71	8	19	....	768	124	....	84	25	22
$15,502	$1,560	$23,241	$2,305	$7,272	....	$291,850	$58,761	....	$34,136	$7,730	23
1,268	248	678	384	1,149	246	8,449	4,708	190	4,046	2,194	24
1,123	204	550	294	996	173	6,999	3,888	121	3,264	1,700	25
1,151	220	600	305	1,050	187	7,478	4,084	138	3,393	1,766	26
$703,587	$86,208	$393,220	$134,366	$450,878	$92,819	$3,704,341	$1,784,059	$48,389	$1,311,179	$623,783	27
956	174	477	256	774	150	6,071	2,793	116	2,324	1,144	28
$640,227	$78,560	$363,083	$126,043	$406,365	$85,696	$3,317,616	$1,490,847	$44,419	$1,107,349	$502,408	29
162	25	106	16	110	19	972	988	14	596	364	30
$60,393	$5,816	$27,229	$5,084	$27,190	$5,674	$333,076	$256,180	$3,221	$148,477	$89,439	31
31	21	18	33	166	18	435	303	8	473	258	32
$2,967	$1,832	$2,908	$3,239	$17,323	$1,549	$53,660	$37,032	$749	$65,353	$31,936	33
967	178	493	278	774	147	6,101	2,900	118	2,378	1,152	34
963	173	492	272	780	144	6,072	2,888	119	2,354	1,126	35
962	177	486	264	787	146	6,119	2,910	110	2,354	1,157	36
961	180	492	258	803	151	6,108	2,888	113	2,322	1,170	37
953	179	469	254	800	151	6,036	2,878	116	2,303	1,159	38
949	184	461	237	753	146	6,966	2,671	106	2,263	1,117	39
949	171	458	233	746	140	5,842	2,626	107	2,215	1,110	40
950	165	461	235	762	143	6,843	2,631	112	2,225	1,106	41
965	166	479	236	763	148	6,990	2,694	117	2,281	1,133	42
959	171	471	267	771	165	6,170	2,725	124	2,364	1,162	43
955	174	482	266	775	169	6,289	2,740	124	2,407	1,166	44
968	176	485	271	782	167	6,313	2,969	132	2,419	1,176	45
163	23	116	16	109	20	963	995	14	611	370	46
167	23	114	14	109	20	966	992	14	616	356	47
162	22	113	16	118	18	988	1,000	14	618	357	48
168	24	120	17	116	18	962	985	14	606	373	49
167	25	95	16	117	18	977	984	14	607	361	50
157	29	94	18	105	19	953	965	14	580	357	51
152	25	87	15	106	19	926	956	12	668	345	52
158	26	91	15	109	19	921	953	12	567	344	53
159	25	103	15	107	19	966	983	14	673	362	54
165	25	105	17	108	23	996	997	13	590	375	55
162	25	113	17	107	20	1,038	1,014	14	607	379	56
160	26	114	15	107	20	1,014	1,030	14	611	393	57
32	22	18	37	172	18	440	308	9	484	277	58
32	22	18	33	172	18	439	310	9	488	261	59
32	23	18	34	176	18	446	307	8	483	261	60
31	22	18	33	178	18	442	306	9	485	270	61
31	23	18	33	176	18	438	306	9	482	270	62
31	22	18	33	170	18	433	298	8	456	253	63
31	21	18	31	168	18	422	294	8	456	260	64
31	20	18	30	166	18	424	291	8	465	248	65
31	19	18	30	157	18	424	296	7	464	251	66
31	21	18	32	161	18	432	301	8	473	259	67
29	18	13	36	161	13	436	308	9	472	243	68
31	20	18	37	162	18	442	314	8	476	239	69
471	113	229	161	405	119	3,002	1,393	92	1,605	790	70
93	20	13	11	29	16	554	400	14	446	299	71
6	....	....	3	26	3	151	140	1	11	214	72
112	13	60	22	69	6	108	146	....	121	37	73
31	2	2	....	....	....	245	14	....	16	2	74
110	11	....	10	39	2	267	115	....	94	24	75
$294,604	$17,201	$411,696	$31,775	$248,417	$19,254	$3,568,045	$677,187	$10,467	$444,690	$195,520	76
$33,094	$3,870	$23,626	$11,018	$23,483	$6,067	$397,302	$97,512	$5,028	$101,133	$50,562	77
$12,215	$768	$3,751	$2,053	$13,354	$2,198	$68,972	$27,720	$774	$22,154	$12,714	78
$16,057	$1,704	$32,999	$6,341	$38,485	$1,662	$545,022	$63,973	$595	$87,116	$30,420	79
$194,473	$10,869	$284,553	$11,197	$129,184	$9,037	$1,634,394	$229,995	$3,950	$199,315	$83,089	80
$38,764	....	$66,767	$1,166	$38,901	$1,300	$1,122,355	$157,987	$20	$34,972	$18,745	81

TABLE 58.—NEWSPAPERS AND PERIODICALS,

		United States.	Alabama.	Arizona.	Arkansas.	California.	Colorado.
	Materials used:						
82	Aggregate cost	$50,214,904	$158,677	$46,393	$171,979	$1,420,243	$507,899
	Paper—						
83	Total pounds	1,233,142,248	2,950,889	548,651	2,456,256	35,113,672	12,083,992
84	Total cost	$37,823,856	$116,716	$29,567	$124,501	$1,140,424	$405,822
85	News, pounds	956,335,921	2,508,884	351,861	1,476,893	31,725,454	10,855,076
86	Cost	$22,197,060	$74,187	$12,921	$52,388	$895,324	$296,551
87	Periodical, pounds	121,901,749	39,824	600	112,486	840,893	238,226
88	Cost	$5,504,578	$2,010	$30	$7,808	$45,560	$12,606
89	Book and periodical, pounds	80,394,514	26,731	46,000	194,001	459,316	74,455
90	Cost	$3,851,912	$1,715	$4,530	$9,437	$33,059	$4,881
91	Job printing, pounds	74,610,064	375,450	150,200	671,876	2,088,009	916,235
92	Cost	$6,270,306	$38,803	$12,086	$54,868	$166,481	$91,785
93	Ink, pounds	13,436,459	43,688	9,099	29,426	384,797	111,079
94	Cost	$1,374,237	$5,478	$2,597	$6,102	$37,232	$13,252
95	Fuel	$1,276,337	$4,321	$1,444	$5,800	$32,332	$14,934
96	Rent of power and heat	$895,206	$5,314	$995	$2,727	$44,688	$10,630
97	Office supplies	$2,001,699	$7,016	$2,017	$7,085	$53,324	$12,814
98	All other materials	$6,008,035	$7,595	$3,036	$14,768	$79,961	$31,892
99	Freight	$835,534	$12,238	$5,737	$10,996	$32,282	$18,555
	Products:						
100	Total value	$222,983,569	$841,036	$236,976	$839,787	$6,858,192	$2,525,438
101	Newspaper products	$175,789,610	$704,767	$170,083	$532,869	$5,801,721	$2,105,892
102	Advertising	$95,861,127	$410,090	$110,143	$268,424	$3,437,976	$1,289,888
103	Subscriptions and sales	$79,928,483	$294,677	$59,940	$264,445	$2,363,745	$816,004
104	Book and job printing products	$44,859,226	$131,534	$64,040	$301,889	$970,770	$390,884
105	Book and pamphlet publications	$18,407,528	$8,679	$6,760	$9,187	$109,108	$34,006
106	Sheet music and books of music	$544,802	$150		$3,050	$4,000	
107	Job printing	$22,793,322	$116,806	$51,264	$220,850	$774,329	$325,780
108	Bookbinding	$2,067,450	$3,175	$4,850	$12,765	$71,768	$23,566
109	Blank books	$554,557	$1,275	$1,176	$55,735	$4,275	$3,115
110	Electrotyping, engraving, etc	$491,667	$1,450		$302	$7,300	$4,427
111	All other products	$2,334,733	$4,735	$2,852	$5,029	$85,701	$28,662
	Aggregate circulation per issue:						
112	Daily	15,102,156	48,646	11,456	38,140	475,696	157,016
113	Including Sunday	8,645,536	30,450	7,856	34,340	367,280	126,477
114	Except Sunday	6,456,620	18,196	3,600	3,800	108,316	31,539
115	Triweekly	228,610	700		1,000	480	600
116	Semiweekly	2,832,868	4,340		11,285	23,342	2,000
117	Weekly	39,852,062	155,244	22,392	187,578	618,146	285,425
118	Monthly	39,619,897	6,800	206	18,900	194,792	72,947
119	Quarterly	11,217,422			6,000	112,500	1,250
120	All other classes	5,546,329	14,350		1,000	23,800	2,075
	Number of publications:						
121	Total	18,226	176	43	236	622	248
	By period of issue—						
122	Daily	2,226	19	10	20	117	42
123	Including Sunday	567	11	4	10	34	17
124	Morning	359	7	3	4	30	11
125	Evening	208	4	1	6	4	6
126	Except Sunday	1,659	8	6	10	83	26
127	Morning	236	1	1		17	2
128	Evening	1,423	7	5	10	66	23
129	Triweekly	62	1		1	1	1
130	Semiweekly	637	2		4	22	3
131	Weekly	12,979	143	32	199	397	179
132	Monthly	1,817	4	1	8	71	19
133	Quarterly	237			1	6	1
134	All other classes	268	6		3	8	3
	By character—						
135	News, politics, and family reading	14,867	160	41	214	467	199
136	Religion	952	7		6	40	4
137	Agriculture, horticulture, dairying, and stock raising	307	2	1	1	17	9
138	Commerce, finance, insurance, and railroads	190	4			12	3
139	Trade journals	520				21	7
140	General literature, including magazines	239			1	10	
141	Sunday newspapers	72			3	2	1
142	Medicine and surgery	111	1		1	4	1
143	Law	62				4	2
144	Science and mechanics	66				3	2
145	Fraternal organizations	200			6	13	6
146	Education and history	120			2	6	2
147	Society, art, music, and fashion	88			1	2	1
148	College and school periodicals	139		1		2	1
149	Miscellaneous	293	1		1	19	10
	By language—						
150	Bohemian	28					
151	Bohemian and English	1					
152	Chinese	5				5	
153	Dutch	12					
154	English	17,194	174	42	236	572	238
155	Finnish	7					
156	French	27				3	
157	French and English	4					
158	Gaelic and English	3					
159	German	613	1			18	3
160	German and English	20					
161	German and Hebrew	3					
162	Hebrew	13					
163	Hungarian	2					
164	Indian and English	3					
165	Italian	35				9	2
166	Lithuanian	9					
167	Polish	33				1	
168	Portuguese	2				2	
169	Scandinavian	115					
170	Slavonic, not specified	4					
171	Spanish	39		1		4	3
172	Spanish and English	1					
173	Welsh and English	1					
174	All other	52				8	2
	Comparison of products:						
175	Number of establishments reporting for both years	11,002	111	20	144	373	144
176	Value for census year	$195,575,301	$669,965	$179,855	$693,563	$5,390,288	$2,182,244
177	Value for preceding business year	$177,563,659	$596,962	$147,410	$610,411	$4,988,975	$1,945,560

BY STATES AND TERRITORIES: 1900—Continued.

Connecticut.	Delaware.	District of Columbia.	Florida.	Georgia.	Idaho.	Illinois.	Indiana.	Indian Territory.	Iowa.	Kansas.	
$432,772	$56,047	$288,491	$120,627	$370,920	$67,022	$4,138,134	$1,442,214	$31,872	$1,082,549	$533,452	82
10,693,278	1,299,582	8,787,333	1,706,343	7,689,963	617,790	114,853,569	25,546,899	396,180	20,716,211	8,512,671	83
$311,939	$44,143	$227,287	$76,318	$254,880	$44,888	$3,263,149	$908,617	$23,503	$823,192	$391,252	84
9,400,729	1,143,268	7,623,221	1,307,823	6,824,398	325,769	92,016,473	18,304,963	233,539	17,097,376	6,008,311	85
$213,034	$31,918	$163,988	$41,392	$178,889	$15,299	$2,076,730	$471,067	$9,219	$516,538	$203,502	86
34,412	9,955	457,240	13,920	102,680	14,221	12,330,387	1,975,468	6,050	341,156	603,459	87
$2,403	$611	$22,521	$878	$4,767	$936	$530,728	$68,284	$346	$14,905	$21,930	88
605,710	20,084	553,548	114,400	42,970	19,500	4,145,642	2,386,327	30,251	326,378	272,410	89
$39,621	$1,034	$17,312	$6,991	$3,341	$1,413	$204,936	$92,167	$1,486	$18,532	$12,674	90
652,427	126,275	253,324	270,200	719,915	258,300	6,361,067	2,880,141	126,340	2,951,302	1,628,491	91
$56,881	$10,680	$23,466	$27,057	$67,893	$27,240	$451,755	$276,999	$12,462	$273,217	$153,246	92
125,319	12,710	92,055	19,344	113,460	7,430	1,017,503	263,565	6,660	207,731	91,801	93
$11,082	$979	$7,421	$3,330	$10,282	$1,480	$111,011	$52,803	$1,239	$29,496	$16,938	94
$20,711	$2,311	$6,147	$2,150	$11,724	$3,445	$91,353	$36,846	$1,266	$49,180	$23,763	95
$13,863	$2,369	$5,510	$2,322	$9,908	$1,458	$64,637	$21,005	$67	$18,542	$6,670	96
$9,910	$2,276	$15,406	$5,886	$9,984	$3,691	$200,273	$49,221	$1,601	$32,480	$18,543	97
$57,277	$2,746	$24,786	$24,456	$62,923	$4,266	$351,736	$338,554	$1,552	$70,544	$36,690	98
$7,990	$1,233	$1,934	$6,165	$11,219	$7,894	$55,976	$35,268	$2,644	$59,115	$39,696	99
$2,129,073	$219,184	$1,846,535	$480,368	$1,687,049	$299,805	$19,404,955	$6,093,191	$174,069	$4,935,453	$2,348,453	100
$1,755,779	$174,933	$1,690,643	$398,594	$1,441,968	$199,948	$16,386,952	$3,912,514	$110,916	$3,777,690	$1,698,656	101
$1,068,998	$116,116	$1,069,480	$228,352	$808,284	$110,010	$9,029,291	$2,070,544	$60,394	$1,939,852	$893,780	102
$686,781	$58,817	$621,163	$170,242	$633,684	$89,938	$7,357,661	$1,841,970	$50,522	$1,837,838	$804,876	103
$333,368	$43,289	$131,378	$81,349	$230,163	$96,622	$2,865,530	$2,131,603	$62,143	$1,086,713	$628,008	104
$48,980	$450	$38,103	$8,750	$4,593	$75	$974,821	$514,070	$4,404	$57,873	$29,575	105
				$5,000	$2,800	$153,175	$4,765		$1,050	$13,888	106
$273,707	$41,947	$76,475	$72,324	$185,477	$91,307	$1,647,454	$940,935	$57,654	$949,667	$534,924	107
$6,678	$842		$200	$11,185	$1,400	$54,827	$621,568	$110	$21,062	$17,126	108
$1,105	$50	$4,800	$76	$13,908	$1,040	$31,977	$15,771	$75	$49,792	$26,365	109
$3,898		$12,000		$10,000		$3,276	$34,394		$7,279	$6,130	110
$39,926	$962	$24,514	$425	$14,918	$3,235	$162,473	$49,174	$1,010	$71,050	$21,789	111
208,815	34,277	100,848	27,907	102,872	5,100	1,449,087	345,404	3,350	217,589	106,348	112
39,400	34,277	69,606	27,907	55,841	3,000	500,673	96,599	2,100	125,473	36,619	113
169,415		31,242		47,031	2,100	948,414	248,805	1,250	92,116	68,729	114
			1,000			5,338			19,224	800	115
29,325	1,700	1,000	5,000	33,941	4,645	170,720	77,185		168,672	20,040	116
155,507	43,773	304,037	66,295	331,905	36,300	3,866,983	858,424	45,891	1,105,666	653,507	117
44,375	6,150	354,050	12,100	67,425	1,500	3,072,932	715,292	900	301,205	321,050	118
1,800		2,760		1,000		1,683,434	77,700		27,529	21,800	119
17,800		68,140		12,350	1,250	180,874	34,800		44,990	21,775	120
155	30	69	97	265	72	1,548	841	64	1,045	684	121
44	6	8	11	27	5	197	156	6	65	53	122
3	6	7	11	13	1	43	23	4	39	8	123
1	2	3	4	12	1	25	22	1	14	6	124
2	4	4	7	1		18	1	3	25	2	125
41		1		14	4	154	133	2	26	45	126
12				3	2	19	4		2	1	127
29		1		11	2	135	129	2	24	44	128
			1			4			7	1	129
22	1	1	1	9	5	72	41		58	3	130
74	21	31	76	205	59	1,000	561	56	831	563	131
9	2	22	8	17	1	219	64	2	64	51	132
2		2		1		23	10		8	5	133
4		5		6	2	33	9		12	8	134
130	28	32	86	236	69	1,141	730	62	942	608	135
6		4	7	10		85	36	1	39	16	136
2		1	2	2	1	35	16		14	16	137
4		3		1		17	3		2	2	138
1		2		5	1	101	14		4	6	139
		5	2	2		28	3		2	2	140
3		2				4	5		1		141
2		1		4		12	4				142
		1		1		8			1		143
		5				9			1		144
4	1	2			1	18	13		13	11	145
3	1	1				17	3	1	5	6	146
		1				24	1		3	1	147
		2		1		10	8		9	7	148
		7		3		39	5		9	9	149
						11			3		150
											151
											152
						3			5		153
145	29	67	96	264	72	1,415	814	64	976	668	154
											155
						1					156
											157
											158
5	1	2		1		68	24		46	12	159
							2			3	160
											161
1						3					162
											163
											164
1						5					165
						2					166
						10	1				167
											168
2						30			15	1	169
											170
											171
											172
											173
1			1								174
103	15	51	49	158	42	943	501	28	653	413	175
$2,037,255	$142,259	$1,819,560	$363,726	$1,162,212	$217,900	$16,371,047	$4,063,399	$83,279	$4,067,777	$1,938,818	176
$1,857,312	$130,049	$1,612,374	$356,947	$1,074,676	$199,631	$14,608,718	$3,648,737	$65,716	$3,594,407	$1,591,326	177

TABLE 58.—NEWSPAPERS AND PERIODICALS,

		United States.	Alabama.	Arizona.	Arkansas.	California.	Colorado.
	Power:						
178	Number of establishments reporting	6,515	30	12	27	206	72
179	Total horsepower	76,264	341	70	169	1,769	610
	Owned—						
	Engines—						
180	Steam, number	2,080	4	1	6	20	16
181	Horsepower	34,607	149	20	91	242	249
182	Gas or gasoline, number	2,836	13	10	16	99	17
183	Horsepower	10,508	40	36	52	334	56
184	Water wheels, number	420	3	...	1	9	21
185	Horsepower	1,912	16	...	2	30	86
186	Electric motors, number	534	...	...	2	...	...
187	Horsepower	6,175	...	...	5	...	...
188	Other power, number	367	1	...	...	6	...
189	Horsepower	1,163	2	...	...	23	...
	Rented—						
190	Electric, horsepower	18,292	...	14	19	1,054	214
191	Other kind, horsepower	3,607	134	...	...	86	5
192	Furnished to other establishments, horsepower	869	...	...	...	1	...
	Establishments classified by number of persons employed, not including proprietors and firm members:						
193	Total number of establishments	15,305	156	32	217	512	212
194	No employees	1,174	9	20	12	43	26
195	Under 5	8,764	110	11	159	290	108
196	5 to 20	4,309	33	1	43	144	65
197	21 to 50	673	4	...	3	21	5
198	51 to 100	204	...	...	...	8	5
199	101 to 250	133	...	...	...	5	3
200	251 to 500	36	...	...	...	1	...
201	501 to 1,000	9	...	...	...	...	...
202	1,001 to 5,000	3	...	...	...	...	...

		Kentucky.	Louisiana.	Maine.	Maryland.	Massachusetts.	Michigan.
1	Number of establishments	248	134	120	141	396	591
	Character of organization:						
2	Individual	151	92	62	72	191	395
3	Firm and limited partnership	36	15	23	33	73	123
4	Incorporated company	56	27	31	36	121	69
5	Miscellaneous	6	...	4	...	11	4
6	Established during the decade	113	62	37	39	107	197
7	Established during the census year	16	3	...	3	10	13
	Capital:						
8	Total	$2,683,855	$1,132,148	$1,668,820	$2,473,094	$10,392,258	$4,114,760
9	Land	$294,025	$83,700	$36,225	$259,263	$793,085	$176,957
10	Buildings	$290,240	$88,205	$113,550	$391,888	$618,784	$352,416
11	Machinery, tools, and implements	$929,157	$542,297	$716,944	$1,028,707	$4,074,133	$2,083,949
12	Cash and sundries	$1,170,433	$417,946	$802,101	$793,236	$4,906,256	$1,501,438
13	Proprietors and firm members	225	123	101	145	346	644
	Salaried officials, clerks, etc.:						
14	Total number	367	127	219	388	2,141	836
15	Total salaries	$325,851	$129,937	$182,099	$383,027	$2,027,034	$685,533
	Officers of corporations—						
16	Number	62	15	27	16	131	87
17	Salaries	$96,918	$23,040	$51,402	$40,560	$310,136	$136,601
	General superintendents, managers, clerks, and salesmen—						
18	Total number	305	112	192	372	2,010	749
19	Total salaries	$228,933	$106,897	$130,697	$342,467	$1,716,898	$548,932
	Men—						
20	Number	248	101	139	316	1,573	590
21	Salaries	$208,487	$104,212	$109,427	$326,937	$1,513,395	$501,093
	Women—						
22	Number	57	11	53	56	437	159
23	Salaries	$20,446	$2,685	$21,270	$15,530	$203,503	$47,839
	Wage-earners, including pieceworkers, and total wages:						
24	Greatest number employed at any one time during the year	1,393	973	1,524	1,635	5,954	3,451
25	Least number employed at any one time during the year	1,099	853	1,168	1,473	5,142	2,789
26	Average number	1,154	873	1,309	1,629	5,432	2,916
27	Wages	$521,739	$532,895	$473,026	$758,335	$3,769,204	$1,302,493
	Men, 16 years and over—						
28	Average number	1,015	766	664	1,427	4,066	2,186
29	Wages	$491,715	$508,281	$331,651	$735,469	$3,220,702	$1,126,223
	Women, 16 years and over—						
30	Average number	102	52	615	43	1,278	553
31	Wages	$26,260	$18,262	$137,137	$16,488	$532,912	$154,227
	Children, under 16 years—						
32	Average number	37	55	30	69	88	177
33	Wages	$3,764	$6,352	$4,238	$6,378	$15,590	$22,043
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
34	January	1,023	776	671	1,449	4,116	2,205
35	February	1,026	782	677	1,440	4,115	2,191
36	March	1,043	788	692	1,417	4,157	2,191
37	April	1,045	765	679	1,415	4,105	2,183
38	May	1,053	767	666	1,418	4,114	2,138
39	June	1,004	760	647	1,396	4,043	2,118
40	July	966	745	640	1,387	3,894	2,168
41	August	960	741	645	1,408	3,937	2,166
42	September	1,004	740	656	1,436	4,015	2,163
43	October	1,014	787	664	1,461	4,092	2,221
44	November	1,005	775	664	1,459	4,086	2,244
45	December	1,036	769	666	1,439	4,124	2,243
	Women, 16 years and over—						
46	January	103	52	639	45	1,311	561
47	February	105	53	646	45	1,312	569
48	March	110	53	662	44	1,322	571
49	April	110	53	656	45	1,312	572
50	May	107	53	641	45	1,283	562
51	June	101	55	588	48	1,245	535
52	July	91	51	553	41	1,171	525

BY STATES AND TERRITORIES: 1900—Continued.

Connecticut.	Delaware.	District of Columbia.	Florida.	Georgia.	Idaho.	Illinois.	Indiana.	Indian Territory.	Iowa.	Kansas.	
89	17	16	22	41	16	531	325	13	442	173	178
1,341	130	390	149	698	43	5,121	2,695	41	2,283	971	179
56	4	6	4	16	1	121	68	1	88	41	180
750	38	195	39	316	2	2,009	795	8	705	356	181
6	7	5	13	13	3	271	217	12	284	97	182
63	24	45	56	87	8	959	917	33	888	316	183
11	1	...	1	6	10	18	9	...	23	11	184
35	2	...	5	79	27	136	47	...	77	61	185
3	...	1	...	1	...	46	33	...	1	1	186
23	...	50	...	10	...	427	168	...	10	3	187
6	...	...	2	...	...	11	10	...	...	18	188
13	...	...	6	...	...	25	48	...	5	78	189
457	66	100	44	202	6	1,151	685	...	564	167	190
...	...	...	...	4	...	414	35	...	34	...	191
43	...	10	1	...	...	256	5	...	...	4	192
116	26	60	86	233	66	1,269	638	58	910	595	193
4	...	4	5	35	9	79	30	9	71	68	194
38	13	20	48	131	40	704	365	37	558	382	195
52	7	25	27	55	16	396	210	12	239	131	196
19	6	7	6	5	1	66	24	...	27	10	197
3	...	1	1	4	...	14	5	...	15	4	198
...	...	3	...	3	...	4	3	...	...	...	199
...	...	...	...	...	...	4	...	...	...	...	200
...	...	...	...	...	...	2	...	...	...	...	201
...	...	...	...	...	...	...	1	...	...	...	202

Minnesota.	Mississippi.	Missouri.	Moutana.	Nebraska.	Nevada.	New Hampshire.	New Jersey.	New Mexico.	New York.	North Carolina.	
660	165	814	78	492	29	75	261	35	1,206	165	1
379	124	524	45	382	14	43	169	23	682	101	2
116	27	164	11	64	12	16	31	6	186	34	3
60	14	117	22	41	3	16	60	6	323	30	4
5	...	9	...	5	...	...	1	...	15	...	5
252	77	352	47	204	11	16	73	17	363	82	6
17	5	19	6	17	1	1	8	3	23	7	7
$6,382,125	$405,042	$6,507,800	$715,985	$2,252,556	$92,372	$1,018,753	$4,210,267	$163,472	$55,486,474	$645,432	8
$369,400	$13,055	$192,115	$54,885	$62,770	$5,396	$103,179	$440,915	$1,650	$3,977,982	$35,155	9
$778,091	$29,450	$667,565	$88,402	$154,865	$18,363	$103,700	$468,162	$6,850	$3,944,294	$52,675	10
$1,948,076	$250,031	$2,706,241	$393,111	$1,118,389	$46,104	$467,622	$2,331,640	$119,541	$15,564,120	$366,463	11
$3,286,558	$112,506	$2,941,879	$179,587	$916,531	$23,509	$344,262	$969,540	$35,431	$32,000,078	$191,139	12
617	180	860	68	506	36	74	240	36	1,107	170	13
933	28	1,264	91	277	3	65	354	17	7,415	145	14
$750,386	$22,965	$1,130,265	$134,788	$242,814	$2,400	$63,084	$344,461	$18,790	$9,096,420	$87,851	16
62	5	155	15	39	...	20	54	4	458	22	16
$99,882	$6,460	$271,545	$23,930	$59,951	...	$25,284	$80,325	$5,290	$1,346,523	$17,089	17
871	23	1,109	76	238	3	46	300	13	6,957	123	18
$650,504	$16,505	$858,720	$110,858	$182,863	$2,400	$37,800	$264,136	$13,500	$7,749,897	$70,762	19
612	21	902	70	202	3	31	257	13	6,578	116	20
$550,511	$16,037	$765,472	$106,618	$167,789	$2,400	$31,153	$247,047	$13,500	$7,102,814	$67,875	21
269	2	207	6	36	...	14	43	...	1,379	7	22
$99,993	$468	$93,248	$4,240	$16,074	...	$6,647	$17,089	...	$647,083	$2,887	23
2,970	551	4,284	499	1,628	80	673	2,359	178	18,071	733	24
2,483	416	3,597	426	1,315	67	520	1,907	124	15,317	627	25
2,714	440	3,758	455	1,334	68	571	2,077	142	16,460	653	26
$1,304,229	$164,435	$2,056,148	$310,802	$626,597	$35,024	$261,871	$1,162,033	$75,477	$10,924,755	$230,941	27
2,187	315	2,747	395	947	48	395	1,775	114	13,304	492	28
$1,195,120	$144,891	$1,839,571	$295,513	$542,826	$31,434	$196,346	$1,082,939	$69,416	$9,861,947	$210,366	29
313	35	567	27	212	3	170	201	12	2,849	41	30
$90,564	$9,066	$161,528	$10,625	$58,721	$1,303	$64,548	$64,633	$4,025	$1,018,564	$8,580	31
214	90	444	33	175	17	6	101	16	307	120	32
$18,545	$10,478	$55,049	$4,664	$25,050	$2,287	$977	$14,461	$2,036	$44,244	$12,005	33
2,195	341	2,804	393	967	48	398	1,782	118	13,509	600	34
2,186	337	2,717	390	961	48	391	1,776	116	13,417	494	35
2,247	320	2,835	387	952	48	404	1,814	122	13,362	494	36
2,218	304	2,830	389	947	49	397	1,815	111	13,254	491	37
2,213	310	2,778	392	939	47	401	1,804	113	13,453	487	38
2,178	303	2,727	392	909	47	412	1,763	115	13,280	500	39
2,108	303	2,638	380	904	47	389	1,741	102	12,966	483	40
2,119	297	2,586	388	903	48	389	1,712	102	12,925	487	41
2,165	302	2,676	402	929	46	388	1,707	111	13,048	486	42
2,208	317	2,747	405	988	47	390	1,782	116	13,267	491	43
2,226	323	2,777	417	986	49	389	1,800	117	13,502	494	44
2,193	324	2,854	410	986	47	386	1,800	119	13,669	498	45
306	35	582	27	203	4	166	215	12	3,013	40	46
300	35	578	27	209	4	165	211	13	3,071	39	47
314	33	575	26	214	4	184	219	12	3,041	40	48
316	32	670	26	215	4	171	220	12	2,962	39	49
311	33	661	26	212	4	169	192	12	2,877	45	50
314	29	566	26	209	4	172	182	11	2,820	44	51
310	29	547	27	204	3	167	180	11	2,519	41	52

		Kentucky.	Louisiana.	Maine	Maryland	Massachusetts.	Michigan.
	Average number of wage-earners, including pieceworkers, employed during each month—Continued.						
	Women, 16 years and over—Continued.						
53	August	93	51	545	41	1,190	527
54	September	95	52	579	40	1,261	527
55	October	102	52	607	40	1,300	546
56	November	101	51	636	42	1,313	565
57	December	105	51	639	41	1,313	577
	Children, under 16 years—						
58	January	33	61	31	58	89	178
59	February	34	60	29	57	91	177
60	March	32	61	29	57	88	182
61	April	34	58	28	55	92	187
62	May	34	56	28	57	91	178
63	June	35	58	26	56	86	177
64	July	36	52	29	58	83	173
65	August	41	51	29	58	79	172
66	September	40	52	29	61	85	172
67	October	41	50	32	62	89	175
68	November	40	52	32	63	89	178
69	December	40	48	32	67	94	176
	Compositors (included in wage-earners)—						
70	Men, 16 years and over	692	332	290	604	1,932	1,251
71	Women, 16 years and over	56	31	278	24	634	351
72	Children, under 16 years	6	7	8	11	5	78
	Compositors operating type-casting or typesetting machines—						
73	Men	81	72	42	151	362	94
74	Women	2	....	34	....	46	101
75	Type-casting and typesetting machines used, number	66	10	44	82	291	97
	Miscellaneous expenses:						
76	Total	$325,093	$161,383	$480,690	$349,663	$3,301,822	$591,407
77	Rent of works	$50,601	$19,055	$27,923	$52,607	$315,707	$80,168
78	Taxes	$12,273	$6,581	$9,468	$14,968	$97,819	$27,488
79	Newspaper and periodical postage	$49,841	$18,406	$175,039	$38,827	$235,966	$83,605
80	Rent of offices, interest, insurance, and all sundry expenses not hitherto included.	$139,609	$87,773	$215,384	$171,220	$1,951,182	$302,027
81	Contract work	$72,769	$29,568	$52,876	$72,041	$701,148	$98,119
	Materials used:						
82	Aggregate cost	$445,000	$307,421	$514,384	$573,563	$3,921,665	$1,023,853
	Paper—						
83	Total pounds	11,416,789	6,982,114	16,055,803	16,464,816	92,347,453	24,267,484
84	Total cost	$336,048	$241,096	$382,172	$420,574	$2,603,528	$781,125
85	News, pounds	10,115,952	6,470,564	8,621,379	15,475,805	79,207,152	19,059,894
86	Cost	$248,156	$201,863	$189,798	$347,120	$1,822,451	$459,692
87	Periodical, pounds	75,005	181,450	6,446,350	65,785	4,589,082	1,016,314
88	Cost	$4,274	$9,988	$117,897	$3,284	$187,941	$43,772
89	Book and periodical, pounds	585,760	47,000	330,313	146,250	4,067,948	1,783,680
90	Cost	$27,844	$3,079	$15,587	$6,604	$212,287	$65,669
91	Job printing, pounds	640,072	283,100	657,761	776,976	4,483,271	2,407,596
92	Cost	$55,774	$26,166	$58,890	$63,566	$380,849	$211,992
93	Ink, pounds	95,726	77,572	159,794	209,025	1,040,069	286,659
94	Cost	$14,001	$8,409	$13,457	$14,766	$88,134	$28,778
95	Fuel	$15,727	$7,994	$14,759	$16,454	$66,442	$45,558
96	Rent of power and heat	$10,438	$8,937	$9,446	$9,256	$56,082	$18,949
97	Office supplies	$16,748	$5,848	$30,832	$22,207	$118,912	$35,521
98	All other materials	$38,858	$19,471	$59,306	$86,565	$976,459	$87,771
99	Freight	$13,180	$15,666	$4,412	$3,741	$13,108	$26,151
	Products:						
100	Total value	$2,240,724	$1,436,738	$2,190,017	$2,618,799	$16,765,100	$5,119,740
101	Newspaper products	$1,818,706	$1,300,338	$1,876,214	$2,263,338	$13,170,875	$3,819,560
102	Advertising	$942,010	$751,304	$1,044,695	$1,490,189	$6,906,320	$2,137,461
103	Subscriptions and sales	$876,696	$549,034	$831,519	$773,149	$6,264,555	$1,682,099
104	Book and job printing products	$308,567	$128,045	$269,675	$292,333	$3,547,927	$1,153,364
105	Book and pamphlet publications	$84,349	$26,631	$49,452	$44,750	$1,509,622	$144,398
106	Sheet music and books of music	$1,893	....	....	$2,000	$173,060	$2,315
107	Job printing	$211,873	$99,389	$219,823	$237,583	$1,497,491	$830,619
108	Bookbinding	$4,870	....	$300	$500	$313,587	$140,913
109	Blank books	$4,634	$25	$50	....	$1,350	$8,037
110	Electrotyping, engraving, etc	$948	$2,000	$50	$7,500	$52,817	$27,082
111	All other products	$113,451	$8,355	$44,128	$63,128	$46,298	$146,816
	Aggregate circulation per issue:						
112	Daily	164,624	106,990	59,838	247,552	1,130,820	370,848
113	Including Sunday	77,124	88,900	14,298	39,172	581,097	224,798
114	Except Sunday	87,500	18,090	45,540	208,380	549,723	146,050
115	Triweekly	1,800	2,400	....	....	....	7,975
116	Semiweekly	125,575	32,698	17,728	17,360	32,350	192,098
117	Weekly	425,323	137,434	220,759	316,505	2,066,369	752,032
118	Monthly	262,450	14,750	6,120,490	93,259	2,257,142	984,025
119	Quarterly	6,500	....	7,050	3,000	363,096	50,400
120	All other classes	112,900	5,800	8,200	2,200	349,350	17,025
	Number of publications:						
121	Total	282	160	177	166	486	698
	By period of issue—						
122	Daily	27	23	15	18	98	70
123	Including Sunday	12	10	2	2	11	8
124	Morning	7	6	1	2	8	5
125	Evening	5	4	1	....	3	3
126	Except Sunday	15	13	13	16	87	62
127	Morning	3	2	4	6	17	9
128	Evening	12	11	9	10	70	53
129	Triweekly	1	2	....	....	....	5
130	Semiweekly	24	6	5	2	7	23
131	Weekly	190	112	100	127	273	522
132	Monthly	32	15	45	15	85	65
133	Quarterly	3	....	8	1	15	5
134	All other classes	5	2	4	3	8	8
	By character—						
135	News, politics, and family reading	220	134	128	130	312	615
136	Religion	22	6	9	12	48	23
137	Agriculture, horticulture, dairying, and stock raising	8	4	1	3	6	7
138	Commerce, finance, insurance, and railroads	....	1	4	2	8	3
139	Trade journals	10	3	1	6	27	18
140	General literature, including magazines	....	3	21	1	27	8
141	Sunday newspapers	1	....	....	....	8	1
142	Medicine and surgery	3	....	1	1	2	5

BY STATES AND TERRITORIES: 1900—Continued.

Minnesota.	Mississippi.	Missouri.	Montana.	Nebraska.	Nevada.	New Hampshire.	New Jersey.	New Mexico.	New York.	North Carolina.	
311	31	538	27	209	3	158	179	11	2,724	41	53
319	32	563	27	220	3	164	186	12	2,634	43	54
324	42	571	30	220	3	171	209	12	2,805	38	55
316	44	565	30	212	3	173	208	11	2,848	38	56
312	44	588	30	216	4	177	213	12	2,869	33	57
229	94	436	35	182	17	7	100	17	309	120	58
227	93	433	35	181	17	7	102	16	316	123	59
231	94	437	33	177	17	7	103	16	315	121	60
230	88	453	33	174	17	7	101	16	307	122	61
233	90	451	33	176	17	7	101	16	308	121	62
206	86	446	33	177	17	8	101	18	302	118	63
200	83	446	33	173	17	6	99	16	296	113	64
194	81	432	33	171	17	4	99	16	294	117	65
198	82	437	33	166	17	5	97	16	303	117	66
203	95	448	33	174	17	6	101	16	315	123	67
204	97	447	33	174	17	6	101	16	309	123	68
211	97	457	33	176	17	6	106	17	311	125	69
1,252	228	1,525	224	647	37	204	1,081	85	6,026	350	70
149	35	298	7	187	4	128	159	9	704	27	71
101	65	165	...	119	5	4	37	...	80	93	72
186	10	156	43	61	2	26	115	6	962	22	73
14	...	105	1	2	...	12	...	...	56	...	74
113	8	168	27	61	3	23	108	4	799	21	75
$1,219,343	$31,372	$1,385,340	$96,453	$377,666	$6,570	$63,072	$289,011	$11,947	$15,178,916	$73,777	76
$131,267	$11,906	$182,513	$20,185	$60,354	$2,929	$16,517	$56,443	$5,969	$1,175,060	$15,188	77
$29,669	$2,691	$25,351	$5,240	$9,719	$934	$5,285	$18,142	$1,064	$241,097	$4,424	78
$146,792	$3,684	$347,346	$7,616	$49,887	$907	$7,941	$12,597	$1,318	$1,211,274	$13,640	79
$670,008	$9,733	$401,178	$58,525	$198,691	$1,800	$30,904	$158,209	$3,666	$6,666,362	$35,395	80
$241,607	$3,358	$428,952	$4,887	$69,015	...	$2,425	$43,620	$30	$5,885,123	$5,130	81
$1,073,934	$114,325	$2,204,785	$173,570	$624,472	$17,669	$166,624	$892,690	$33,622	$14,511,890	$156,944	82
26,663,512	1,560,884	66,173,770	2,918,505	11,544,598	156,576	3,445,068	17,034,314	330,587	378,603,033	2,562,834	83
$803,873	$93,298	$1,681,103	$102,746	$495,462	$9,049	$124,973	$719,652	$23,173	$11,109,993	$123,379	84
21,724,809	996,379	60,058,571	2,399,065	7,980,338	109,020	2,769,676	11,912,651	177,522	261,858,413	1,838,139	85
$492,543	$42,600	$1,287,382	$58,231	$231,379	$5,089	$69,948	$328,647	$7,716	$5,426,535	$64,925	86
1,083,806	54,706	2,599,118	800	917,007	1,000	34,400	842,126	...	61,190,338	76,420	87
$52,222	$2,794	$116,697	$40	$53,462	$76	$2,542	$43,580	...	$2,863,185	$3,723	88
2,065,634	38,585	1,382,977	28,759	718,617	6,000	232,977	521,932	800	46,386,675	19,000	89
$82,856	$2,077	$84,940	$2,677	$41,261	$375	$11,826	$26,401	$64	$2,135,900	$1,031	90
1,789,263	471,214	2,133,104	489,881	1,928,636	40,656	408,016	3,767,605	152,265	9,167,607	629,275	91
$176,252	$45,827	$192,084	$41,798	$169,360	$3,510	$40,657	$320,924	$15,394	$684,373	$53,700	92
316,426	19,106	795,966	28,755	114,479	1,808	34,660	202,703	3,612	3,944,417	27,736	93
$29,488	$3,868	$54,414	$3,758	$12,915	$347	$5,072	$24,937	$799	$375,549	$4,116	94
$43,776	$3,280	$50,602	$5,725	$27,084	$2,127	$5,561	$25,826	$1,675	$262,041	$5,385	95
$14,924	$695	$18,167	$8,926	$4,353	$620	$8,561	$15,369	$1,030	$298,966	$3,643	96
$49,484	$4,027	$63,921	$4,012	$18,961	$1,405	$5,652	$33,812	$1,306	$518,190	$6,008	97
$109,968	$2,683	$292,490	$12,476	$36,033	$2,288	$13,465	$61,519	$1,366	$1,897,405	$6,005	98
$22,421	$6,474	$44,088	$35,927	$29,664	$1,833	$3,250	$11,675	$4,273	$49,746	$8,408	99
$5,790,148	$560,097	$9,254,097	$911,668	$2,553,051	$111,052	$752,560	$3,731,068	$197,521	$62,965,076	$827,425	100
$3,981,874	$395,068	$8,144,216	$705,229	$1,887,933	$93,702	$507,663	$2,663,899	$128,839	$49,216,268	$610,418	101
$2,295,482	$195,133	$4,615,545	$390,698	$1,002,462	$49,272	$274,818	$1,813,518	$76,513	$25,369,048	$290,566	102
$1,686,392	$199,935	$3,528,671	$314,631	$885,471	$44,430	$232,846	$850,381	$52,326	$23,847,220	$319,852	103
$1,625,001	$164,442	$1,016,109	$204,573	$655,127	$17,300	$238,266	$1,045,021	$68,632	$13,286,016	$206,339	104
$897,254	$9,560	$261,204	$3,500	$37,984	$1,650	$16,244	$103,794	$1,600	$9,986,552	$600	105
$2,775	...	$6,630	...	$3,625	...	...	$1,600	...	$4,953	...	106
$614,669	$146,747	$678,114	$175,648	$505,195	$16,550	$195,959	$921,838	$59,904	$2,896,680	$178,506	107
$13,566	$6,050	$51,429	$10,886	$26,622	$100	$12,013	$8,867	$3,300	$271,429	$14,508	108
$64,861	$2,085	$13,569	$14,489	$77,586	...	$5,050	$2,828	$2,050	$21,254	$12,725	109
$31,876	...	$5,163	$50	$4,115	...	$10,000	$6,094	$1,778	$105,148	...	110
$183,273	$587	$93,772	$1,866	$9,991	$50	$6,631	$22,148	$50	$462,792	$10,668	111
300,266	16,348	810,492	42,164	122,414	5,226	42,419	223,233	3,820	3,896,967	44,620	112
144,119	5,586	713,004	28,922	92,615	...	...	6,545	...	3,006,426	18,150	113
156,147	10,762	97,488	13,242	29,799	5,226	42,419	216,688	3,820	890,541	26,470	114
5,000	502	200	...	1,200	160	5,250	...	...	146,175	...	115
95,660	1,080	329,153	9,380	53,008	1,760	...	1,900	...	460,867	24,490	116
908,478	142,702	1,862,856	62,109	650,349	10,517	158,900	367,021	25,000	12,607,099	197,706	117
452,329	6,610	1,378,586	6,495	255,935	500	5,250	28,950	600	16,927,062	12,050	118
4,550	...	895,050	7,000	2,950	...	...	136,500	800	2,276,625	700	119
183,347	1,700	219,465	...	9,682	...	...	2,251,500	2,300	1,311,300	8,350	120
622	178	940	89	538	35	88	298	42	1,477	200	121
44	13	92	11	32	9	14	49	3	207	26	122
9	3	33	6	9	...	...	4	...	49	8	123
5	3	16	5	5	...	...	2	...	26	7	124
4	...	17	1	4	...	...	2	...	23	1	125
35	10	59	5	23	9	14	45	3	158	18	126
7	...	8	...	2	3	2	5	...	37	1	127
28	10	51	5	21	6	12	40	3	121	17	128
1	1	1	...	1	1	2	...	...	8	...	129
9	2	14	4	16	3	...	2	...	52	15	130
493	156	695	70	454	21	67	225	35	872	142	131
60	4	101	3	28	1	5	17	1	272	10	132
2	...	14	1	3	...	...	4	1	35	1	133
13	2	23	...	4	...	...	1	2	31	6	134
516	169	739	79	481	34	80	274	36	1,004	168	135
20	5	45	2	14	...	2	6	4	79	22	136
11	1	22	5	9	...	2	1	1	25	4	137
5	...	11	...	2	...	...	1	...	56	2	138
21	...	36	...	9	...	1	5	...	111	1	139
6	...	12	...	3	...	1	1	...	51	...	140
...	...	2	...	...	...	...	...	...	8	2	141
4	...	18	...	...	...	...	...	...	19	...	142

TABLE 58.—NEWSPAPERS AND PERIODICALS,

		Kentucky.	Louisiana.	Maine.	Maryland.	Massachusetts.	Michigan.
	Number of publications—Continued.						
	Total—Continued.						
	By character—Continued.						
143	Law	1			2		1
144	Science and mechanics		1	1	4	5	1
145	Fraternal organizations	3	1	3		7	5
146	Education and history	1		1		8	4
147	Society, art, music, and fashion		1			7	
148	College and school periodicals	8	3	4		5	3
149	Miscellaneous	5	3	3	5	16	4
	By language—						
150	Bohemian						
151	Bohemian and English						
152	Chinese						
153	Dutch						
154	English	276	148	172	156	477	659
155	Finnish			1			2
156	French		5	4		2	2
157	French and English		2			2	
158	Gaelic and English						
159	German	6	3		8	4	18
160	German and English						
161	German and Hebrew						
162	Hebrew				1		
163	Hungarian						
164	Indian and English						
165	Italian		1				
166	Lithuanian						
167	Polish				1	1	4
168	Portuguese						
169	Scandinavian						1
170	Slavonic, not specified						
171	Spanish		1				
172	Spanish and English						
173	Welsh and English						
174	All other						12
	Comparison of products:						
175	Number of establishments reporting for both years	164	92	102	86	341	421
176	Value for census year	$1,820,937	$1,374,251	$2,126,834	$2,313,372	$14,977,009	$4,487,583
177	Value for preceding business year	$1,600,687	$1,221,297	$1,929,250	$2,107,114	$14,670,010	$4,014,390
	Power:						
178	Number of establishments reporting	97	29	84	65	241	317
179	Total horsepower	1,147	578	786	1,143	4,199	2,845
	Owned—						
	Engines—						
180	Steam, number	25	7	39	42	80	119
181	Horsepower	470	172	418	870	1,885	1,589
182	Gas or gasoline, number	41	15	8	17	37	144
183	Horsepower	132	67	42	63	139	507
184	Water wheels, number	13	1	6	3	17	11
185	Horsepower	38	6	27	7	74	50
186	Electric motors, number	12		2	9	29	11
187	Horsepower	154		10	105	478	145
188	Other power, number	2		11	2	3	12
189	Horsepower	3		36	4	6	37
	Rented—						
190	Electric, horsepower	350	333	253	85	1,533	441
191	Other kind, horsepower				9	84	76
192	Furnished to other establishments, horsepower	18		7	78	18	23
	Establishments classified by number of persons employed, not including proprietors and firm members:						
193	Total number of establishments	248	134	120	141	396	591
194	No employees	16	10	5	4	28	45
195	Under 5	134	86	42	76	112	367
196	5 to 20	82	29	56	45	187	151
197	21 to 50	12	6	10	11	45	19
198	51 to 100	3	1	4	1	11	4
199	101 to 250	1	1	3	2	9	3
200	251 to 500		1		1	2	2
201	501 to 1,000				1	2	
202	1,001 to 5,000						

		North Dakota.	Ohio.	Oklahoma.	Oregon.	Pennsylvania.	Rhode Island.
1	Number of establishments	131	837	98	159	1,042	32
	Character of organization:						
2	Individual	104	472	61	103	632	15
3	Firm and limited partnership	16	186	28	32	246	6
4	Incorporated company	1	157	9	24	152	11
5	Miscellaneous		22			12	
6	Established during the decade	58	247	82	78	325	9
7	Established during the census year	1	20	10	10	34	
	Capital:						
8	Total	$553,052	$11,327,865	$389,158	$1,312,263	$23,952,145	$930,593
9	Land	$26,680	$651,865	$17,980	$40,485	$2,366,820	$191,200
10	Buildings	$51,200	$1,103,821	$30,875	$584,975	$3,297,929	$89,984
11	Machinery, tools, and implements	$251,640	$5,557,691	$245,445	$454,129	$9,333,799	$429,993
12	Cash and sundries	$223,532	$4,014,488	$94,858	$232,674	$8,953,597	$219,416
13	Proprietors and firm members	137	363	115	167	1,169	30
	Salaried officials, clerks, etc.:						
14	Total number	45	1,456	41	72	3,028	44
15	Total salaries	$38,195	$1,277,427	$30,446	$86,931	$2,812,873	$51,969
	Officers of corporations—						
16	Number	15	179	16	14	199	6
17	Salaries	$15,541	$291,325	$16,440	$24,000	$443,910	$20,700
	General superintendents, managers, clerks, and salesmen—						
18	Total number	30	1,277	25	58	2,829	38
19	Total salaries	$22,654	$986,102	$14,006	$62,931	$2,368,963	$31,269
	Men—						
20	Number	29	994	21	46	2,235	28
21	Salaries	$22,354	$884,874	$12,906	$58,484	$2,139,354	$27,905
	Women—						
22	Number	1	283	4	12	594	10
23	Salaries	$300	$101,228	$1,100	$4,447	$229,609	$3,364

BY STATES AND TERRITORIES: 1900—Continued.

Minnesota.	Mississippi.	Missouri.	Montana.	Nebraska.	Nevada.	New Hampshire.	New Jersey.	New Mexico.	New York.	North Carolina.	
4		7		1					9		143
2		7		1					15		144
12		7	1	7	1		1		12		145
6		5					2		16		146
1		5		1			1		18		147
5	2	8		3			1	1	5	1	148
9	1	16	2	7		2	5		49		149
		1							2		150
											151
											152
							1				153
564	178	897	86	508	35	86	272	31	1,379	200	154
1									2		155
1						2			3		156
											157
											158
20		31	3	18			19		48		159
1		1							3		160
		2									161
		1							6		162
									1		163
									3		164
							4		10		165
		2									166
1									2		167
											168
34		1		4					1		169
									1		170
		4					2	10	5		171
								1			172
									1		173
				8					10		174
481	105	564	47	314	16	60	192	20	967	114	175
$5,364,445	$376,353	$7,859,426	$764,378	$2,020,841	$70,064	$670,037	$3,239,273	$160,844	$58,581,182	$685,368	176
$4,756,531	$319,758	$7,033,884	$702,688	$1,740,612	$64,430	$653,719	$2,954,946	$140,991	$53,622,514	$596,545	177
203	21	238	39	144	11	60	181	7	610	40	178
2,211	111	3,026	299	921	66	615	1,731	45	16,556	250	179
41	8	66	19	27	5	23	97	2	308	9	180
896	47	1,546	78	335	29	188	932	16	7,176	72	181
118	10	152	6	94	3	7	49	4	139	19	182
310	34	511	18	275	8	23	198	12	686	72	183
12	2	4	1	4	6	13	9	2	61		184
42	12	9	2	11	29	46	26	9	406		185
17		25		4			6		169		186
157		371		71			33		2,277		187
4		9		5			10		116		188
8		24		10			32		407		189
798	18	556	160	1		229	510		3,937	85	190
		9	41	218		29		8	1,667	21	191
79	7	6	5	4					219		192
560	165	814	78	492	29	75	261	35	1,206	165	193
43	16	69	10	53	2	2	11	2	64	7	194
389	121	527	47	366	22	33	106	22	521	105	195
104	24	176	15	62	5	33	115	8	434	45	196
14	4	28	3	6		4	22	3	100	7	197
4		6	2	2		3	6		35	1	198
3		6	1	3			1		37		199
3		2							10		200
									3		201
									2		202

South Carolina.	South Dakota.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin.	Wyoming.	
98	198	217	654	62	61	162	188	147	495	38	1
57	155	128	466	32	37	105	107	99	322	20	2
22	31	51	146	17	8	27	40	26	98	12	3
19	11	29	36	13	14	21	31	21	73	6	4
	1	9	6		2	9	10	1	2		5
42	64	114	352	42	17	53	107	57	177	21	6
4	7	5	30	6	4	7	16	4	9	2	7
$434,255	$637,839	$2,622,242	$2,479,073	$679,281	$500,698	$1,126,736	$796,114	$1,050,150	$4,390,988	$143,620	8
$22,550	$33,760	$119,386	$110,038	$62,850	$25,987	$34,000	$16,315	$60,325	$374,395	$3,960	9
$37,550	$75,135	$411,482	$266,930	$63,445	$52,208	$75,525	$23,565	$77,725	$814,413	$7,900	10
$226,582	$333,177	$1,066,170	$1,364,515	$260,144	$283,029	$625,534	$517,523	$506,580	$1,847,556	$91,050	11
$147,573	$195,767	$1,025,204	$737,590	$302,842	$139,474	$391,677	$238,711	$405,520	$1,354,624	$40,710	12
99	215	239	775	63	54	160	192	151	522	40	13
56	43	403	263	78	71	178	217	92	411	6	14
$42,631	$30,376	$329,140	$275,910	$67,769	$50,135	$107,831	$175,974	$73,207	$349,073	$5,644	16
17	6	54	31	12	10	22	12	16	79	2	16
$8,885	$6,110	$73,552	$61,125	$14,060	$10,461	$21,798	$27,080	$21,330	$105,145	$2,500	17
39	37	349	232	66	61	156	205	76	332	4	18
$33,746	$24,236	$255,588	$214,785	$53,709	$39,674	$86,033	$148,894	$51,877	$243,928	$3,144	19
34	30	284	199	54	49	133	188	67	267	4	20
$31,186	$21,374	$230,037	$197,957	$50,183	$35,304	$80,785	$138,178	$47,981	$223,149	$3,144	21
5	7	65	33	12	12	23	17	9	65		22
$2,560	$2,892	$25,551	$16,828	$3,526	$4,370	$5,248	$10,716	$3,896	$20,779		23

TABLE 58.—NEWSPAPERS AND PERIODICALS,

		North Dakota.	Ohio.	Oklahoma.	Oregon.	Pennsylvania.	Rhode Island.
	Wage-earners, including pieceworkers, and total wages:						
24	Greatest number employed at any one time during the year	392	7,068	500	718	10,478	519
25	Least number employed at any one time during the year	295	6,011	327	485	9,022	472
26	Average number	326	6,360	379	610	9,565	488
27	Wages	$143,096	$3,119,596	$139,021	$292,579	$5,094,769	$318,219
	Men, 16 years and over—						
28	Average number	263	4,907	313	417	7,841	442
29	Wages	$128,683	$2,784,987	$127,978	$237,151	$4,677,768	$301,929
	Women, 16 years and over—						
30	Average number	37	1,149	44	142	1,125	39
31	Wages	$11,707	$300,146	$8,238	$48,743	$345,945	$15,245
	Children, under 16 years—						
32	Average number	26	304	22	51	599	7
33	Wages	$2,706	$34,463	$2,805	$6,685	$71,056	$1,045
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
34	January	261	4,957	319	425	8,002	439
35	February	262	4,958	327	412	7,831	443
36	March	267	4,959	332	420	7,872	439
37	April	268	4,996	312	422	7,890	445
38	May	267	4,955	305	446	7,799	444
39	June	265	4,825	279	417	7,682	443
40	July	238	4,738	292	395	7,613	442
41	August	244	4,752	304	385	7,613	443
42	September	267	4,828	318	399	7,764	440
43	October	276	4,934	310	404	7,956	439
44	November	272	4,960	324	434	8,009	440
45	December	272	5,009	335	447	8,063	441
	Women, 16 years and over—						
46	January	43	1,214	46	149	1,157	38
47	February	43	1,215	45	142	1,146	40
48	March	35	1,212	47	150	1,185	41
49	April	35	1,166	43	138	1,181	40
50	May	37	1,138	45	141	1,155	40
51	June	37	1,079	38	139	1,086	38
52	July	36	1,063	42	136	1,060	38
53	August	35	1,061	41	132	1,059	38
54	September	35	1,094	40	135	1,076	38
55	October	34	1,160	47	147	1,109	39
56	November	35	1,167	44	146	1,131	39
57	December	33	1,225	44	155	1,152	39
	Children, under 16 years—						
58	January	26	309	18	52	608	7
59	February	25	315	25	51	605	7
60	March	26	314	26	58	608	7
61	April	27	314	24	56	617	7
62	May	27	315	25	56	593	7
63	June	26	300	26	51	593	7
64	July	25	293	22	49	586	7
65	August	25	292	21	45	583	7
66	September	25	296	18	47	590	7
67	October	25	302	21	46	597	7
68	November	26	308	22	47	606	7
69	December	26	294	22	51	608	7
	Compositors (included in wage-earners)—						
70	Men, 16 years and over	202	2,609	161	262	4,160	159
71	Women, 16 years and over	17	716	23	105	484	24
72	Children, under 16 years	6	97	2	1	187	62
	Compositors operating type-casting or typesetting machines—						
73	Men	17	336	15	29	606	58
74	Women	1	17	3	9	26	4
75	Type-casting and typesetting machines used, number	11	281	1	17	497	34
	Miscellaneous expenses:						
76	Total	$50,920	$1,733,296	$20,732	$140,280	$3,621,281	$122,974
77	Rent of works	$14,221	$184,756	$6,875	$18,415	$388,907	$15,772
78	Taxes	$3,889	$60,616	$2,825	$7,030	$79,411	$5,348
79	Newspaper and periodical postage	$5,098	$242,673	$3,337	$15,316	$340,953	$4,099
80	Rent of offices, interest, insurance, and all sundry expenses not hitherto included.	$24,028	$910,646	$7,695	$68,380	$1,860,480	$67,263
81	Contract work	$3,684	$334,606		$31,139	$951,530	$10,492
	Materials used:						
82	Aggregate cost	$119,002	$2,883,006	$113,193	$240,113	$5,969,788	$166,091
	Paper—						
83	Total pounds	1,662,800	73,544,764	1,407,298	4,276,261	155,846,813	5,564,505
84	Total cost	$78,122	$2,179,374	$91,516	$178,040	$4,645,709	$129,360
85	News, pounds	1,265,721	57,482,155	658,806	3,326,432	125,527,046	5,316,716
86	Cost	$42,141	$1,328,585	$27,141	$100,777	$2,726,880	$111,322
87	Periodical, pounds	25,550	7,788,563	7,622	183,299	14,311,777	42,680
88	Cost	$1,212	$293,976	$504	$11,027	$797,026	$2,307
89	Book and periodical, pounds	6,920	2,811,845	112,980	189,640	7,941,000	71,850
90	Cost	$412	$120,440	$6,092	$11,741	$448,785	$4,270
91	Job printing, pounds	364,609	5,462,201	627,890	576,880	8,066,990	133,259
92	Cost	$34,357	$436,373	$57,779	$54,495	$673,018	$11,461
93	Ink, pounds	14,076	767,257	8,601	64,399	1,958,268	59,233
94	Cost	$3,551	$92,325	$2,558	$9,115	$175,657	$3,555
95	Fuel	$6,248	$68,717	$4,264	$7,132	$130,909	$4,187
96	Rent of power and heat	$1,646	$34,825	$582	$4,906	$73,703	$6,727
97	Office supplies	$4,677	$128,590	$3,827	$6,414	$349,186	$2,376
98	All other materials	$15,876	$338,196	$4,947	$28,030	$544,211	$18,400
99	Freight	$8,882	$40,979	$5,499	$6,476	$50,413	$1,486
	Products:						
100	Total value	$587,889	$12,189,640	$481,663	$1,078,337	$23,249,080	$940,806
101	Newspaper products	$420,195	$9,643,982	$250,681	$825,455	$18,364,367	$866,401
102	Advertising	$259,041	$4,863,620	$138,537	$463,172	$10,741,028	$555,503
103	Subscriptions and sales	$161,154	$4,780,362	$112,144	$362,283	$7,623,339	$310,898
104	Book and job printing products	$150,605	$2,441,641	$225,377	$226,327	$4,679,371	$72,255
105	Book and pamphlet publications	$5,052	$702,351	$7,594	$13,223	$2,129,568	$10,611
106	Sheet music and books of music		$59,018			$74,058	
107	Job printing	$133,458	$1,490,416	$175,912	$180,883	$2,326,634	$61,544
108	Bookbinding	$4,860	$108,799	$14,341	$5,776	$73,255	$100
109	Blank books	$7,225	$5,945	$27,530	$26,165	$19,319	
110	Electrotyping, engraving, etc	$10	$75,112		$280	$56,537	
111	All other products	$17,089	$104,017	$5,605	$26,555	$205,342	$2,150

BY STATES AND TERRITORIES: 1900—Continued.

South Carolina	South Dakota.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin.	Wyoming.	
464	511	1,055	2,139	501	509	865	748	797	3,003	110	24
398	414	890	1,802	409	405	773	548	665	2,523	80	25
413	422	951	1,829	431	436	771	626	707	2,679	86	26
$156,924	$164,456	$456,418	$916,029	$235,174	$176,748	$338,618	$315,500	$295,413	$1,174,242	$47,840	27
368	276	697	1,453	344	280	635	535	501	1,954	69	28
$149,400	$133,544	$395,188	$852,564	$216,994	$133,532	$315,928	$291,216	$250,106	$1,018,634	$42,492	29
27	48	152	99	52	144	48	50	140	519	10	30
$6,128	$16,928	$47,887	$29,899	$14,496	$41,445	$13,065	$18,921	$37,812	$135,228	$4,492	31
18	98	102	277	35	12	88	41	66	206	7	32
$1,396	$13,984	$13,343	$33,566	$3,681	$1,771	$9,625	$5,360	$7,495	$20,380	$856	33
383	278	704	1,472	347	287	648	539	501	1,969	72	34
376	274	705	1,470	341	290	644	530	508	1,961	69	35
375	274	709	1,463	362	290	643	553	501	1,975	68	36
375	279	709	1,452	336	288	652	550	506	1,999	69	37
372	277	709	1,444	351	286	648	548	507	1,967	69	38
355	279	704	1,375	347	281	612	534	501	1,947	70	39
355	275	689	1,363	326	271	603	523	498	1,901	66	40
356	265	656	1,389	322	267	605	520	493	1,890	65	41
358	272	672	1,445	338	272	620	524	499	1,917	70	42
365	278	705	1,497	348	275	636	519	497	1,945	67	43
369	279	702	1,517	344	280	650	518	499	1,986	69	44
375	284	701	1,550	360	275	662	556	497	1,994	70	45
27	51	150	104	51	144	51	49	139	528	11	46
27	48	149	100	52	151	51	48	136	526	11	47
27	47	155	100	57	149	51	55	137	525	9	48
27	48	160	99	59	152	49	54	142	525	10	49
27	47	160	103	57	149	47	51	145	519	10	50
27	48	159	95	51	144	47	49	146	511	9	51
26	46	161	93	47	137	43	49	137	498	9	52
28	45	146	90	47	139	44	50	136	500	9	53
28	49	142	94	45	140	49	50	137	509	10	54
28	48	154	99	50	137	47	50	139	520	10	55
27	49	147	101	54	138	47	50	142	531	10	56
26	48	145	107	55	148	47	49	142	533	10	57
19	105	101	285	34	12	86	41	65	207	7	58
19	105	102	282	36	13	86	42	66	207	7	59
19	102	101	283	36	13	87	42	66	206	7	60
18	98	101	279	35	12	97	42	66	204	7	61
18	96	98	280	35	13	97	43	66	204	7	62
18	94	96	266	32	12	86	41	67	200	7	63
18	92	96	263	33	12	84	41	64	201	7	64
18	94	96	267	33	12	84	41	64	201	7	65
18	95	104	275	36	12	85	40	65	208	7	66
18	96	107	277	35	12	85	41	67	206	7	67
18	100	109	283	36	12	93	41	69	210	7	68
18	99	112	284	38	13	92	41	66	212	7	69
260	242	539	996	134	176	411	322	276	1,144	51	70
22	39	98	94	23	105	30	38	93	352	10	71
....	12	59	136	....	....	3	22	18	13	....	72
....	....	60	90	25	12	63	50	35	119	9	73
....	....	15	....	3	5	1	1	4	7	....	74
16	7	59	15	24	10	43	33	29	61	6	75
$40,367	$55,504	$300,890	$391,325	$92,129	$53,113	$167,482	$202,906	$75,561	$462,784	$12,806	76
$9,290	$13,580	$26,212	$67,211	$11,147	$9,717	$23,169	$32,246	$16,674	$72,108	$5,230	77
$3,631	$4,644	$9,698	$15,796	$3,068	$2,783	$5,322	$4,518	$4,065	$21,502	$1,383	78
$7,101	$5,851	$46,941	$52,484	$14,126	$6,374	$19,728	$15,376	$13,128	$95,210	$916	79
$17,800	$26,163	$131,747	$190,631	$57,144	$25,639	$75,835	$95,642	$40,261	$205,531	$3,934	80
$2,545	$5,266	$86,292	$65,203	$6,644	$8,600	$43,428	$55,124	$1,433	$68,433	$1,343	81
$97,776	$127,066	$446,540	$631,382	$138,290	$115,285	$212,821	$206,540	$187,513	$902,588	$32,308	82
1,849,953	1,569,169	9,786,819	11,075,808	2,424,121	1,943,599	4,581,295	4,505,960	2,916,238	17,383,974	302,462	83
$74,354	$83,156	$351,186	$469,005	$93,803	$85,925	$170,265	$156,231	$146,307	$633,720	$20,542	84
1,431,464	1,144,559	7,029,904	9,315,392	2,050,961	1,295,780	3,651,782	4,016,211	2,023,297	12,747,208	173,132	85
$42,344	$45,884	$184,628	$320,943	$61,542	$39,013	$105,628	$113,981	$66,497	$336,153	$7,580	86
66,440	43,585	1,442,474	304,581	99,260	6,940	276,250	84,190	93,636	827,688	2,530	87
$2,897	$2,311	$63,420	$15,296	$6,647	$350	$13,051	$5,447	$4,954	$42,172	$193	88
105,764	32,713	459,580	82,635	78,015	55,334	169,860	37,820	136,725	400,603	20,600	89
$6,290	$1,901	$23,615	$5,371	$5,922	$3,005	$8,602	$2,382	$6,499	$21,778	$1,300	90
246,285	348,312	854,861	1,373,200	195,885	585,545	483,403	367,739	662,580	3,408,475	106,200	91
$22,823	$33,060	$79,523	$127,395	$19,692	$43,557	$12,984	$34,421	$68,357	$233,617	$11,469	92
24,643	18,073	121,600	111,911	22,981	27,520	52,560	49,038	29,513	210,381	3,235	93
$3,659	$4,090	$14,017	$16,658	$3,922	$3,372	$5,772	$5,627	$5,753	$30,249	$827	94
$3,594	$9,462	$15,733	$20,037	$2,727	$4,043	$7,380	$4,808	$5,471	$71,717	$3,175	95
$2,812	$2,038	$5,787	$11,604	$5,192	$5,033	$6,946	$11,050	$1,876	$21,174	$248	96
$3,123	$5,889	$14,745	$57,081	$4,135	$3,179	$7,388	$9,695	$5,837	$25,965	$1,319	97
$4,224	$11,233	$34,702	$31,780	$20,019	$8,634	$9,367	$11,360	$13,458	$94,214	$2,574	98
$6,010	$11,198	$10,370	$25,217	$8,492	$5,099	$5,703	$7,769	$8,811	$25,549	$3,623	99
$510,529	$633,125	$2,205,112	$3,387,410	$593,562	$546,991	$1,145,577	$1,321,044	$907,156	$4,103,415	$157,789	100
$416,594	$475,668	$1,715,886	$2,864,387	$455,498	$371,110	$907,025	$1,178,721	$576,493	$2,900,231	$108,851	101
$198,422	$245,737	$761,785	$1,600,616	$234,087	$200,307	$510,729	$772,517	$282,845	$1,414,475	$62,150	102
$218,172	$229,931	$954,101	$1,263,771	$221,411	$170,803	$396,296	$406,204	$293,648	$1,485,756	$46,701	103
$93,392	$146,437	$414,473	$486,172	$133,283	$171,554	$227,975	$131,737	$318,122	$1,116,487	$48,098	104
$15,852	$5,245	$86,982	$16,986	$42,378	$51,950	$58,354	$2,609	$11,921	$207,574	$11,710	105
....	$1,125	$14,000	$4,513	$600	$772	....	....	$2,350	$1,637	....	106
$72,940	$130,967	$245,984	$462,086	$72,139	$118,742	$163,526	$128,397	$276,537	$870,382	$36,388	107
$2,500	$5,225	$51,090	$1,922	$15,089	....	$5,810	$250	$19,512	$29,889	....	108
$2,000	$3,850	$3,115	$500	$2,639	$40	$280	$466	$7,777	$6,579	....	109
$100	$25	$13,302	$165	$438	$50	$5	$15	$25	$426	....	110
$543	$11,020	$74,753	$36,851	$4,781	$4,327	$10,577	$10,586	$12,541	$86,697	$840	111

TABLE 58.—NEWSPAPERS AND PERIODICALS,

		North Dakota.	Ohio.	Oklahoma.	Oregon.	Pennsylvania.	Rhode Island.
	Aggregate circulation per issue:						
112	Daily	18,021	1,224,716	14,674	51,191	1,917,426	118,844
113	Including Sunday	10,600	494,512	14,674	42,433	987,931	72,200
114	Except Sunday	7,421	730,203	...	8,758	929,495	46,644
115	Triweekly	...	13,300	...	...	8,206	100
116	Semiweekly	7,100	211,161	800	14,810	282,142	6,754
117	Weekly	106,219	2,411,172	99,953	166,511	3,691,954	37,671
118	Monthly	7,550	1,420,501	4,150	75,038	3,246,779	4,225
119	Quarterly	...	1,795,609	...	...	1,991,819	3,000
120	All other classes	...	390,900	500	4,400	142,041	...
	Number of publications:						
121	Total	139	1,039	110	188	1,365	40
	By period of issue—						
122	Daily	9	170	9	21	196	12
123	Including Sunday	4	30	9	9	21	2
124	Morning	4	17	2	7	14	1
125	Evening	...	13	7	2	7	1
126	Except Sunday	5	140	...	12	175	10
127	Morning	...	7	...	2	38	2
128	Evening	5	133	...	10	137	8
129	Triweekly	...	8	...	...	5	1
130	Semiweekly	2	53	1	14	47	3
131	Weekly	126	692	96	124	883	21
132	Monthly	2	90	3	27	178	2
133	Quarterly	...	15	...	...	42	1
134	All other classes	...	11	1	2	14	...
	By character—						
135	News, politics, and family reading	138	880	106	137	1,008	30
136	Religion	...	55	2	11	164	3
137	Agriculture, horticulture, dairying, and stock raising	...	8		7	14	1
138	Commerce, finance, insurance, and railroads	...	10	...	3	20	...
139	Trade journals	...	29	...	7	45	3
140	General literature, including magazines	...	9	1	2	22	1
141	Sunday newspapers	...	3	...	...	15	...
142	Medicine and surgery	...	5	1	1	11	...
143	Law	...	6	...	1	6	...
144	Science and mechanics	...	1	...	...	7	...
145	Fraternal organizations	...	7	...	10	12	...
146	Education and history	...	3	...	3	4	...
147	Society, art, music, and fashion	...	5	...	1	9	...
148	College and school periodicals	1	9	...	2	6	1
149	Miscellaneous	...	9	...	3	22	1
	By language—						
150	Bohemian	...	5	...	...	...	...
151	Bohemian and English	...	...	...	...	...	...
152	Chinese	...	...	...	...	...	...
153	Dutch	...	...	...	...	...	...
154	English	132	945	109	185	1,277	37
155	Finnish	...	...	...	1	...	...
156	French	...	...	...	...	1	3
157	French and English	...	...	...	...	...	...
158	Gaelic and English	...	...	...	...	3	...
159	German	3	81	1	1	51	...
160	German and English	...	1	...	...	5	...
161	German and Hebrew	...	...	...	...	1	...
162	Hebrew	...	...	...	...	1	...
163	Hungarian	...	1	...	...	...	...
164	Indian and English	...	...	...	...	...	...
165	Italian	...	...	...	...	3	...
166	Lithuanian	...	...	...	...	5	...
167	Polish	...	5	...	...	7	...
168	Portuguese	...	...	...	...	...	...
169	Scandinavian	...	...	...	1	1	...
170	Slavonic, not specified	...	...	...	...	3	...
171	Spanish	...	1	...	...	2	...
172	Spanish and English	...	...	...	...	...	...
173	Welsh and English	...	...	...	...	...	...
174	All other	4	...	...	...	5	...
	Comparison of products:						
175	Number of establishments reporting for both years	75	626	61	122	814	28
176	Value for census year	$355,153	$10,803,196	$381,065	$956,955	$21,534,388	$886,436
177	Value for preceding business year	$306,923	$9,898,415	$324,682	$813,413	$19,456,718	$824,350
	Power:						
178	Number of establishments reporting	33	509	22	49	654	23
179	Total horsepower	156	5,573	99	342	10,388	639
	Owned—						
	Engines—						
180	Steam, number	6	138	2	12	324	12
181	Horsepower	33	2,910	15	160	6,160	252
182	Gas or gasoline, number	26	276	21	7	212	...
183	Horsepower	80	1,239	84	27	925	...
184	Water wheels, number	4	21	...	15	20	3
185	Horsepower	13	91	...	43	93	10
186	Electric motors, number	2	56	...	...	78	...
187	Horsepower	8	310	...	...	1,123	...
188	Other power, number	...	23	...	...	73	...
189	Horsepower	...	82	...	...	178	...
	Rented—						
190	Electric, horsepower	19	794	...	108	1,591	156
191	Other kind, horsepower	3	147	...	4	328	221
192	Furnished to other establishments, horsepower	131	837	98	159	1,042	32
	Establishments classified by number of persons employed, not including proprietors and firm members:						
193	Total number of establishments	...	35	...	...	10	...
194	No employees	20	43	5	21	48	2
195	Under 5	86	435	67	85	498	9
196	5 to 20	23	277	22	47	387	13
197	21 to 50	2	52	2	5	67	7
198	51 to 100	...	15	1	...	17	...
199	101 to 250	...	12	1	1	18	1
200	251 to 500	...	3	...	...	6	...
201	501 to 1,000	...	...	...	...	1	...
202	1,001 to 5,000	...	...	...	...	...	...

BY STATES AND TERRITORIES: 1900—Continued.

South Carolina.	South Dakota.	Tennessee.	Texas.	Utah.	Vermont.	Virginia.	Washington.	West Virginia.	Wisconsin.	Wyoming.	
18,850	16,463	165,718	147,602	24,163	26,699	92,370	84,570	43,577	213,882	3,300	112
13,600	6,000	58,168	96,989	15,538	....	67,995	35,250	26,200	104,592	1,200	113
5,250	10,463	107,550	50,613	8,625	26,699	24,375	49,320	17,377	109,290	2,100	114
200	....	....	....	2,000	....	3,100	500	....	1,000	500	115
23,327	1,600	7,700	101,392	30,630	8,400	13,030	7,850	4,900	161,995	985	116
110,111	151,438	1,136,199	732,867	36,036	107,597	291,690	161,990	169,936	771,574	20,902	117
8,000	34,400	270,150	61,400	13,800	35,250	96,890	41,418	6,400	189,948	7,000	118
....	....	1,540,900	1,250	150	300	120,500	5,300	....	69,600	....	119
1,500	28,265	10,350	10,250	16,500	10,400	9,700	5,500	1,200	18,500	....	120
117	218	251	722	72	79	204	199	176	595	42	121
7	16	16	83	6	9	37	15	19	60	4	122
3	3	7	34	2	....	16	7	6	13	1	123
3	3	7	20	2	....	13	6	4	11	1	124
....	....	....	14	....	....	3	1	2	2	....	125
4	13	9	49	4	9	21	8	13	47	3	126
....	1	2	2	....	2	2	2	2	4	....	127
4	12	7	47	4	7	19	6	11	43	3	128
1	....	....	....	1	....	3	1	....	1	1	129
15	1	6	22	7	2	6	3	4	21	2	130
83	189	187	579	49	53	126	154	141	463	32	131
10	9	28	33	4	10	23	21	11	42	3	132
....	....	10	1	2	1	6	2	....	5	....	133
1	3	4	4	3	4	3	3	1	3	....	134
100	203	198	648	55	63	153	152	165	527	40	135
9	....	32	25	6	3	32	8	5	17	....	136
3	3	5	12	3	4	4	5	3	5	1	137
....	1	....	....	....	....	....	9	....	1	....	138
1	2	3	9	....	1	3	1	....	5	....	139
....	1	1	1	....	2	....	2	....	7	1	140
....	....	....	6	....	....	2	....	....	3	....	141
....	....	3	1	....	1	2	1	....	2	....	142
....	....	....	1	3	....	1	1	....	1	....	143
....	1	....	....	....	....	....	....	....	....	....	144
....	3	3	....	2	....	1	9	2	3	....	145
....	4	2	3	....	....	1	3	....	7	....	146
....	....	....	2	....	....	....	1	....	2	....	147
4	....	3	6	2	3	5	3	1	3	....	148
....	....	1	8	1	2	....	4	....	12	....	149
....	....	....	1	....	....	....	....	....	5	....	150
....	....	....	1	....	....	....	....	....	....	....	151
....	....	....	....	....	....	....	....	....	....	....	152
....	....	....	....	....	....	....	....	....	3	....	153
116	211	249	692	70	79	201	196	171	486	42	154
....	....	....	....	....	....	....	....	....	....	....	155
....	....	....	....	....	....	....	....	....	....	....	156
....	....	....	....	....	....	....	....	....	....	....	157
....	....	....	....	....	....	....	....	....	....	....	158
1	5	2	19	1	....	3	2	5	79	....	159
....	....	....	2	....	....	....	....	....	2	....	160
....	....	....	....	....	....	....	....	....	....	....	161
....	....	....	....	....	....	....	....	....	....	....	162
....	....	....	....	....	....	....	....	....	....	....	163
....	....	....	....	....	....	....	....	....	....	....	164
....	....	....	....	....	....	....	....	....	....	....	165
....	....	....	....	....	....	....	....	....	....	....	166
....	....	....	....	....	....	....	....	....	....	....	167
....	....	....	....	....	....	....	....	....	....	....	168
....	2	....	....	1	....	....	1	....	20	....	169
....	....	....	....	....	....	....	....	....	....	....	170
....	....	....	6	....	....	....	....	....	....	....	171
....	....	....	....	....	....	....	....	....	....	....	172
....	....	....	....	....	....	....	....	....	....	....	173
....	....	....	1	....	....	....	....	....	....	....	174
59	120	155	402	40	50	116	26	78	373	23	175
$318,322	$454,867	$1,644,398	$2,742,924	$545,378	$491,716	$967,089	$1,054,091	$596,829	$3,455,364	$111,786	176
$262,440	$387,758	$1,400,536	$2,444,512	$445,510	$455,106	$879,850	$923,466	$481,712	$3,108,786	$90,905	177
27	55	50	157	13	45	61	57	59	269	14	178
137	228	851	1,132	163	263	369	380	407	1,830	57	179
11	11	26	41	5	8	19	8	28	58	1	180
52	55	436	572	60	51	174	47	170	781	6	181
15	35	14	92	1	7	12	12	21	129	10	182
48	103	51	274	3	22	35	33	149	394	31	183
....	5	3	....	....	6	5	14	14	21	....	184
....	17	11	....	....	22	22	69	62	62	....	185
....	....	11	4	....	....	....	1	1	10	....	186
....	....	146	44	....	....	....	2	7	38	....	187
....	2	1	....	....	11	6	2	5	15	1	188
....	4	1	....	....	53	11	7	18	29	13	189
37	45	184	242	100	111	127	222	1	526	7	190
....	4	22	....	....	4	....	....	....	....	....	191
....	....	....	....	....	....	....	....	....	40	....	192
98	198	217	654	62	61	162	188	147	495	38	193
4	15	28	67	8	6	9	45	8	29	5	194
63	152	143	452	36	18	98	113	99	295	25	195
28	29	31	121	13	30	44	26	35	148	8	196
2	2	6	10	1	5	9	1	....	15	....	197
1	....	7	4	2	2	2	1	5	4	....	198
....	....	2	....	2	....	....	2	....	3	....	199
....	....	....	....	....	....	....	....	....	1	....	200
....	....	....	....	....	....	....	....	....	....	....	201
....	....	....	....	....	....	....	....	....	....	....	202

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 217. WASHINGTON, D. C. JUNE 30, 1902.

MANUFACTURES.

SLAUGHTERING AND MEAT PACKING.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, the statistics of the slaughtering and meat packing industry in the United States for the census year 1900, prepared under my direction by Mr. Harry C. McCarty, of the Census Office.

The statistics included in the report were collected, as at the Eleventh Census in 1890, upon a special schedule. The returns made on this schedule were tabulated under two classifications—Slaughtering, Wholesale, not including Meat Packing; and Slaughtering and Meat Packing, Wholesale. The figures of these two classifications are united in all the tables of this bulletin, except in Tables 5 and 6, which present the figures for the several states, separately for each classification.

Although slaughtering and meat packing has been treated as a manufacturing industry at each census since 1850, it is closely allied with the agricultural features of the raising of live stock.

The statistics are presented in 12 tables. Table 1 shows the growth of the industry for the half century which terminated with the Twelfth Census; Table 2 shows a comparative summary of the industry as between 1890 and 1900 for the several states; Table 3 presents the percentage of capital invested and of value of products for the 13 states leading in value of products in 1900, as compared with the total capital invested and value of products for the United States; Table 4 is a comparative table of the statistics for 1880, 1890, and 1900 of those cities that, in 1900, reported a production to the value of $1,000,000 and over; Table 5 shows the detailed statistics for slaughtering operations as conducted by establishments not engaged in meat packing; Table 6 shows the detailed statistics for the establishments engaged in meat packing, including such slaughtering as was carried on by the packing establishments; Table 7 is a comparative statement between 1890 and 1900 of the quantity and cost of the materials used, with the percentage of increase; Table 8 shows the quantity and value of the products reported in 1890 and 1900, with the percentage of increase; Table 9 shows the detailed statistics of production in these cities showing in 1900 a value of products of $1,000,000 and over. From this table the figures for several cities are omitted, for the reason that their publication would reveal the operations of individual establishments; Table 10 is a statement of live stock imports and exports during the fiscal years from 1890 to 1900, both inclusive, which ended June 30, one month later than the census year; Table 11 presents the statistics of exports and imports of animal products also for the same fiscal years; Table 12 is a detailed summary of the industry as a whole, as it existed at the taking of the Twelfth Census. These tables are supplemented by four small tables, showing the receipts, shipments, and number of live stock slaughtered in Chicago, Kansas City, Omaha, and St. Louis, respectively. A diagram, which shows the relative order of the 12 cities leading in 1900 in value of products, accompanies Table 9.

Owing to changes in the method of taking the census, comparisons between the earlier and later decades, represented in Table 1, should be drawn only in the most general way. The manufacturing statistics of the censuses prior to 1850 were too imperfect and fragmentary in character to make it proper to reproduce them in such a table as a measure of industrial growth in the first half of the century.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital—that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries—was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1890 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

In some instances the number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations or cooperative establishments.

The reports show a capital of $189,198,264 invested in this industry. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the establishments conducting business under a corporate form of organization. The value of products is returned at $785,562,433, to produce which involved an outlay of $10,123,247 for salaries of officials, clerks, etc.; $33,457,013 for wages; $24,060,412 for miscellaneous expenses, including rent, taxes, etc.; and $683,583,577 for material used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is, in any sense, indicative of the profits in the manufacture of the products during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the shop or factory. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures.

SLAUGHTERING AND MEAT PACKING.

By Harry C. McCarty.

The process of converting live stock into food for human consumption is an industry that, directly and indirectly, furnishes employment to a considerable portion of the population of the United States, and sustenance to all. The Census Office recognizes two classifications of this process—one, slaughtering, wholesale, not including meat packing, which involves the preparation of fresh meat; the other, slaughtering and meat packing, wholesale, which comprehends the packing of meat and the preparation of the various other animal products and by-products. Up to the census of 1890 these two branches were reported together under various names, but at that time the classification was subdivided as indicated above. This classification was also adopted at the Twelfth Census in 1900. The figures of these subdivisions are united in Table 1.

Table 1.—COMBINED SLAUGHTERING AND MEAT PACKING: COMPARATIVE SUMMARY, 1850 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.						PER CENT OF INCREASE.				
	1900	1890	1880	1870	1860	1850	1890 to 1900	1880 to 1890	1870 to 1880	1860 to 1870	1850 to 1860
Number of establishments	921	1,118	872	768	259	185	[1]17.6	28.2	13.5	196.5	40.0
Capital	$189,198,264	$116,887,504	$49,419,213	$24,224,692	$10,158,362	$3,482,500	61.9	136.5	104.0	138.5	191.7
Salaried officials, clerks, etc., number	10,227	[2]3,971	(3)	(3)	(3)	(3)	157.5	......	......	......	......
Salaries	$10,123,247	[2]$4,536,600	(3)	(3)	(3)	(3)	123.1	......	......	......	......
Wage-earners, average number	68,634	43,975	27,297	8,366	5,058	3,276	55.8	61.1	226.3	65.4	54.4
Total wages	$33,457,013	$24,304,976	$10,508,530	$2,553,447	$1,019,266	$1,231,536	37.7	131.3	311.6	150.5	[1]17.2
Men, 16 years and over	63,922	42,285	26,113	7,906	5,039	3,267	51.2	61.9	230.3	56.9	54.2
Wages	$32,239,847	$23,887,890	(3)	(3)	(3)	(3)	35.0	......	......	......	......
Women, 16 years and over	2,945	990	......	202	19	9	197.5	......	[1]100.0	963.2	111.1
Wages	$853,813	$285,654	......	(3)	(3)	(3)	199.0	......	......	......	......
Children, under 16 years	1,667	700	1,184	258	(3)	(3)	138.1	[1]40.9	358.9	......	......
Wages	$363,353	$131,532	(3)	(3)	(3)	(3)	176.3	......	......	......	......
Miscellaneous expenses	$24,060,412	$16,716,735	(4)	(4)	(4)	(4)	53.1	......	......	......	......
Cost of materials used	$683,583,677	$480,962,211	$267,738,902	$61,674,024	$23,564,433	$9,451,096	42.1	79.6	334.1	161.7	149.3
Value of products	$785,562,433	$561,611,668	$303,562,413	$75,826,500	$29,441,776	$11,981,642	39.9	85.0	300.3	157.5	145.7

[1] Decrease.
[2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 12.)
[3] Not reported separately.
[4] Not reported.

The development of this industry during the half century covered by the table has been almost phenomenal. The settlement of the Western country and the consequent expansion of territory devoted to stock raising; the extension of railroads and the increased facility of communication; the methods devised to insure preservation of meats, such as improved methods of curing, and the introduction and improvement of mechanical and chemical processes of refrigeration, rendering summer packing possible; the utilization of every part of the animal; and the adoption of labor-saving devices, are among the factors that have contributed to its growth. In the fifty years the number of establishments increased from 185 to 921; the capital invested, from $3,482,500 to $189,198,264; the number of wage-earners, from 3,276 to 68,534; the wages paid, from $1,231,536 to $33,457,013; the cost of materials used, from $9,451,096 to $683,583,577; and the value of products, from $11,981,642 to $785,562,433. The average amount of capital invested per establishment grew from $18,824 in 1850 to $205,427 in 1900; the average yearly earnings of the wage-earners grew from $376 to $488; and the average value of products per establishment rose from $64,766 to $852,945. The growth was steady.

During the ten years covered by the Eighth Census, taken in 1860, the center of the meat industry was at Cincinnati and in the Ohio Valley. The average amount of capital invested per establishment increased from $18,824 to $39,221, or 108.4 per cent, while the average value of products per establishment increased from $64,766 to $113,675, or 75.5 per cent. From that time concentration in definite centers was a marked feature of the growth. The effects of the industrial crisis of 1857, with its wholesale reduction of wages, is seen by the difference in the average yearly wage paid in 1850 and 1860. In 1850 it was $376, which decreased to $202 in 1860, a decrease of 46.3 per cent. The winter packing in eight principal Western centers grew from 720,500 hogs in 1850 to 992,310 hogs in 1860.

In the following decade, from 1860 to 1870, a still greater relative growth is shown. The number of establishments increased 509, or 196.5 per cent, the largest increase in this item recorded in the half century. The sum of $14,066,330 was added to the capital invested; 3,308 wage-earners more than formerly found employment, and the benefit to the stock raiser is shown approximately in the increase of $38,109,591, or 161.7 per cent paid for materials used. The value of the product increased $46,384,724, or 157.5 per cent. It should be remembered, however, that these values were expressed in a currency which was at a discount in gold, and should therefore be reduced about one-fifth for purposes of comparison with the other census years. This decade saw the beginning of the dressed-beef trade. The refrigerator car was invented, and in September, 1869, the first cargo of dressed beef was shipped from Chicago to Boston. The capital invested per establishment decreased from $39,221 to $31,543, or 19.6 per cent. This decrease was due principally to the large increase in the number of small establishments. The average value of products per establishment decreased from $113,675 to $98,732, or 13.1 per cent.

The development in the decade from 1870 to 1880 was due primarily to the improvement in various refrigerating processes, and the consequent inauguration of summer packing on a large scale. Up to 1872, in the pork-packing branch of the industry, summer slaughtering and packing had not assumed large proportions, but in the packing year 1872–1873, 505,500 hogs were killed during the summer season. The increase was steady until the summer season of 1879–1880, when 4,051,248 hogs were killed and packed. In 1872–1873 summer packing amounted to 8.5 per cent of the pack for the entire year, while in 1879–1880 it had grown to 37.7 per cent. During the same period, winter packing grew from 5,410,314 hogs in 1872–1873 to 6,950,451 hogs in 1879–1880. Winter packing increased 28.5 per cent, while summer packing increased 701.6 per cent. This latter growth affords an illustration of the influence that refrigeration had on the growth of the meat trade. The yearly pack increased from 5,915,814 hogs in 1872–1873 to 11,001,699 in 1879–1880, or 86 per cent. The dressed-beef trade, too, was given an impetus by the introduction of the refrigerating processes. Up to 1875 this trade had been of minor importance except for local consumption, but with the introduction of the refrigerator car, allowing shipment to markets at a distance from the place of slaughtering, it assumed large proportions. The beginning of the export of fresh beef dates from 1876. The canning of beef was attempted in Chicago in the sixties, and had some growth, but it was not until 1879 that it was taken up on a large scale. The decrease in the number of women employed, and the increase in the number of children, is a noticeable feature. The table shows, however, a large increase in all other items.

In the ninth decade (1880–1890), the capital invested and the wages had very nearly the same growth per cent, although the total amount of wages was a little more than one-fifth the amount of capital invested. The value of products increased $258,049,255, or 85 per cent. The number of establishments increased faster than in the preceding decade. The average amount of the capital invested per establishment increased from $56,673 in 1880 to $104,551 in 1890; the average value of products per establishment increased from $348,122 to $502,336, an increase of 44.3 per cent. This decade is the only one in which the growth per cent of the value of products exceeded the growth per cent of the cost of materials used. This was due to the fact that the packer began to utilize the waste that was formerly thrown away, thus giving an increased value to the product, while the value of the stock, as purchased from the stock raiser, did not increase in corresponding ratio.

In the tenth decade (1890–1900), the progress of concentration went steadily on. In 1900 there were 921 establishments, with an invested capital of $189,198,264, an average capital of $205,427, as against 1,118 establishments in 1890, with a capital of $116,887,504, and an average of $104,551 invested per establishment, or an increase in the individual establishment in the ten years of 96.5 per cent. These figures show this period to be the most rapid in its tendency toward concentration. The more extended use and consequent increased operating expenses of the refrigerator car system, owned by the packers, explains part of the increase in the miscellaneous expenses. In 1890 the miscellaneous expenses were 2.8 per cent of the value of the product, and 3.1 per cent in 1900. The largest percentage of increase appears in the number of women and children employed and the wages paid them. The number of women employed increased 197.5 per cent, and their wages 199 per cent; the number of children employed increased 138.1 per cent, and their wages 176.3 per cent.

A reference to Table 2, showing the comparative summary, by states, is instructive as indicating the geographical location of this industry, and, roughly, its movement during the decade 1890–1900.

TABLE 2.—COMBINED SLAUGHTERING AND MEAT PACKING: COMPARATIVE SUMMARY, BY STATES, 1890 AND 1900.

STATES.	Year.	Number of establishments.	Capital.	Salaried officials, clerks, etc.: Number.	Salaried officials, clerks, etc.: Salaries.	Average number of wage-earners and total wages: Total: Average number.	Total: Wages.	Men, 16 years and over: Average number.	Men, 16 years and over: Wages.	Women, 16 years and over: Average number.	Women, 16 years and over: Wages.	Children, under 16 years: Average number.	Children, under 16 years: Wages.	Miscellaneous expenses.	Cost of materials used.	Value of products.
United States	1900	921	$189,198,264	10,227	$10,123,247	68,534	$33,457,013	63,922	$32,239,847	2,945	$853,813	1,667	$363,353	$24,060,412	$683,583,577	$785,562,433
	1890	1,118	116,887,604	[1] 3,971	[1] 4,636,600	43,975	24,304,976	42,285	23,887,890	990	285,554	700	131,532	15,716,735	480,962,211	561,611,668
California	1900	58	3,913,081	180	254,567	925	544,669	915	638,611	10	6,048	.....	.....	441,210	13,555,445	15,717,712
	1890	50	2,220,536	144	190,430	436	333,697	435	333,467	.....	.....	1	240	290,208	8,075,060	9,768,858
Colorado	1900	14	1,380,518	48	60,896	261	170,744	259	170,244	2	500	.....	.....	56,384	3,721,610	4,343,983
	1890	5	348,650	14	21,668	81	58,424	81	58,424	.....	.....	.....	.....	29,665	1,872,349	2,184,580
Connecticut	1900	12	562,564	37	36,662	380	174,239	378	173,829	2	410	.....	.....	76,721	3,143,590	3,663,393
	1890	15	662,885	42	46,627	384	190,559	383	190,039	1	520	.....	.....	42,365	3,428,072	4,153,378
Delaware	1900	4	234,420	22	13,610	37	20,398	36	20,242	.....	.....	1	156	9,899	442,389	521,076
	1890	6	149,400	6	4,840	40	20,210	40	20,210	.....	.....	.....	.....	3,522	250,750	320,206
Dist. Columbia	1900	7	248,200	32	15,784	116	63,607	114	62,931	2	676	.....	.....	19,935	2,013,827	2,210,860
	1890	24	118,230	27	19,970	82	37,113	80	36,697	.....	.....	2	416	11,029	664,753	858,439
Georgia	1900	7	115,827	34	20,235	104	32,440	102	32,115	1	75	1	250	11,234	483,695	591,227
	[2] 1890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Illinois	1900	64	71,229,262	4,226	4,424,285	27,861	14,044,838	25,792	13,462,377	1,473	427,203	596	155,258	14,211,396	246,713,309	287,922,277
	1890	81	40,807,115	984	1,087,367	17,932	10,500,038	17,022	10,271,345	502	152,412	408	76,281	6,463,616	180,903,912	212,291,382
Indiana	1900	36	8,860,284	303	314,603	3,597	1,565,752	3,157	1,455,428	387	101,499	53	8,825	530,956	38,608,841	43,862,273
	1890	21	5,346,255	142	139,559	2,107	1,018,104	1,956	983,724	117	29,196	34	5,184	1,358,233	24,425,470	27,913,840
Iowa	1900	27	6,351,353	193	197,376	2,887	1,208,167	2,643	1,163,421	29	9,906	215	34,840	441,986	21,556,644	25,695,044
	1890	29	4,485,020	153	189,262	2,575	1,122,695	2,518	1,108,755	7	2,100	50	11,840	526,765	20,655,223	23,426,576
Kansas	1900	14	16,486,177	1,841	1,631,866	8,117	3,575,049	7,170	3,330,631	661	190,802	286	53,616	2,003,771	67,908,960	77,411,883
	1890	18	11,086,058	205	253,356	5,018	2,646,309	4,698	2,554,568	217	69,581	103	22,160	3,322,200	36,120,014	44,696,077
Kentucky	1900	28	1,326,976	62	51,799	511	214,271	507	213,711	4	560	.....	.....	105,694	4,444,621	5,177,167
	1890	26	1,447,945	55	49,617	414	130,767	413	130,663	.....	.....	1	104	136,116	2,604,664	3,374,011
Maine	1900	11	132,580	6	2,840	38	17,900	37	17,600	1	300	.....	.....	6,819	457,031	553,742
	1890	7	70,875	10	6,450	23	15,238	23	15,238	.....	.....	.....	.....	6,057	354,607	418,811
Maryland	1900	82	1,548,488	68	48,804	597	276,413	584	273,819	10	2,118	3	476	109,017	7,109,079	8,046,359
	1890	17	993,081	55	55,724	389	182,568	382	181,312	3	650	4	606	76,159	3,969,563	4,670,690
Massachusetts	1900	22	11,314,075	220	250,296	2,748	1,318,077	2,724	1,311,395	13	3,582	11	3,100	591,102	28,040,069	31,633,483
	1890	24	7,187,735	113	136,806	1,779	826,409	1,769	824,277	10	2,132	.....	.....	497,382	16,372,177	20,221,645
Michigan	1900	29	1,438,351	71	66,661	456	230,637	453	230,137	2	450	1	50	87,291	4,770,640	5,337,417
	1890	30	1,026,223	87	76,209	329	168,089	326	167,408	2	481	1	200	58,738	3,446,164	3,998,978
Minnesota	1900	20	1,355,011	125	102,709	668	303,977	650	299,105	9	3,000	9	1,872	90,796	6,823,255	7,810,555
	1890	18	741,346	41	43,064	222	119,792	216	118,710	1	300	5	782	60,453	2,062,954	2,510,431
Missouri	1900	37	7,944,033	242	253,775	3,102	1,440,742	2,977	1,416,457	8	2,160	117	22,125	364,267	39,108,137	43,040,885
	1890	68	4,986,780	175	223,696	1,264	645,322	1,189	632,202	73	12,620	2	500	386,743	15,142,352	18,320,193
Montana	1900	5	241,826	9	12,600	37	33,693	35	32,493	2	1,200	.....	.....	7,798	821,070	934,640
	[3] 1890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Nebraska	1900	12	16,524,895	721	684,240	6,090	2,990,863	5,602	2,862,441	173	57,425	315	70,997	1,591,516	63,048,186	71,280,366
	1890	7	5,069,499	146	142,935	2,144	1,191,595	2,075	1,178,895	16	4,800	53	7,900	525,518	26,296,950	28,941,144
New Jersey	1900	41	1,588,389	100	94,080	558	331,825	556	331,565	.....	.....	2	260	164,281	12,849,902	14,046,217
	1890	50	1,825,650	136	188,566	610	437,322	610	437,322	.....	.....	.....	.....	157,625	16,233,681	17,813,166
New York	1900	110	15,357,075	602	584,386	3,099	1,846,434	3,009	1,820,954	79	23,636	11	1,844	1,274,534	50,523,186	57,431,293
	1890	181	12,605,460	559	739,026	3,744	2,434,142	3,725	2,430,284	16	3,462	4	396	960,083	67,560,780	76,642,151
North Dakota	1900	3	104,371	8	8,760	34	15,977	38	15,677	1	300	.....	.....	8,975	198,175	256,160
	[3] 1890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	1900	71	5,355,626	313	266,001	1,765	811,398	1,717	798,514	29	8,656	19	4,228	639,008	17,927,953	20,660,780
	1890	138	3,582,540	287	801,369	1,346	682,581	1,335	679,825	6	2,300	5	456	234,983	14,341,520	17,012,198
Oregon	1900	9	760,448	41	47,130	172	87,821	166	86,441	1	480	5	900	35,768	1,359,361	1,638,480
	1890	7	1,587,600	21	39,500	107	91,500	105	91,150	1	100	1	250	37,548	1,552,760	1,978,625
Pennsylvania	1900	111	6,548,577	376	317,153	1,669	920,190	1,646	914,467	13	3,895	10	1,828	526,972	21,601,810	25,238,772
	1890	242	6,180,789	388	396,826	1,682	772,422	1,568	768,524	11	3,100	3	798	316,572	18,575,330	21,991,604
Rhode Island	1900	7	759,850	16	17,636	209	107,104	206	106,268	.....	.....	3	836	44,736	2,246,780	2,503,466
	1890	10	753,100	49	50,680	242	135,329	239	134,579	.....	.....	3	750	45,149	4,213,329	4,627,366
Tennessee	1900	8	651,740	15	17,365	156	60,945	152	60,775	4	170	.....	.....	25,268	1,453,128	1,671,218
	1890	3	54,500	8	6,120	26	11,700	26	11,700	.....	.....	.....	.....	1,782	124,090	150,742
Texas	1900	12	1,232,267	49	61,797	414	179,505	394	173,438	19	5,867	1	200	66,749	3,170,536	3,904,491
	[3] 1890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Utah	1900	8	117,027	6	2,472	42	18,653	42	18,653	.....	.....	.....	.....	5,940	385,353	453,456
	1890	4	302,134	12	14,770	62	45,984	61	45,840	.....	.....	1	144	16,096	457,064	545,200
Virginia	1900	4	159,500	19	14,340	65	28,884	65	28,884	.....	.....	.....	.....	3,988	637,730	748,620
	[2] 1890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900 but not included in this table. (See Table 12.)
[2] Included in "all other states."
[3] None reported in 1890.

TABLE 2.—COMBINED SLAUGHTERING AND MEAT PACKING: COMPARATIVE SUMMARY, BY STATES, 1890 AND 1900—Continued.

STATES.	Year.	Number of establishments.	Capital.	Salaried officials, clerks, etc.: Number.	Salaried officials, clerks, etc.: Salaries.	Average number of wage-earners and total wages: Total: Average number.	Total: Wages.	Men, 16 years and over: Average number.	Men, 16 years and over: Wages.	Women, 16 years and over: Average number.	Women, 16 years and over: Wages.	Children, under 16 years: Average number.	Children, under 16 years: Wages.	Miscellaneous expenses.	Cost of materials used.	Value of products.
Washington	1900	18	$1,014,086	88	$81,116	231	$156,531	229	$155,631	2	$900	......	......	$80,008	$4,252,435	$4,892,857
	[1]1890	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
West Virginia	1900	3	313,000	16	11,800	84	42,646	76	40,642	6	1,620	2	$384	4,623	1,133,954	1,337,578
	[1]1890	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Wisconsin	1900	13	3,811,616	123	145,333	1,367	563,208	1,365	562,833	2	375	......	......	408,991	11,889,524	13,649,750
	1890	22	2,622,821	63	69,179	860	392,683	842	389,033	3	1,400	15	2,250	108,512	9,176,673	10,346,398
All other states and territories.[2]	1900	14	216,671	15	10,270	137	59,426	131	58,118	......	......	6	1,308	12,779	1,183,352	1,374,953
	1890	16	625,277	49	43,084	177	94,384	168	93,709	5	400	4	275	44,616	2,082,050	2,435,979

[1] Included in "All other states."

[2] Includes establishments distributed as follows: 1890—Florida, 2; Georgia, 1; New Hampshire, 2; North Carolina, 1; South Dakota, 2; Vermont, 1; Virginia, 1; Washington, 4; West Virginia, 2; 1900—Alabama, 2; Arkansas, 2; North Carolina, 1; New Hampshire, 1; New Mexico, 2; Oklahoma, 2; South Carolina, 1; South Dakota, 1; Wyoming, 2.

In value of products Illinois was the leading state in both years. As between the two census years it is seen that Kansas advanced from third place to second, New York dropped from second place to fourth, Nebraska advanced from fourth to third, Indiana occupied fifth place in both years, Iowa fell from sixth to eighth, Massachusetts advanced from eighth to seventh, and California from thirteenth to eleventh. The list of the leading 13 states, in their order, in 1890 is as follows: Illinois, New York, Kansas, Nebraska, Indiana, Iowa, Pennsylvania, Massachusetts, Missouri, New Jersey, Ohio, Wisconsin, and California; in 1900 the order was: Illinois, Kansas, Nebraska, New York, Indiana, Missouri, Massachusetts, Iowa, Pennsylvania, Ohio, California, New Jersey, and Wisconsin. The falling off in the value of products in New York and New Jersey is noteworthy. Of these 13 states the greatest gain per cent was made by Nebraska, with 146.3 per cent, followed by Missouri, with 134.9 per cent. During the decade Illinois made by far the greatest absolute gain, $75,630,895, an amount nearly equal to the entire value of products for Kansas, the second state in 1900. In absolute gain, Nebraska, with $42,339,222, held second place; Kansas, with $32,715,806, third; and Missouri, with $24,720,692, fourth; Indiana came next with $15,948,433. In these 5 states the number of establishments decreased from 195 to 163; their capitalization increased by $53,748,944, of which Illinois was credited with $30,422,147, or more than the increase of the other four put together. The products of the leading thirteen states increased $191,355,048, which was 85.4 per cent of the total increase of $223,950,765 reported for the country.

Table 2 shows the expansion that has taken place in this industry in the Middle West. Illinois is far in the lead. This state in 1900 had 6.9 per cent of the establishments, 37.6 per cent of the capital, 40.7 per cent of the wage-earners, paid 42 per cent of the wages, and produced 36.7 per cent of the products. The industry in the Southern states can hardly be said to exist in an industrial sense, except as a so-called "neighborhood" industry. The Northeastern states are coming more and more to rely upon the West as the source of their meat supply. The decline in New York of 25.1 per cent in the value of products, and in New Jersey of 21.1 per cent, shows that the Western dressed meat is supplying much of the demand that was formerly filled by the Eastern dressed article.

In the extreme West the fact that the production of Oregon decreased from $1,978,625 to $1,638,480, or 17.2 per cent, while that of California increased from $9,768,858 to $15,717,712, or 60.9 per cent, is noteworthy. No comparison can be made for the state of Washington, owing to the fact that the figures for 1890 can not be shown without disclosing the operations of individual establishments. The table shows a growth of 65 establishments in Maryland. Minnesota shows a growth of $5,300,124, or 211.1 per cent, in the value of products. Texas reported no establishments in 1890, but in 1900 returned 12 establishments, with a capital invested of $1,232,267, employing 414 wage-earners, who earned $179,505 during the census year, and produced a product valued at $3,904,491. Utah, although reporting an increase of 4 establishments (from 4 to 8), shows a decrease of $91,744, or 16.8 per cent, in the value of products. The progress of concentration is shown in Pennsylvania, where the number of establishments decreased from 242 to 111, or 54.1 per cent. Delaware shows a loss of 1 establishment, but an increase in the value of products from $320,206 to $521,076, an increase of $200,870, or 62.7 per cent. The number of establishments in the District of Columbia decreased from 24 to 7, but the value of products increased $1,352,421, or 157.5 per cent. Connecticut lost 3 establishments and $489,985 in value of products, or 11.8 per cent.

In consulting Table 3 it should be borne in mind that these figures do not represent an actual increase or decrease in amounts, but a change as compared with the figures for the industry for the entire country.

TABLE 3.—COMBINED SLAUGHTERING AND MEAT PACKING: PERCENTAGES OF CAPITAL AND PRODUCTS FOR THIRTEEN STATES LEADING IN 1900 IN VALUE OF PRODUCTS TO TOTAL CAPITAL AND TOTAL VALUE OF PRODUCTS, 1890 AND 1900.

STATES.	PER CENT OF TOTAL CAPITAL OF THE UNITED STATES.		PER CENT OF TOTAL VALUE OF PRODUCTS OF THE UNITED STATES.	
	1890	1900	1890	1900
Illinois	34.9	37.6	37.8	36.7
Kansas	9.5	8.7	8.0	9.9
Nebraska	4.3	8.7	5.2	9.1
New York	10.8	8.1	13.6	7.3
Indiana	4.6	4.7	5.0	5.6
Missouri	4.3	4.2	3.3	5.5
Massachusetts	6.1	6.0	3.6	4.0
Iowa	3.8	3.4	4.2	3.3
Pennsylvania	5.3	3.6	3.9	3.2
Ohio	3.1	2.8	3.0	2.6
California	1.9	2.1	1.7	2.0
New Jersey	1.6	0.8	3.2	1.8
Wisconsin	2.2	2.0	1.8	1.7

This table presents the percentage of capital invested and of value of products in the 13 states leading in value of products in 1890 and 1900, as compared with the totals of these items for the United States. It shows the figures of Table 2 in this regard, expressed to make clearer the relative importance of these states. Illinois gained 2.7 per cent in capital invested, but lost 1.1 per cent in value of products. A large decrease is shown in New York, where the capital invested fell off 2.7 per cent and the products 6.3 per cent. Kansas shows a loss of 0.8 per cent in capital invested, but a gain of 1.9 per cent in value of products. Nebraska shows a gain of 4.4 per cent in capital and 3.9 per cent in value of products. Massachusetts shows a falling off of 0.1 per cent in capital invested, but a gain of 0.4 per cent in value of products. The gain in California indicates a normal and steady growth, due to increase of population and of export demand. Missouri shows a slight loss per cent in capital invested, but a considerable gain in value of products. New Jersey suffered a loss in both items. In connection with this table it should be noticed that although in 1900 Iowa led in the production of hogs, and stood second in the number of cattle raised, it was eighth, as shown by Table 3, in the value of meat products. This indicates the tendency for slaughtering and packing operations to concentrate in well-defined centers, as shown in Table 4.

TABLE 4.—COMBINED SLAUGHTERING AND MEAT PACKING: COMPARATIVE SUMMARY OF CITIES HAVING A PRODUCT VALUED AT OVER $1,000,000, 1880 TO 1900.[1]

CITIES.	Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
Allegheny, Pa	1900	8	$1,497,666	52	$57,800	438	$233,028	$111,546	$3,338,805	$3,996,807
	1890	7	140,860	[2]13	[2]9,750	42	17,390	7,104	233,876	294,065
	[3]1880									
Baltimore, Md	1900	73	1,344,953	57	44,724	508	233,898	99,546	6,257,558	7,066,461
	1890	14	958,521	[2]53	[2]63,904	368	171,208	76,232	3,668,147	4,311,412
	1880	6	705,000	(3)	(3)	194	85,300	(4)	2,559,662	2,742,645
Boston, Mass	1900	6	40,915	14	8,996	34	23,030	14,006	1,144,276	1,329,010
	1890	3	452,087	[2]19	[2]34,507	199	140,466	22,176	2,524,447	2,782,823
	1880	21	918,000	(3)	(3)	211	153,263	(4)	6,609,139	7,096,777
Brooklyn Borough, N. Y	1900	10	618,825	35	32,660	227	136,777	59,293	3,783,042	4,126,632
	1890	37	1,672,528	[2]95	[2]155,258	449	335,959	120,002	11,640,449	13,087,354
	1880	28	1,125,000	(3)	(3)	260	194,568	(4)	7,340,450	8,010,492
Buffalo, N. Y	1900	24	6,173,694	203	146,523	928	436,869	342,878	10,026,676	11,601,167
	1890	34	2,915,280	[2]90	[2]96,374	766	377,849	128,844	8,437,164	9,951,044
	1880	6	872,500	(3)	(3)	289	170,433	(4)	3,023,924	3,441,280
Chicago, Ill	1900	38	67,137,569	4,010	4,233,994	25,345	12,875,676	13,829,826	218,241,331	256,527,949
	1890	57	39,222,195	[2]900	[2]1,003,668	16,975	10,002,573	6,218,026	173,568,365	203,606,402
	1880	70	8,455,200	(3)	(3)	7,478	3,392,748	(4)	74,546,319	85,324,371
Cincinnati, Ohio	1900	27	2,893,064	98	103,830	856	414,621	437,889	8,806,652	10,370,177
	1890	83	2,215,490	[2]149	[2]173,404	675	373,859	152,462	7,873,703	9,511,188
	1880	49	4,074,682	(3)	(3)	1,143	338,302	(4)	10,454,991	11,614,810
Cleveland, Ohio	1900	10	1,827,288	173	135,886	577	285,023	175,132	6,769,023	7,514,470
	1890	13	744,465	[2]73	[2]79,080	382	200,981	30,670	4,983,627	5,682,666
	1880	12	447,000	(3)	(3)	416	192,892	(4)	4,886,771	5,427,938
Dayton, Ohio	1900	10	242,925	12	9,900	147	75,881	10,332	959,661	1,097,525
	1890	4	63,750	[2]15	[2]14,500	42	23,700	3,842	265,436	336,928
	1880	5	50,500	(3)	(3)	29	20,980	(4)	178,136	236,318
Denver, Colo	1900	7	833,618	27	36,496	171	103,274	33,184	2,404,458	2,858,947
	1890	3	200,150	[2]9	[2]13,920	59	44,322	23,946	1,415,849	1,625,711
	1880	4	49,000	(3)	(3)	40	15,990	(4)	586,920	590,945
Detroit, Mich	1900	16	1,184,776	61	59,581	338	177,856	70,687	3,628,440	4,047,749
	1890	19	818,023	[2]78	[2]70,526	280	145,288	46,009	2,953,987	3,404,424
	1880	7	485,000	(3)	(3)	147	79,067	(4)	1,413,426	1,721,231

[1] The following cities, having a product valued at over $1,000,000, are not included in the above table, because in 1900 they had less than 3 establishments, except Patterson, N. J., and Seattle, Wash., which cities, together with those of 1880 and 1890 shown below, are not included because they are no comparative figures. These establishments are distributed as follows: 1890—Cambridge, Mass., 2: Cedar Rapids, Iowa, 1; Chicopee, Mass., 1; Clinton, Iowa, 1; Hammond, Ind., 1; Los Angeles, Cal., 1; Marshalltown, Iowa, 1; Nebraska City, Nebr., 1; New Haven, Conn,, 2; Orange, Conn., 1; Ottumwa, Iowa, 1; Paterson, N. J., 3, Seattle, Wash., 8, Topeka, Kans., 1; Wheeling (and Ohio County), W. Va., 2; Wichita, Kans., 1. 1890—Los Angeles, Cal., 6. 1880—Cambridge, Mass., 5; Wheeling, W. Va., 4; Worcester, Mass., 5.

[2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this summary.

[3] Not reported separately.

[4] Not reported.

TABLE 4.—COMBINED SLAUGHTERING AND MEAT PACKING: COMPARATIVE SUMMARY OF CITIES HAVING A PRODUCT VALUED AT OVER $1,000,000, 1880 TO 1900[1]—Continued.

CITIES.	Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
East St. Louis, Ill	1900	3	$3,183,288	156	$138,259	2,159	$985,497	$305,594	$25,370,543	$27,676,818
	[2]1890	...	...	...	...	...	...	...	...	...
	1880	3	1,550,000	(2)	(2)	2,540	530,019	(3)	6,104,019	7,950,000
Indianapolis, Ind	1900	7	3,807,246	136	128,834	1,943	783,226	218,989	17,400,330	18,781,442
	1890	8	990,220	[4]51	[4]48,000	827	386,472	108,015	6,408,053	6,295,975
	1880	7	1,618,000	(2)	(2)	892	345,236	(3)	7,890,208	9,014,422
Jersey City, N. J	1900	13	473,485	27	26,882	183	130,707	58,342	5,872,946	6,243,217
	1890	18	697,640	[4]57	[4]88,332	240	197,304	51,295	10,712,166	11,356,511
	1880	20	1,272,200	(2)	(2)	433	303,800	(3)	17,404,689	18,551,783
Kansas City, Kans	1900	8	15,114,601	1,771	1,679,436	7,713	3,381,510	1,919,411	65,082,581	73,787,771
	1890	6	8,964,586	[4]159	[4]180,373	4,458	2,378,153	3,058,931	32,284,123	39,927,192
	1880	3	437,500	(2)	(2)	288	166,500	(3)	739,071	965,000
Louisville, Ky	1900	12	1,218,426	52	45,739	449	189,417	100,312	3,828,486	4,444,978
	1890	12	1,272,415	[4]33	[4]22,967	327	101,328	124,475	2,023,501	2,555,154
	1880	23	2,144,500	(2)	(2)	366	141,092	(3)	3,438,459	4,287,158
Milwaukee, Wis	[5]1900	7	3,578,690	116	140,333	1,293	530,483	385,102	11,405,186	13,045,979
	1890	9	2,291,971	[4]43	[4]56,728	742	358,830	96,989	8,635,671	9,704,966
	1880	7	789,000	(2)	(2)	953	187,596	(3)	5,529,618	6,099,486
Newark, N. J	1900	10	363,777	39	32,708	176	94,993	40,275	3,276,004	3,537,896
	1890	14	541,910	[4]34	[4]56,640	207	141,144	80,032	3,205,374	3,666,696
	1880	7	232,000	(2)	(2)	88	53,822	(3)	1,368,288	1,527,660
New York (Manhattan and Bronx boroughs)	1900	42	8,648,436	320	378,194	1,705	1,166,749	829,740	34,230,835	38,752,586
	1890	56	7,143,468	[4]282	[4]418,226	2,165	1,677,238	639,338	44,761,606	50,251,504
	1880	58	1,801,000	(2)	(2)	895	575,521	(3)	27,763,577	29,297,527
Pawtucket, R. I	1900	3	501,430	...	...	84	47,280	12,129	1,045,754	1,134,946
	1890	3	495,000	[4]23	[4]30,262	102	56,650	31,253	2,670,000	2,895,191
	[2]1880	...	...	...	...	...	...	...	...	...
Philadelphia, Pa	1900	58	1,882,732	141	111,925	617	372,610	221,674	10,321,065	12,020,462
	1890	202	3,722,207	[4]264	[4]291,776	908	514,177	207,080	13,674,466	16,094,498
	1880	19	1,965,025	(2)	(2)	359	165,353	(3)	7,042,781	7,869,114
Pittsburg, Pa	1900	5	786,810	47	42,713	150	93,950	28,001	1,779,600	2,054,521
	1890	4	321,500	[4]18	[4]21,600	61	33,012	37,261	1,149,965	1,341,900
	1880	9	693,000	(2)	(2)	110	41,379	(3)	1,302,167	1,451,816
Portland, Oreg	1900	4	604,282	34	39,790	121	54,025	29,700	1,109,939	1,306,996
	1890	5	439,600	[4]18	[4]35,100	82	73,300	16,718	1,222,330	1,570,935
	[2]1880	...	...	...	...	...	...	...	...	...
Providence, R. I	1900	3	252,720	16	17,636	122	58,024	30,597	1,155,026	1,316,220
	1890	6	245,500	[4]26	[4]20,418	136	76,636	13,641	1,520,940	1,695,105
	1880	6	273,000	(2)	(2)	89	44,362	(3)	1,318,116	1,458,740
St. Joseph (including South St. Joseph), Mo	1900	5	6,200,899	131	106,001	2,216	980,749	190,550	27,645,318	29,704,973
	[2]1890	...	...	...	...	...	...	...	...	...
	[6]1880	5	134,500	(2)	(2)	204	37,290	(3)	1,224,208	1,439,843
St. Louis, Mo	1900	25	2,608,249	103	142,673	841	448,287	171,902	11,120,325	12,943,376
	1890	60	3,216,571	[4]129	[4]170,226	631	366,011	98,639	9,864,639	12,048,114
	1880	32	1,243,000	(2)	(2)	584	269,763	(3)	7,085,909	8,424,064
St. Paul, Minn	1900	6	250,998	16	11,390	84	42,252	21,097	989,749	1,288,364
	1890	6	448,600	[4]16	[4]15,700	62	35,476	14,067	659,636	783,370
	1880	5	165,000	(2)	(2)	33	17,100	(3)	371,050	429,747
San Francisco, Cal	1900	26	2,305,362	114	177,490	532	323,931	306,408	8,622,994	9,991,599
	1890	25	1,591,779	[4]86	[4]122,090	249	198,637	226,259	5,576,801	6,670,474
	1880	24	1,586,200	(2)	(2)	309	239,868	(3)	4,611,721	6,013,602
Sioux City, Iowa	1900	3	1,209,695	21	24,250	892	471,944	165,222	6,856,684	8,982,896
	1890	3	1,662,736	[4]32	[4]43,340	694	283,155	192,373	6,872,132	7,589,228
	[2]1880	...	...	...	...	...	...	...	...	...
Somerville, Mass	1900	4	6,801,141	46	70,618	1,435	692,999	314,036	14,233,788	15,692,242
	[2]1890	...	...	...	...	...	...	...	...	...
	1880	3	760,840	(2)	(2)	263	122,889	(3)	3,368,396	3,702,601
South Omaha, Nebr	1900	6	15,657,418	712	677,256	5,940	2,915,732	1,475,848	60,159,430	67,889,749
	[2]1890	...	...	...	...	...	...	...	...	...
	[2]1880	...	...	...	...	...	...	...	...	...
Washington, D. C	1900	7	248,200	32	15,784	116	63,607	19,935	2,013,827	2,210,860
	1890	24	118,230	[4]27	[4]19,970	82	37,113	10,274	664,754	858,439
	[2]1880	...	...	...	...	...	...	...	...	...

[1] The following cities, having a product valued at over $1,000,000, are not included in the above table, because in 1900 they had less than 3 establishments, except Paterson, N. J. and Seattle, Wash., which cities, together with those of 1880 and 1890 shown below, are not included because there are no comparative figures. These establishments are distributed as follows: 1900—Cambridge, Mass., 2; Cedar Rapids, Iowa, 1; Chicopee, Mass., 1; Clinton, Iowa, 1; Hammond, Ind., 1; Los Angeles, Cal., 1; Marshalltown, Iowa, 1; Nebraska City, Nebr., 1; New Haven, Conn., 2; Orange, Conn., 1; Ottumwa, Iowa, 1; Paterson, N. J., 3; Seattle, Wash., 8; Topeka, Kans., 1; Wheeling (and Ohio County), W. Va., 2; Wichita, Kans., 1. 1890—Los Angeles, Cal., 6. 1880—Cambridge, Mass., 5; Wheeling, W. Va., 4; Worcester, Mass., 5.

[2] Not reported separately.

[3] Not reported.

[4] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this summary.

[5] Includes, for 1900, Cudahy, Wis.

[6] Does not include South St. Joseph, Mo., for 1880.

Table 4 is a comparative summary for 1880, 1890, and 1900, of those cities that, in 1900, showed a production to the value of $1,000,000 and over. The product of Chicago alone reached a value of $256,527,949 in 1900, or 32.7 per cent of the total value for the United States; in 1890, this ratio was 36.3 per cent, a net loss during the decade of 3.6 per cent. Chicago's advance in value of products during these ten years was $52,921,547, or 26 per cent. The number of establishments steadily decreased, falling from 70 ir 1880 to 57 in 1890 and 38 in 1900. Kansas City stood second in value of products, in 1900, gaining during the decade, $33,860,579, or 84.8 per cent. Of the total value of products in the United States, Kansas City furnished 9.4 per cent in 1900 and 7.1 per cent in 1890, a gain of 2.3 per cent. Unfortunately the figures upon which to base such a comparison for South Omaha are not available. The industry had no existence there in 1880, and the figures for 1890 were not published separately. The total production for the state of Nebraska for 1890, however, of which South Omaha constituted a part, was $28,941,144, which was exceeded in 1900 by $38,948,605 by South Omaha alone. In 1900 South Omaha produced 8.6 per cent of the total value of the product of the United States.

At the Twelfth Census New York city (boroughs of Manhattan and Bronx) stood fourth in value of products, showing a decrease between 1890 and 1900 of $11,498,918. Brooklyn in the same time fell off $8,960,722. Jersey City and Newark also show a decrease. This was not due to any decrease in the amount of local consumption, but to the growing importance of the western dressed meat in the eastern markets. Boston shows a continuous and steady decrease in the value of products. Baltimore, on the other hand, steadily gained in number of establishments and in value of products. Philadelphia shows a gain from 1880 to 1890, but a decrease from 1890 to 1900. South St. Joseph, Mo., sprang into prominence between 1890 and 1900, and in 1900, with St. Joseph, produced 3.8 per cent of the total value of the product for the United States. The product of St. Louis, Mo., remained about the same. The figures for East St. Louis, Ill., for 1890 were not reported separately, so that no comparison can be made. In the extreme West, San Francisco gained 58.8 per cent in production between 1890 and 1900, while Portland, Oreg., fell off 16.8 per cent in the same period.

This table as a whole indicates a growth of the average establishment. While in many cases a considerable decrease is shown in the number of establishments, yet a large increase is shown in the average capital invested, and in the average value of the product of the single establishment.

The statistics of slaughtering as conducted separately from packing operations was not included in the census returns prior to the taking of the Eleventh Census, in 1890. Tables 5 and 6 should be consulted together, in order to arrive at the relative importance of the two branches for the several states.

TABLE 5.—SLAUGHTERING, WHOLESALE, NOT INCLUDING

		United States.	California.	Colorado.	Connecticut.	Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.
1	Number of establishments	348	35	7	7	3	13	11	7	3	13
	Character of organization:										
2	Individual	205	14	3	3	2	1	9	4	1	11
3	Firm and limited partnership	96	15		2	1	6	2	1	1	2
4	Incorporated company	47	6	4	2		6		2	1	
	Capital:										
5	Total	$15,103,567	$1,037,093	$118,443	$150,814	$6,427	$446,901	$202,250	$86,775	$75,700	$70,870
6	Land	$1,719,794	$85,600	$13,000	$25,500	$3,200	$37,100	$39,350	$26,300	$21,500	$15,300
7	Buildings	$3,645,060	$92,400	$15,700	$51,885	$1,325	$112,500	$49,200	$33,900	$19,000	$14,300
8	Machinery, tools, and implements	$1,508,670	$76,555	$21,000	$5,460	$102	$85,430	$49,250	$15,700	$20,700	$6,000
9	Cash and sundries	$8,230,143	$782,638	$68,743	$67,969	$1,800	$211,871	$64,450	$10,875	$14,500	$35,270
10	Proprietors and firm members	398	45	3	5	4	12	13	6	1	16
	Salaried officials, clerks, etc.:										
11	Total number	569	57	11	7	2	45	5	3	11	
12	Total salaries	$650,594	$80,415	$9,360	$4,910	$610	$43,636	$3,500	$1,320	$11,856	
	Officers of corporations—										
13	Number	51	9	2			5		2	3	
14	Salaries	$123,738	$14,400	$2,400			$10,060		$720	$6,240	
	General superintendents, managers, clerks, etc.—										
15	Total number	518	48	9	7	2	40	5	1	8	
16	Total salaries	$526,856	$66,015	$6,960	$4,910	$610	$33,576	$3,500	$600	$5,616	
	Men—										
17	Number	475	47	8	4	2	39	5	1	8	
18	Salaries	$506,975	$65,715	$6,840	$3,350	$610	$33,226	$3,500	$600	$5,616	
	Women—										
19	Number	43	1	1	3		1				
20	Salaries	$19,881	$300	$120	$1,560		$350				
	Wage-earners, including pieceworkers, and total wages:										
21	Greatest number employed at any one time during the year.	4,799	314	63	19	8	274	52	17	59	46
22	Least number employed at any one time during the year.	3,916	247	45	18	8	235	44	13	35	39
23	Average number	3,751	265	49	12	6	235	47	13	49	42
24	Wages	$2,377,298	$200,470	$31,234	$6,314	$1,390	$145,888	$28,728	$6,486	$31,272	$19,434
	Men, 16 years and over—										
25	Average number	3,725	265	49	10	5	235	46	13	49	42
26	Wages	$2,371,183	$200,470	$31,234	$5,904	$1,315	$145,888	$28,628	$6,486	$31,272	$19,434
	Women, 16 years and over—										
27	Average number	10			2	1					
28	Wages	$3,839			$410	$75					
	Children, under 16 years—										
29	Average number	16						1			
30	Wages	$2,276						$100			
	Average number of wage-earners, including pieceworkers, employed during each month:										
	Men, 16 years and over—										
31	January	3,766	268	55	15	7	222	50	14	59	43
32	February	3,735	267	55	15	7	222	48	14	54	43
33	March	3,743	267	63	12	7	260	46	14	54	42
34	April	3,698	267	53	12	7	239	46	18	49	42
35	May	4,144	269	44	8	7	254	41	13	49	42
36	June	3,401	260	39	7	4	233	43	13	31	41
37	July	3,561	259	41	9	4	228	42	8	31	39
38	August	3,612	258	41	9	4	228	42	11	40	40
39	September	3,648	261	41	9	4	234	44	11	40	36
40	October	3,746	264	43	7	4	233	51	12	59	44
41	November	3,811	271	55	7	4	238	51	16	59	43
42	December	3,835	270	55	11	4	232	49	16	59	44
	Women, 16 years and over—										
43	January	9			2	1					
44	February	12			2	1					
45	March	12			2	1					
46	April	11			1	1					
47	May	23			1	1					
48	June	8			1	1					
49	July	8			2						
50	August	8			2						
51	September	8			2						
52	October	7			1						
53	November	7			1						
54	December	7			1						
	Children, under 16 years—										
55	January	17						1			
56	February	17						1			
57	March	17						1			
58	April	14						1			
59	May	14						1			
60	June	14						1			
61	July	17						1			
62	August	15						1			
63	September	17						1			
64	October	16						1			
65	November	17						1			
66	December	17						1			
	Miscellaneous expenses:										
67	Total	$1,375,575	$69,626	$12,419	$6,808	$489	$53,225	$8,887	$4,883	$3,736	$6,269
68	Rent of works	$271,202	$19,270	$2,600	$640	$60	$9,012	$446		$720	$420
69	Taxes, not including internal revenue	$84,767	$4,644	$1,269	$888	$29	$3,209	$1,146	$831	$226	$874
70	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$1,018,799	$46,562	$8,560	$5,280	$400	$41,004	$7,295	$4,052	$2,790	$4,947
71	Contract work	$807	$50								$28
	Materials used:										
72	Total cost	$77,411,990	$6,756,619	$692,525	$220,079	$27,340	$6,965,830	$847,970	$361,578	$506,715	$545,373
	Slaughtered—										
73	Beeves, number	900,169	112,407	10,159	408	1,420	92,786	14,122	6,776	18,820	9,220
74	Cost	$41,281,671	$3,892,975	$393,472	$16,240	$26,340	$3,191,721	$529,640	$241,160	$421,100	$323,540
75	Sheep, number	3,393,706	476,189	26,394	20,707	100	63,940	11,710	1,474	12,260	9,200
76	Cost	$12,970,850	$1,463,436	$140,017	$74,835	$300	$219,542	$31,725	$6,034	$16,500	$22,855
77	Hogs, number	1,911,782	66,373	8,944	58	100	265,240	29,289	8,424	8,300	15,722
78	Cost	$14,312,037	$544,645	$86,925	$580	$500	$3,440,220	$240,346	$87,588	$57,600	$154,825

MEAT PACKING: BY STATES AND TERRITORIES, 1900.

Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Missouri.	Montana.	Nebraska.	New Jersey.	New York.	Ohio.	Pennsylvania.	Utah.	Washington.	All other states and territories. [1]	
8	35	11	21	7	6	5	4	19	57	11	43	3	4	15	1
5	32	7	14	7	3	3	2	11	28	8	28	2	1	6	2
1	2	2	6		2		2	8	19	3	13	1	1	6	3
2	1	2	1		1	2			10		2		2	3	4
$97,880	$229,571	$2,297,403	$173,200	$143,925	$99,979	$241,826	$36,050	$554,542	$8,047,913	$131,400	$539,230	$33,125	$72,300	$209,950	5
$8,400	$63,306	$300,650	$30,750	$9,150	$2,900	$7,600	$4,550	$25,633	$874,980	$22,175	$64,300	$4,600	$12,100	$21,950	6
$34,750	$101,000	$303,300	$41,025	$60,400	$200	$22,700	$4,400	$44,200	$2,410,425	$32,650	$149,700	$9,000	$13,900	$27,300	7
$2,430	$30,175	$103,615	$18,625	$11,750	$31,755	$10,959	$2,600	$20,600	$857,680	$22,175	$52,984	$4,525	$5,300	$53,200	8
$52,300	$35,090	$1,589,838	$82,800	$62,625	$65,124	$200,567	$24,500	$464,209	$3,904,828	$54,500	$272,246	$15,000	$41,000	$107,500	9
7	36	13	18	6	6	3	6	30	73	14	57	4	3	17	10
2	5	46	8	6	10	9		18	271		27		9	17	11
$1,625	$1,980	$65,166	$8,920	$4,820	$9,300	$12,600		$21,854	$323,612		$27,988		$7,788	$9,334	12
	2	3	1		4	2			17					1	13
	$700	$18,000	$2,000		$5,800	$5,000			$56,918					$1,500	14
2	3	43	7	6	6	7		18	254		27		9	16	15
$1,625	$1,280	$47,166	$6,920	$4,820	$3,600	$7,600		$21,854	$266,694		$27,988		$7,788	$7,834	16
2	3	39	7	6	6	7		18	227		25		8	13	17
$1,625	$1,280	$44,358	$6,920	$4,820	$3,500	$7,600		$21,854	$254,869		$26,920		$7,128	$6,644	18
		4							27		2		1	3	19
		$2,808							$11,825		$1,068		$660	$1,190	20
74	96	481	101	44	67	47	9	222	2,248	70	297	12	28	152	21
15	78	281	80	38	55	32	6	195	1,978	62	269	11	19	113	22
24	83	411	81	41	69	37	7	206	1,569	66	286	8	22	134	23
$10,680	$34,324	$204,134	$44,164	$23,514	$24,062	$33,693	$4,035	$146,088	$1,068,696	$36,110	$186,258	$3,675	$20,635	$67,014	24
23	82	411	80	40	57	35	6	206	1,567	65	282	8	22	127	25
$10,380	$33,874	$204,134	$44,114	$22,914	$23,812	$32,493	$3,976	$145,088	$1,068,292	$36,110	$185,506	$3,675	$20,635	$65,650	26
1	1			1		2			1		1				27
$300	$450			$600		$1,200			$304		$500				28
			1		2		1		1		3			7	29
			$50		$250		$60		$100		$252			$1,464	30
14	91	433	96	39	61	31	7	208	1,652	63	282	6	22	133	31
14	91	447	83	39	63	36	7	201	1,626	62	283	6	22	130	32
14	79	450	80	39	64	33	7	203	1,506	62	280	7	25	129	33
10	79	438	76	39	64	37	6	197	1,526	62	280	12	23	121	34
10	80	334	76	38	62	36	6	197	2,076	62	285	12	23	120	35
10	79	281	78	38	42	33	6	204	1,459	64	286	7	22	121	36
53	79	366	79	38	51	37	6	204	1,490	64	279	7	20	127	37
67	79	401	79	39	51	35	6	207	1,484	64	279	7	20	121	38
33	78	416	79	42	53	36	6	210	1,512	64	285	7	21	127	39
30	79	433	77	42	56	38	7	211	1,543	70	284	7	21	131	40
10	88	451	78	42	59	32	7	221	1,570	69	282	7	21	130	41
9	87	481	81	43	59	34	7	215	1,565	69	282	7	22	134	42
2	2			1							1				43
2	2			1		3					1				44
2	2			1		3					1				45
2	2			1		3					1				46
2	1			1		3			13		1				47
1	1			1		2					1				48
1	1			1		2					1				49
1	1			1		2					1				60
1	1			1		2					1				51
1	1			1		2					1				52
1	1			1		2					1				53
1	1			1		2					1				54
			1		2		1		1		3			8	55
			1		2		1		1		3			8	66
			1		2		1		1		3			8	57
			1		2		1		1		3			5	68
			1		2		1		1		3			5	59
			1		2		1		1		3			5	60
			1		2		1		1		3			8	61
			1		2		1		1		3			6	62
			1		2		1		1		3			8	63
			1		2		1		1		3			8	64
			1		2		1		1		3			8	65
			1		2		1		1		3			8	66
$1,102	$9,778	$126,576	$10,632	$11,734	$13,668	$7,798	$438	$67,007	$754,326	$19,380	$154,604	$865	$13,852	$17,573	67
	$1,330	$7,378	$676	$2,301	$4,300	$5,300		$33,944	$78,227	$780	$96,523	$150	$1,390	$5,735	68
$534	$2,820	$16,084	$1,308	$538	$575	$888	$73	$958	$41,601	$930	$3,234	$200	$480	$1,428	69
$568	$5,628	$103,084	$8,648	$8,895	$8,793	$1,610	$365	$32,105	$633,799	$17,670	$54,847	$515	$11,982	$10,410	70
		$30							$699						71
$322,693	$1,662,362	$3,436,371	$1,444,906	$866,884	$716,894	$821,070	$209,424	$7,406,647	$33,542,478	$921,159	$6,473,714	$93,876	$515,777	$2,063,706	72
1,865	12,517	33,244	31,189	13,500	12,275	12,395	4,487	24,670	332,847	21,311	89,157	2,213	6,672	35,709	73
$70,260	$561,962	$1,305,157	$1,154,406	$495,850	$378,250	$572,530	$115,800	$1,345,380	$19,486,940	$635,178	$4,551,674	$69,622	$258,895	$1,243,579	74
44,815	185,580	407,466	51,305	34,275	6,608	23,092	165	324,957	1,453,474	32,402	146,321	3,705	26,080	32,487	75
$150,603	$792,120	$1,493,278	$172,936	$163,200	$22,494	$91,063	$985	$1,308,217	$5,837,934	$81,856	$638,355	$13,042	$101,660	$128,863	76
425	1,800	125	7,802	21,222	29,200	8,401	1,230	675,836	605,553	9,775	80,764	620	10,865	55,714	77
$5,250	$10,600	$1,100	$59,412	$170,164	$259,600	$34,943	$12,650	$4,027,833	$3,902,045	$88,900	$534,350	$6,673	$122,040	$463,248	78

[1] Includes establishments distributed as follows: Alabama, 1; Arkansas, 1; Delaware, 1; District of Columbia, 1; New Mexico, 2; North Carolina, 1; Oklahoma, 2; Rhode Island, 1; South Carolina, 1; Virginia, 1; Wisconsin, 2; Wyoming, 1.

TABLE 5.—SLAUGHTERING, WHOLESALE, NOT INCLUDING

		United States.	California.	Colorado.	Connecticut.	Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.
	Materials used—Continued.										
	Slaughtered—Continued.										
79	Calves, number	552,331	20,380	1,330	11,620	50	10,136	4,455	3,039	1,150	3,910
80	Cost	$4,344,125	$204,753	$12,100	$92,792	$200	$75,698	$35,700	$19,657	$6,200	$26,664
81	All other animals, cost	$297,555	$128,769	$1,695	$8,080				$250		$3,064
82	Dressed meat, purchased, fresh or partly cured, cost.	$502,869	$4,615	$54,670							$10,400
83	Fuel	$172,728	$6,015	$2,401	$310		$11,493	$4,810	$1,050	$2,540	$1,595
84	Rent of power and heat	$14,824	$2,273				$600	$200			
85	Mill supplies	$28,398	$460	$220	$100		$2,135	$164	$69	$275	$60
86	All other materials	$1,646,668	$96,074	$25	$24,697		$11,521	$5,305	$5,770	$3,500	$2,370
87	Freight	$1,840,265	$412,604	$1,000	$2,445		$2,900	$80			
	Products:										
88	Total value	$87,355,885	$7,485,032	$781,626	$283,281	$33,396	$8,079,442	$971,030	$398,526	$582,744	$635,685
	Beef—										
89	Sold fresh, pounds	528,557,864	62,012,890	6,625,500	224,000	426,000	40,914,263	6,971,100	3,278,544	6,482,000	4,212,668
90	Value	$40,430,090	$3,818,322	$450,900	$15,825	$28,380	$3,101,784	$487,375	$225,960	$407,100	$316,248
91	Salted or cured, pounds	4,605,268	17,000	14,400							
92	Value	$238,032	$1,360	$864							
93	Mutton, sold fresh, pounds	140,132,565	20,269,980	1,439,045	745,252	4,000	2,548,800	579,600	78,700	51,600	339,740
94	Value	$11,750,405	$1,472,794	$123,353	$85,899	$360	$228,125	$37,769	$6,856	$23,056	$27,069
95	Veal, sold fresh, pounds	48,611,311	2,940,280	138,000	929,650	5,000	904,266	422,075	259,780	116,000	298,419
96	Value	$4,596,518	$229,721	$12,420	$103,008	$350	$86,880	$39,866	$21,957	$8,600	$26,960
	Pork—										
97	Sold fresh, pounds	241,029,567	9,160,456	1,584,000	10,510	6,000	54,928,000	4,806,010	1,547,120	1,090,000	2,081,220
98	Value	$16,280,295	$680,924	$97,473	$717	$360	$3,910,508	$282,846	$99,784	$67,700	$161,102
99	Salted, pounds	369,200	56,000								
100	Value	$29,482	$5,750								
101	Hams, pounds	231,663	8,000								
102	Value	$23,226	$1,160								
103	Smoked bacon, sides and shoulders, pounds.	250,563	10,000								
104	Value	$21,724	$1,280								
105	Sausage, fresh or cured, pounds	1,039,484	22,150	117,800						31,300	227,475
106	Value	$75,567	$2,273	$7,374						$1,878	$19,218
107	All other meat, sold fresh, pounds	2,851,930	1,550,000	60,000					5,000		
108	Value	$230,113	$131,500	$4,200					$300		
109	Refined lard, pounds	5,302,974	63,000				577,000	3,000		17,000	452,300
110	Value	$335,729	$6,200				$41,432	$200		$1,200	$31,946
111	Neutral lard, pounds	364,000	10,000							4,000	
112	Value	$27,200	$6,000							$200	
113	Oleomargarine oil, gallons	1,708,530									
114	Value	$968,069									
115	Other oils, gallons	150,817						600	7,200		
116	Value	$65,609						$240	$3,240		
117	Fertilizers, tons	8,381		30	38		1,765	200	5		12
118	Value	$122,687		$750	$760		$7,574	$4,000	$90		$120
119	Hides, number	1,375,560	131,587	11,344	12,028	1,420	102,922	18,587	9,565	19,970	13,130
120	Pounds	58,040,274	6,689,886	576,630	130,756	58,400	5,393,221	851,290	370,883	745,200	491,470
121	Value	$5,215,936	$599,813	$48,787	$16,973	$3,871	$529,217	$79,611	$32,657	$59,500	$40,407
122	Wool, pounds	4,351,776	18,000	18,000							
123	Value	$1,296,894	$3,800	$1,080							
124	All other products, value	$5,583,478	$524,135	$33,214	$60,099	$75	$166,663	$38,873	$7,632	$13,510	$12,552
125	Custom work, value	$64,831		$1,211			$7,259	$250	$50		
	Weight of animals slaughtered:										
	Beeves—										
126	Gross weight, on hoof	975,022,741	122,650,350	10,558,850	347,200	998,000	79,633,384	13,877,040	6,492,000	12,914,000	8,020,200
127	Net weight, dressed	529,463,512	62,507,290	5,710,820	224,000	471,000	42,162,403	7,211,400	3,278,544	6,482,000	4,384,168
	Sheep—										
128	Gross weight, on hoof	278,400,726	43,219,520	2,845,685	1,242,520	8,000	5,583,000	1,159,000	141,400	748,600	594,700
129	Net weight, dressed	142,734,289	21,565,980	1,512,390	745,252	4,000	2,667,000	579,600	78,700	376,120	308,100
	Hogs—										
130	Gross weight, on hoof	310,159,355	12,117,400	2,128,500	13,730	10,000	67,548,000	6,053,400	1,910,200	1,427,500	3,087,084
131	Net weight, dressed	243,554,789	9,337,455	1,704,300	10,510	6,800	54,944,640	4,735,420	1,547,120	1,142,000	2,494,520
	Calves—										
132	Gross weight, on hoof	72,791,904	5,870,400	252,700	1,388,750	7,500	1,546,120	701,500	396,995	147,500	517,935
133	Net weight, dressed	46,988,793	2,939,525	138,000	948,650	3,750	904,226	422,200	262,525	115,950	298,685
	Comparison of products:										
134	Number of establishments reporting for both years.	260	23	4	6	1	12	10	4	1	12
135	Value for census year	$71,672,421	$5,421,968	$500,496	$269,536	$9,510	$7,955,271	$922,046	$253,171	$180,794	$616,955
136	Value for preceding business year	$67,529,770	$5,265,463	$474,500	$258,490	$7,000	$7,183,763	$867,307	$288,819	$200,000	$579,000
	Power:										
137	Number of establishments reporting	110	8	7	1		10	7	4	1	6
138	Total horsepower	4,616	177	227	25		423	81	120	125	91
	Owned—										
	Engines—										
139	Steam, number	129	3	7	1		14	6	4	3	7
140	Horsepower	4,027	110	222	25		398	76	120	125	81
141	Gas or gasoline, number	1									1
142	Horsepower	10									10
143	Water wheels, number	1		1							
144	Horsepower	5		5							
145	Electric motors, number	8					1				
146	Horsepower	140					10				
	Rented—										
147	Electric, horsepower	93	60								
148	Other kind, horsepower	341	7				15	5			
	Furnished to other establishments—										
149	Horsepower	23							10		
	Establishments classified by number of persons employed, not including proprietors and firm members:										
150	Total number of establishments	348	35	7	7	3	13	11	7	3	13
151	No employees	7			2						
152	Under 5	168	10	2	4	3	1	8	6		10
153	5 to 20	130	22	4	1		5	2	1	2	3
154	21 to 50	29	2	1			6	1		1	
155	51 to 100	8	1				1				
156	101 to 250	2									
157	251 to 500	2									
158	501 to 1,000	2									

MEAT PACKING: BY STATES AND TERRITORIES, 1900—Continued.

Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Missouri.	Montana.	Nebraska.	New Jersey.	New York.	Ohio.	Pennsylvania.	Utah.	Washington.	All other states and territories. (1)	
2,934	38,780	73,288	6,824	3,664	5,235	3,396	3,300	55,623	256,245	14,080	19,583	456	1,216	12,637	79
$20,964	$263,180	$462,634	$44,900	$29,537	$43,075	$50,490	$64,200	$496,083	$2,039,320	$100,820	$151,065	$4,214	$10,474	$89,405	80
$70,080	$14,600	...	...	...	...	$4,525	...	...	$1,600	...	$62,000	...	$1,592	$1,300	81
...	$9,760	...	...	...	$6,000	$25,000	...	...	$100,324	$2,000	$231,500	...	$100	$58,500	82
$593	$4,850	$20,020	$3,217	$3,978	$3,425	$2,450	$714	$668	$80,870	$3,855	$10,070	$290	$2,465	$5,049	83
...	$360	$3,780	...	...	...	...	...	$3,175	$400	$36	$4,000	...	...	...	84
$5	$225	$1,075	$375	$90	$310	$100	$50	$365	$20,500	$342	$1,045	$35	$45	$353	85
$138	$4,455	$51,886	$3,340	$875	$3,740	$6,820	$14,025	$3,060	$1,332,316	$1,192	$29,300	...	$280	$45,980	86
$4,800	$250	$97,442	$6,320	$3,190	...	$33,149	$1,000	$221,866	$740,229	$6,980	$260,355	...	$18,226	$27,429	87
$397,506	$1,836,502	$4,127,785	$1,612,656	$1,007,443	$811,758	$934,640	$262,027	$7,846,422	$37,807,106	$1,051,476	$7,412,075	$110,012	$598,904	$2,288,811	88
1,148,500	6,647,180	17,960,150	15,395,100	6,850,000	5,100,000	7,406,667	1,868,500	16,277,350	230,585,496	8,608,430	57,708,976	1,054,000	3,936,500	16,864,050	89
$74,470	$535,024	$1,365,198	$1,113,752	$493,700	$363,000	$557,785	$117,275	$1,326,405	$18,533,291	$585,293	$4,912,417	$72,921	$286,750	$1,240,916	90
...	133,320	...	...	...	...	...	...	...	4,393,048	...	...	...	...	47,500	91
...	$8,289	...	...	...	...	...	...	...	$221,769	...	...	...	...	$5,750	92
2,431,164	7,026,000	16,207,400	1,871,023	1,620,500	278,100	1,142,048	12,000	13,570,273	60,162,992	936,100	5,839,748	196,250	1,299,200	1,483,050	93
$207,059	$774,860	$1,311,978	$154,995	$156,423	$24,434	$100,395	$1,200	$1,082,166	$5,001,173	$74,046	$605,649	$14,397	$104,644	$131,705	94
247,040	2,474,200	5,173,540	566,800	355,598	416,000	659,954	1,020,000	4,658,125	23,324,717	991,000	1,500,402	49,350	164,650	996,465	95
$24,484	$257,200	$408,934	$50,295	$32,618	$43,920	$60,302	$78,780	$518,994	$2,242,979	$97,033	$144,301	$4,401	$12,560	$89,955	96
95,000	95,000	20,000	533,213	2,802,960	4,765,000	1,128,716	530,800	66,264,561	64,792,761	1,622,500	14,609,690	112,500	1,660,000	6,783,550	97
$6,900	$8,500	$1,295	$37,947	$196,945	$268,200	$80,891	$14,600	$4,265,416	$4,327,250	$114,453	$968,170	$7,332	$134,320	$546,662	98
...	30,000	...	121,200	...	...	50,000	...	...	2,000	...	...	...	...	110,000	99
...	$1,800	...	$7,272	...	...	$3,600	...	...	$160	...	...	...	...	$11,000	100
...	30,000	...	92,663	...	...	100,000	...	...	1,000	...	...	...	...	...	101
...	$2,700	...	$9,266	...	...	$10,000	...	...	$100	...	...	...	...	...	102
...	30,000	...	60,563	...	...	150,000	...	...	...	...	...	...	...	...	103
...	$2,100	...	$4,844	...	...	$13,500	...	...	...	...	...	...	...	...	104
...	32,500	...	70,859	...	240,000	50,000	...	24,500	6,900	6,000	...	...	39,000	171,000	105
...	$2,450	...	$4,251	...	$14,400	$3,000	...	$1,750	$513	$640	...	...	$3,300	$14,620	106
...	15,000	...	...	...	...	59,030	...	...	95,500	24,000	1,000,000	...	22,400	21,000	107
...	$2,100	...	...	...	...	$5,903	...	...	$6,730	$2,100	$74,000	...	$1,792	$1,488	108
...	10,000	...	48,450	...	331,000	50,000	...	1,650,328	1,905,021	21,875	...	...	36,000	138,000	109
...	$1,000	...	$3,391	...	$26,660	$3,000	...	$91,393	$115,502	$1,675	...	...	$2,780	$9,350	110
...	...	...	...	...	...	...	...	...	350,000	...	...	...	...	...	111
...	...	...	...	...	...	...	...	...	$21,000	...	...	...	...	...	112
...	...	82,021	...	...	...	...	...	...	1,626,509	...	...	...	...	...	113
...	...	$31,250	...	...	...	...	...	...	$936,819	...	...	...	...	...	114
...	5,000	...	...	...	...	...	...	...	137,767	...	...	...	...	260	115
...	$2,000	...	...	...	...	...	...	...	$60,029	...	...	...	...	$100	116
...	300	1,392	...	247	...	...	45	113	3,445	2	7	...	...	780	117
...	$4,500	$18,100	...	$790	...	...	$450	$3,392	$71,802	$16	$83	...	...	$10,260	118
4,765	53,097	106,492	37,073	17,714	17,510	15,675	7,787	61,113	524,067	35,391	108,740	2,669	7,888	55,026	119
126,050	1,019,280	2,609,300	1,757,218	804,390	715,675	734,350	297,535	2,058,580	23,835,541	1,274,870	5,445,447	108,550	387,032	1,558,820	120
$11,089	$84,223	$237,662	$153,006	$67,322	$64,715	$65,216	$24,333	$172,676	$2,217,864	$88,050	$456,678	$9,062	$30,398	$122,743	121
121,240	5,460	1,450,000	...	...	...	...	...	75,000	2,625,676	...	33,400	...	5,000	...	122
$27,810	$1,385	$442,250	...	...	...	...	...	$25,000	$787,269	...	$7,600	...	$700	...	123
$45,694	$123,871	$311,118	$73,637	$58,210	$6,429	$31,148	$25,089	$356,622	$3,243,137	$88,270	$243,177	$1,899	$21,160	$97,364	124
...	$24,500	...	...	$1,435	...	...	$300	$2,708	$19,719	...	...	...	$500	$6,899	125
1,830,100	12,393,400	32,181,970	39,356,400	13,610,000	10,340,000	13,491,800	3,737,000	28,340,500	405,240,906	16,885,500	101 301,780	2,143,000	7,688,000	30,991,361	126
1,148,500	6,872,730	17,773,762	15,542,575	6,970,000	5,460,250	7,424,061	1,868,500	16,277,350	229,428,783	8,608,430	57,887,276	1,054,000	4,041,620	16,674,050	127
5,105,200	14,035,600	32,519,320	3,788,750	3,238,750	607,700	2,111,660	24,000	26,909,810	115,006,941	1,732,200	12,079,700	390,500	2,598,400	2,809,770	128
2,468,970	7,024,000	16,236,680	1,871,198	1,620,500	278,180	1,146,361	12,000	13,571,273	60,735,367	936,100	6,092,478	197,250	1,299,200	1,407,590	129
124,375	270,000	25,000	1,370,760	3,539,950	5,840,000	1,438,345	261,000	90,966,100	86,061,575	1,965,250	13,318,815	139,160	2,173,000	8,370,211	130
95,000	213,000	20,000	1,096,200	2,802,960	4,960,000	1,081,281	206,800	68,788,820	68,083,890	1,646,500	10,009,690	112,500	1,735,400	6,779,983	131
409,260	4,139,000	7,716,310	799,700	500,990	685,250	958,750	1,278,000	5,695,430	33,457,835	1,702,100	2,565,205	64,224	222,900	1,767,550	132
247,040	2,474,200	5,187,290	567,000	355,098	417,150	658,981	1,020,000	3,758,125	23,395,849	99,100	1,591,962	49,350	165,772	968,365	133
4	33	8	14	5	1	...	1	15	49	11	33	1	1	11	134
$228,896	$846,752	$3,657,581	$909,009	$800,317	$276,600	...	$20,000	$7,424,096	$31,533,516	$1,051,476	$6,696,747	$33,689	$203,604	$1,860,391	135
$215,137	$840,625	$3,818,111	$820,900	$633,613	$187,000	...	$17,000	$7,667,439	$28,894,684	$1,061,255	$6,291,440	$37,284	$147,210	$1,773,730	136
...	2	2	4	3	4	2	2	7	16	7	5	2	2	8	137
...	68	315	74	26	176	55	32	174	1,666	113	334	34	14	266	138
...	2	2	4	3	4	2	2	2	39	6	4	2	2	10	139
...	68	290	74	26	156	55	32	45	1,551	110	149	34	14	266	140
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	141
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	142
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	143
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	144
...	...	...	...	...	2	...	...	...	5	...	...	...	...	...	145
...	...	...	...	...	15	...	...	...	115	...	...	...	...	...	146
...	...	...	...	...	5	...	...	...	...	3	25	...	...	...	147
...	...	25	...	...	...	...	...	129	...	...	160	...	...	...	148
...	...	...	...	...	...	...	...	...	13	...	...	...	...	...	149
8	35	11	21	7	6	6	4	19	57	11	43	3	4	15	150
2	1	...	2	...	...	...	...	...	...	...	...	...	...	...	151
1	31	7	12	2	3	1	4	6	16	6	28	...	1	6	152
3	3	2	6	5	3	3	...	9	24	5	14	3	3	7	153
2	...	1	1	...	...	1	...	3	8	...	...	...	...	2	154
...	...	...	...	...	...	...	...	1	5	...	...	...	...	...	155
...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	156
...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	157
...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	158

[1] Includes establishments distributed as follows: Alabama, 1; Arkansas, 1; Delaware, 1; District of Columbia, 1; New Mexico, 2; North Carolina, 1; Oklahoma, 2; Rhode Island, 1; South Carolina, 1; Virginia, 1; Wisconsin, 2; Wyoming, 1.

		United States.	California.	Colorado.	Connecticut.	Delaware.	District of Columbia.
1	Number of establishments	573	23	7	5	3	6
	Character of organization:						
2	Individual	211	8		2	1	5
3	Firm and limited partnership	190	5	2	2	2	1
4	Incorporated company	172	10	5	1		
	Capital:						
5	Total	$174,094,697	$2,875,988	$1,262,075	$411,750	$224,220	$205,800
6	Land	$10,415,240	$411,474	$149,800	$51,500	$20,000	$49,000
7	Buildings	$30,859,070	$688,560	$494,000	$104,500	$33,000	$58,000
8	Machinery, tools, and implements	$18,631,273	$425,156	$83,000	$60,250	$41,060	$37,800
9	Cash and sundries	$114,189,114	$1,350,798	$535,275	$195,500	$130,160	$81,000
10	Proprietors and firm members	664	19	4	8	6	7
	Salaried officials, clerks, etc.:						
11	Total number	9,658	123	37	30	12	31
12	Total salaries	$9,472,653	$174,152	$51,536	$31,752	$9,040	$15,720
	Officers of corporations—						
13	Number	320	8	14	2		
14	Salaries	$940,948	$26,520	$25,836	$5,000		
	General superintendents, managers, clerks, etc.—						
15	Total number	9,338	115	23	28	12	31
16	Total salaries	$8,531,705	$147,632	$25,700	$26,752	$9,040	$15,720
	Men—						
17	Number	8,438	109	23	27	12	31
18	Salaries	$8,023,509	$144,182	$25,700	$26,232	$9,040	$15,720
	Women—						
19	Number	900	6		1		
20	Salaries	$508,196	$3,450		$520		
	Wage-earners, including pieceworkers, and total wages:						
21	Greatest number employed at any one time during the year	81,416	744	232	381	29	97
22	Least number employed at any one time during the year	57,119	623	198	352	29	83
23	Average number	64,783	660	212	368	29	91
24	Wages	$31,079,715	$344,189	$139,510	$167,925	$16,602	$43,207
	Men, 16 years and over—						
25	Average number	60,197	650	210	368	29	89
26	Wages	$29,868,664	$338,141	$139,010	$167,925	$16,602	$42,531
	Women, 16 years and over—						
27	Average number	2,936	10	2			2
28	Wages	$849,974	$6,048	$500			$676
	Children, under 16 years—						
29	Average number	1,651					
30	Wages	$361,077					
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
31	January	61,151	649	215	378	29	89
32	February	60,000	639	212	378	29	87
33	March	59,368	652	217	373	29	90
34	April	57,453	653	219	352	29	87
35	May	58,096	663	214	352	29	86
36	June	58,399	640	204	355	29	86
37	July	58,954	640	200	355	29	86
38	August	59,260	647	204	355	29	86
39	September	59,350	651	208	370	29	89
40	October	62,006	670	209	381	29	88
41	November	63,576	641	210	381	29	93
42	December	64,751	657	207	381	29	95
	Women, 16 years and over—						
43	January	2,956	9	2			2
44	February	2,880	8	2			2
45	March	2,756	7	2			2
46	April	2,667	7	2			2
47	May	2,582	8	2			2
48	June	2,423	7	2			2
49	July	2,717	8	2			2
50	August	2,982	10	2			2
51	September	3,169	17	2			2
52	October	3,318	19	2			2
53	November	3,405	15	2			2
54	December	3,366	8	2			2
	Children, under 16 years—						
55	January	1,574					
56	February	1,578					
57	March	1,503					
58	April	1,517					
59	May	1,549					
60	June	1,646					
61	July	1,722					
62	August	1,759					
63	September	1,734					
64	October	1,657					
65	November	1,797					
66	December	1,776					
	Miscellaneous expenses:						
67	Total	$22,684,837	$371,684	$43,965	$69,913	$9,610	$14,735
68	Rent of works	$343,228	$13,212	$1,515	$600	$3,120	$2,000
69	Taxes, not including internal revenue	$742,683	$12,388	$5,656	$5,859	$596	$750
70	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$21,588,111	$344,484	$36,794	$63,454	$5,894	$10,185
71	Contract work	$10,815	$1,600				$1,800
	Materials used:						
72	Total cost	$606,171,587	$6,798,826	$3,029,085	$2,923,511	$352,835	$980,795
	Slaughtered—						
73	Beeves, number	4,630,742	61,706	24,775		5,085	4,050
74	Cost	$206,084,141	$2,124,777	$1,036,845		$101,700	$180,650
75	Sheep, number	5,796,784	218,869	39,694		2,050	2,050
76	Cost	$24,166,692	$733,926	$147,826		$4,200	$9,875
77	Hogs, number	28,742,551	162,302	151,266	254,723	15,200	90,800
78	Cost	$264,424,924	$1,444,563	$1,417,472	$2,547,594	$193,040	$596,000
79	Calves, number	347,417	8,151	2,440		128	2,340
80	Cost	$3,012,435	$76,205	$26,840		$636	$20,280
81	All other animals, cost	$262,284	$36,252	$4,200			
82	Dressed meat, purchased, fresh or partly cured, cost	$54,212,627	$1,893,354	$309,200	$132,000	$48,300	$145,200
83	Fuel	$2,574,878	$63,290	$15,612	$19,100	$1,917	$7,693
84	Rent of power and heat	$16,122	$955	$375			
85	Mill supplies	$309,058	$3,212	$1,960	$1,485	$103	$840
86	All other materials	$46,726,986	$319,945	$43,295	$144,350	$1,425	$6,195
87	Freight	$4,381,440	$102,347	$26,460	$78,982	$1,514	$14,062

PACKING, WHOLESALE: BY STATES, 1900.

Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
4	51	25	20	11	15	3	47	11	8	13	1
2	8	6	6	2	10	2	32	4	2	4	2
1	16	10	4	1	2	1	14	2	4	7	3
1	27	9	10	8	3	...	1	5	2	2	4
$109,400	$70,782,361	$8,658,034	$6,264,578	$16,410,477	$1,256,106	$34,800	$1,318,917	$9,016,672	$1,265,151	$1,211,086	5
$13,500	$3,381,255	$437,536	$161,750	$771,728	$85,160	...	$100,009	$882,182	$123,945	$62,000	6
$27,700	$10,447,918	$1,718,347	$1,198,153	$2,639,200	$157,550	...	$301,500	$2,073,715	$166,040	$186,540	7
$24,700	$6,859,804	$1,402,127	$499,375	$1,658,062	$210,133	$3,100	$188,660	$1,219,523	$100,771	$120,442	8
$43,500	$50,093,384	$5,100,024	$4,415,300	$11,341,487	$803,263	$31,700	$728,748	$4,841,252	$874,395	$842,104	9
4	50	27	13	8	15	6	72	8	11	21	10
32	4,181	298	190	1,830	62	4	63	174	63	119	11
$19,625	$4,380,649	$311,103	$196,056	$1,620,010	$51,799	$1,215	$46,824	$185,130	$57,741	$97,889	12
4	74	22	12	9	5	...	...	2	8	...	13
$4,000	$352,380	$80,200	$36,000	$47,450	$10,500	...	...	$7,500	$18,500	...	14
28	4,107	276	178	1,821	57	4	63	172	55	119	15
$15,625	$4,028,269	$230,903	$160,066	$1,572,560	$41,299	$1,215	$46,824	$177,630	$39,241	$97,889	16
28	3,786	255	166	1,515	57	2	61	157	48	103	17
$15,625	$3,822,285	$220,944	$155,019	$1,397,200	$41,299	$790	$45,904	$170,064	$35,681	$90,449	18
...	321	21	12	306	...	2	2	15	7	16	19
...	$205,984	$9,959	$5,037	$175,360	...	$425	$920	$7,566	$3,560	$7,440	20
135	31,672	3,952	3,453	9,446	549	21	553	2,533	429	1,016	21
74	24,359	3,227	2,436	6,995	455	21	471	2,226	334	540	22
98	27,626	3,550	2,874	8,068	469	14	514	2,337	375	627	23
$31,050	$13,898,950	$1,537,024	$1,201,681	$3,543,777	$194,837	$7,220	$242,089	$1,113,943	$186,473	$280,463	24
97	25,557	3,111	2,630	7,121	465	14	502	2,313	373	610	25
$30,800	$13,316,489	$1,426,800	$1,156,935	$3,299,359	$194,277	$7,220	$239,945	$1,107,261	$186,023	$276,191	26
...	1,473	387	29	661	4	...	9	13	2	8	27
...	$427,203	$101,499	$9,906	$190,802	$560	...	$1,668	$3,582	$450	$2,400	28
1	596	52	215	286	...	...	3	11	...	9	29
$250	$155,258	$8,725	$34,840	$53,616	...	...	$476	$3,100	...	$1,872	30
118	26,137	3,240	2,951	6,787	632	21	514	2,477	416	678	31
118	26,048	3,140	2,635	6,724	480	21	514	2,346	369	608	32
116	25,335	2,948	2,671	6,460	452	21	505	2,292	362	570	33
87	24,579	2,931	2,523	6,607	437	21	498	2,239	351	548	34
83	24,758	2,958	2,628	6,793	438	21	491	2,237	346	566	35
87	24,421	3,079	2,729	7,002	438	9	497	2,273	346	573	36
81	24,486	3,140	2,624	7,011	463	9	475	2,287	333	563	37
79	24,926	3,104	2,473	7,221	452	9	479	2,250	372	553	38
77	24,769	3,099	2,360	7,636	438	9	495	2,267	379	589	39
110	26,289	3,309	2,421	7,866	437	9	516	2,330	389	630	40
105	27,174	3,166	2,686	7,819	504	9	526	2,370	408	662	41
107	27,764	3,216	2,961	7,527	525	9	518	2,388	404	776	42
...	1,543	366	25	685	11	...	9	14	2	2	43
...	1,534	358	25	635	5	...	9	13	2	2	44
...	1,521	344	25	613	1	...	9	13	2	2	45
...	1,409	346	26	525	1	...	9	12	2	2	46
...	1,303	362	32	549	1	...	9	12	2	2	47
...	1,050	401	33	572	1	...	9	14	2	2	48
...	1,209	472	34	616	1	...	9	14	2	7	49
...	1,454	459	33	652	1	...	9	14	2	10	50
...	1,510	409	31	795	1	...	9	14	2	9	51
...	1,632	386	31	810	1	...	9	14	2	13	52
...	1,736	374	27	826	11	...	9	14	2	23	53
...	1,767	367	25	754	11	...	9	14	2	22	54
2	570	41	292	205	...	...	3	12	...	7	55
3	582	38	281	200	...	...	3	11	...	9	56
2	590	38	167	221	...	...	3	9	...	8	57
1	564	36	172	239	...	...	3	11	...	9	58
...	551	44	180	281	...	...	3	10	...	11	59
...	530	52	181	320	...	...	3	12	...	15	60
...	583	77	181	361	...	...	3	11	...	14	61
...	603	73	182	345	...	...	3	9	...	11	62
...	611	61	182	356	...	...	3	10	...	12	63
...	634	64	172	318	...	...	3	12	...	2	64
...	653	53	287	314	...	...	3	11	...	4	65
4	681	47	297	267	...	...	3	9	...	6	66
$10,745	$14,158,171	$522,069	$437,103	$2,000,035	$99,425	$5,717	$99,239	$464,526	$76,659	$79,062	67
$860	$64,252	$3,190	$4,130	$44,460	$2,240	$802	$12,427	$3,130	$745	$2,600	68
$1,360	$273,231	$47,266	$19,345	$108,644	$6,398	$127	$7,310	$61,793	$10,054	$6,848	69
$8,525	$13,820,688	$471,623	$413,628	$1,846,931	$90,787	$4,788	$78,002	$399,603	$65,860	$69,114	70
...	...	...	...	...	...	...	$1,500	...	...	$500	71
$456,355	$239,757,479	$37,760,871	$21,195,066	$67,402,245	$3,899,248	$134,338	$5,446,717	$24,603,698	$3,325,734	$5,956,371	72
9,186	1,964,273	344,463	71,070	908,519	11,478	925	7,320	...	2,110	39,200	73
$198,800	$90,097,822	$18,776,065	$2,271,225	$37,743,953	$421,142	$36,800	$249,610	...	$68,850	$1,404,491	74
2,700	3,075,220	352,127	12,212	624,572	2,607	3,750	...	...	1,055	59,442	75
$5,150	$13,339,166	$1,591,410	$54,072	$2,282,246	$8,196	$11,250	...	...	$4,702	$248,920	76
25,895	8,026,466	1,921,081	1,914,274	2,841,348	487,134	2,500	663,935	1,876,120	334,013	401,103	77
$164,500	$79,539,458	$13,465,016	$17,433,707	$23,472,678	$3,294,898	$26,000	$3,995,229	$19,853,661	$2,932,063	$3,453,232	78
1,675	139,314	8,488	1,252	35,570	1,297	535	752	...	1,060	2,555	79
$5,940	$1,302,686	$71,627	$10,436	$288,254	$9,136	$3,175	$4,420	...	$9,320	$21,052	80
$2,425	$70,959	$100	...	...	...	...	$540	...	...	$8,080	81
$60,800	$21,373,908	$2,646,377	$415,891	$683,879	$54,500	$54,000	$863,997	$2,154,746	$161,675	$500,293	82
$2,400	$703,904	$80,138	$140,816	$335,927	$26,735	$483	$46,175	$129,490	$19,878	$38,462	83
...	$6,920	...	...	$300	...	...	...	$1,096	...	$400	84
$1,200	$132,714	$14,349	$18,963	$13,510	$1,190	$55	$4,782	$14,060	$1,285	$3,400	85
$1,790	$32,593,245	$868,654	$845,420	$2,550,542	$83,401	$3,375	$148,784	$1,157,878	$116,961	$269,600	86
$13,350	$596,707	$247,135	$4,536	$30,956	$50	$200	$133,280	$1,292,767	$11,000	$8,441	87

Table 6.—SLAUGHTERING AND MEAT

		United States.	California.	Colorado.	Connecticut.	Delaware.	District of Columbia.
	Products:						
88	Total value	$698,206,548	$8,232,680	$3,562,357	$3,380,112	$416,144	$1,131,312
	Beef—						
89	Sold fresh, pounds	2,391,900,433	31,805,131	14,164,180		1,522,500	1,573,300
90	Value	$170,638,844	$2,154,147	$1,050,333		$106,575	$145,400
91	Canned, pounds	112,449,021	868,382	16,000			
92	Value	$9,167,531	$61,450	$1,440			
93	Salted or cured, pounds	132,984,035	2,495,762	52,500	450,000	281	400,000
94	Value	$9,423,802	$172,021	$4,950	$45,000	$45	$16,000
95	Mutton, sold fresh, pounds	264,051,036	9,335,987	1,699,700		78,750	87,180
96	Value	$21,212,814	$701,140	$147,376		$4,675	$8,718
97	Veal, sold fresh, pounds	36,953,896	1,024,528	279,000		7,860	181,600
98	Value	$3,216,196	$96,984	$27,520		$709	$16,850
	Pork—						
99	Sold fresh, pounds	982,009,421	9,155,109	8,870,600	7,044,000	453,900	2,260,800
100	Value	$67,739,092	$743,870	$566,214	$513,520	$39,684	$190,965
101	Salted, pounds	1,375,165,558	2,502,691	9,500,000	4,800,000	522,000	1,093,357
102	Value	$88,644,534	$199,824	$413,580	$333,500	$41,700	$76,512
103	Hams, pounds	787,295,310	11,974,749	4,650,000	8,434,000	782,000	1,227,000
104	Value	$73,769,786	$1,303,290	$400,460	$815,240	$78,760	$125,647
105	Smoked bacon, sides and shoulder, pounds	985,471,649	14,243,894	3,227,000	11,820,000	601,000	2,486,285
106	Value	$74,852,123	$1,367,557	$230,010	$887,800	$42,320	$214,179
107	Sausage, fresh or cured, pounds	291,124,591	1,382,347	2,417,600	2,651,700	157,000	2,141,500
108	Value	$21,396,846	$113,200	$146,492	$167,000	$11,860	$191,330
109	All other meat, sold fresh, pounds	77,556,281	745,977	140,000			200,000
110	Value	$7,582,965	$59,783	$9,400			$10,000
111	Refined lard, pounds	886,135,443	3,935,612	7,672,000	6,163,334	968,000	1,404,000
112	Value	$52,284,619	$307,937	$417,480	$390,400	$70,080	$106,780
113	Neutral lard, pounds	128,981,282	172,500	6,000	750,000		26,000
114	Value	$8,561,150	$10,483	$480	$59,000		$1,820
115	Oleomargarine oil, gallons	17,402,590					
116	Value	$10,514,473					
117	Other oils, gallons	8,094,762	5,276				
118	Value	$3,374,749	$2,699				
119	Fertilizers, tons	160,129	1,570	160	2,880	30	
120	Value	$3,177,445	$37,328	$1,280	$80,100	$450	
121	Hides, number	4,906,392	69,857	26,940	50	5,213	6,390
122	Pounds	278,487,633	3,531,977	1,551,700	350	305,000	223,500
123	Value	$28,709,975	$360,511	$113,610	$42	$17,266	$17,897
124	Wool, pounds	8,830,370	99,710	200			
125	Value	$2,038,930	$19,942	$30			
126	All other products, value	$41,824,201	$511,414	$31,702	$88,510	$1,020	$9,214
127	Custom work, value	$76,473	$9,100				
	Weight of animals slaughtered:						
	Beeves—						
128	Gross weight, on hoof	4,938,475,865	60,844,894	25,710,000		3,052,000	4,050,000
129	Net weight, dressed	2,696,146,926	32,988,803	14,022,550		1,526,350	2,170,000
	Sheep—						
130	Gross weight, on hoof	492,674,476	18,977,310	3,510,400		159,500	166,000
131	Net weight, dressed	249,761,744	9,131,608	1,725,112		80,125	86,250
	Hogs—						
132	Gross weight, on hoof	6,374,499,561	29,300,584	36,405,700	54,933,913	4,047,000	11,942,500
133	Net weight, dressed	4,965,925,575	23,336,290	29,320,200	45,368,632	3,254,400	9,487,700
	Calves—						
134	Gross weight, on hoof	53,260,926	1,813,961	410,000		19,432	328,900
135	Net weight, dressed	33,526,409	1,025,242	279,000		10,732	181,500
	Comparison of products:						
136	Number of establishments reporting for both years	467	17	4	5	2	6
137	Value for census year	$665,510,992	$7,078,351	$2,854,401	$3,380,112	$278,034	$1,131,312
138	Value for preceding business year	$615,733,547	$7,070,866	$2,365,000	$2,998,949	$269,993	$1,095,594
	Power:						
139	Number of establishments reporting	500	16	7	5	2	6
140	Total horsepower	90,553	1,035	627	335	112	312
	Owned—						
	Engines—						
141	Steam, number	1,075	24	17	6	3	10
142	Horsepower	79,518	988	612	335	112	297
143	Gas or gasoline, number	24	2				
144	Horsepower	425	16				
145	Electric motors, number	563					1
146	Horsepower	10,021					16
147	Other power, number	4					
148	Horsepower	95					
	Rented—						
149	Electric, horsepower	480	30	15			
150	Other kind, horsepower	12	1				
151	Furnished to other establishments, horsepower	188					
	Establishments classified by number of persons employed, not including proprietors and firm members:						
152	Total number of establishments	573	23	7	5	3	6
153	No employees	1					
154	Under 5	98	4			1	2
155	5 to 20	210	9	3	2	1	
156	21 to 50	138	6	2	1	1	4
157	51 to 100	52	2	1			
158	101 to 250	29	1	1	2		
159	251 to 500	12	1				
160	501 to 1,000	14					
161	Over 1,000	19					

PACKING, WHOLESALE: BY STATES, 1900—Continued.

Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
$557,831	$279,842,835	$42,891,243	$25,296,518	$76,829,139	$4,541,482	$156,236	$6,209,857	$27,505,698	$3,724,761	$6,803,112	88
3,300,000	1,001,320,043	212,195,474	27,299,798	445,493,433	4,216,939	510,000	2,308,000		1,072,525	19,809,666	89
$205,000	$71,219,927	$15,989,386	$1,899,068	$30,622,996	$298,292	$37,900	$189,640		$70,646	$1,189,202	90
5,200	76,296,560	5,343,207	1,627,920	14,034,995		1,800	6,000				91
$312	$6,446,283	$395,116	$85,466	$1,341,215		$180	$600				92
56,000	67,917,743	1,538,988	1,305,205	8,967,600	601,334		175,300	1,116,500	17,285	807,115	93
$4,800	$5,066,362	$172,930	$84,838	$540,960	$40,036		$16,750	$62,000	$1,185	$56,449	94
118,000	145,454,835	15,332,070	1,081,036	24,257,945	100,276	112,500	200		54,595	2,965,342	95
$8,630	$11,614,616	$1,375,753	$91,238	$1,871,164	$9,095	$12,730	$25		$4,957	$203,032	96
110,000	16,769,630	733,433	197,801	3,753,293	89,683	32,620	46,800		107,600	285,312	97
$8,980	$1,402,438	$67,517	$18,015	$274,381	$9,049	$3,684	$4,745		$10,520	$22,821	98
1,408,000	356,448,731	24,456,275	30,227,091	85,152,483	4,741,510	398,333	11,924,713	44,487,608	11,503,214	14,552,028	99
$107,440	$24,863,977	$1,702,160	$2,237,437	$5,001,307	$362,296	$32,000	$915,147	$3,525,294	$783,598	$850,162	100
782,000	522,096,362	30,704,461	135,513,117	78,884,690	21,371,238	202,500	8,769,909	67,884,374	12,375,700	23,819,650	101
$53,740	$36,179,898	$1,819,740	$9,403,836	$4,814,529	$1,091,135	$12,600	$626,583	$3,785,017	$773,692	$1,362,540	102
230,000	228,284,156	42,658,638	39,741,810	57,996,957	10,662,435	220,000	12,800,500	57,134,534	8,295,567	5,920,898	103
$23,900	$22,746,703	$3,552,687	$3,565,663	$4,940,298	$974,201	$23,200	$1,314,003	$4,719,658	$623,224	$667,570	104
220,000	185,240,920	117,787,185	30,781,171	138,485,250	10,680,870	140,000	20,154,859	92,227,868	15,009,216	7,713,147	105
$17,800	$14,434,759	$8,222,656	$2,399,670	$9,657,119	$791,864	$10,400	$1,525,178	$8,103,673	$1,051,953	$571,336	106
647,000	96,536,421	8,532,981	8,917,759	24,905,403	4,089,156	65,000	10,277,652	22,800,805	3,599,898	3,579,898	107
$42,187	$7,881,854	$579,760	$562,596	$1,467,522	$289,931	$4,450	$706,588	$1,674,512	$208,734	$275,740	108
832,000	57,936,886	5,732,510	1,800	6,489,044	42,684		37,000	21,086	160,000	2,456,636	109
$45,840	$6,159,827	$373,351	$90	$412,267	$1,779		$2,921	$1,265	$10,000	$271,634	110
92,000	326,130,241	45,088,290	63,086,918	91,949,141	6,824,546	173,000	6,956,261	68,843,633	2,098,116	8,248,174	111
$5,840	$18,658,450	$2,777,173	$3,590,506	$4,969,091	$369,724	$11,300	$455,922	$4,220,098	$148,812	$507,922	112
25,400	45,455,528	3,583,150	7,354,874	24,033,743	1,381,570		5,396,552	1,000,000	138,317		113
$1,512	$3,596,474	$260,829	$491,049	$1,255,008	$90,050		$331,666	$60,000	$9,682		114
	9,760,701	1,146,483	175,708	1,928,813							115
	$5,907,572	$750,628	$87,854	$1,204,905							116
	4,385,191	175,983	266,509	1,268,691						157,633	117
	$2,010,394	$84,666	$95,277	$586,487						$76,821	118
175	51,849	8,709	6,921	26,118	1,675		295	3,707	430	1,218	119
$2,840	$1,204,945	$139,011	$84,189	$504,080	$23,256		$4,190	$70,710	$6,245	$20,515	120
9,611	2,103,415	352,951	72,255	880,762	12,776	1,160	8,072		3,170	41,555	121
380,440	123,309,352	22,699,324	3,907,803	49,676,135	742,303	56,850	395,340		140,700	2,247,136	122
$24,318	$12,563,343	$2,565,994	$387,526	$5,496,695	$74,101	$3,967	$28,997		$12,851	$227,430	123
3,600	8,389,307			2,000	1,000						124
$1,200	$1,935,373			$375	$200						125
$2,742	$25,949,345	$2,061,836	$210,925	$1,855,162	$116,473	$3,826	$65,952	$1,264,488	$7,662	$499,858	126
$750	$300		$1,276	13,578			$20,950	$13,983	$1,000	$80	127
7,790,000	2,099,506,022	395,743,511	74,573,710	961,609,827	10,888,967	930,000	6,602,000		2,102,410	41,379,920	128
3,804,750	1,134,386,763	222,787,621	41,144,172	523,454,771	5,752,879	510,000	3,479,000		1,081,320	21,237,859	129
202,500	259,684,321	30,466,196	1,100,840	50,859,636	158,127	225,000			103,950	3,941,282	130
95,700	133,251,174	15,586,613	532,103	26,561,060	78,210	112,500			52,595	2,955,964	131
4,017,500	1,913,417,755	335,669,541	451,547,489	661,788,374	85,473,502	515,000	85,588,321	431,016,694	68,911,930	87,569,045	132
2,875,930	1,489,691,733	269,617,295	322,456,065	504,506,235	67,102,481	407,500	66,539,723	343,614,967	54,720,300	67,929,170	133
179,500	21,942,668	1,310,600	199,407	5,857,680	151,493	59,200	77,840		153,400	407,880	134
100,200	14,063,920	805,273	130,829	3,615,542	89,683	32,625	46,440		107,600	278,890	135
3	42	25	15	9	10	2	39	11	8	7	136
$254,939	$277,472,607	$42,891,243	$23,824,046	$76,191,207	$4,392,894	$137,170	$4,137,546	$27,505,698	$3,724,761	$5,863,299	137
$258,700	$254,322,753	$40,703,181	$24,613,416	$72,611,901	$3,840,179	$128,000	$4,014,883	$30,647,950	$3,198,406	$4,709,898	138
4	48	22	15	11	13	3	41	10	8	12	139
127	27,870	4,868	4,099	12,802	435	52	1,595	2,707	609	939	140
6	181	58	43	66	23	3	47	27	14	18	141
119	24,007	4,464	3,078	10,778	425	52	1,594	2,584	574	919	142
			1	10					1		143
			16	209					35		144
1	166	36	40	83	1		1	16		1	145
8	3,603	404	1,005	1,715	10		1	105		5	146
				3						1	147
				90						5	148
	260							18		10	149
				10							150
	145	1						30			151
4	51	25	20	11	15	3	47	11	8	13	152
							1				163
	3	5	3	1	5	1	19			3	154
	19	9	5	2	4	2	18	2	1	7	155
2	9	6	5	2	4		7	3	5	1	156
2	5		2		1		2	1		1	157
	1	3	2	2				2	2		158
	2			1	1			1			159
	4		2					1		1	160
	8	2	1	3				1			161

		Missouri.	Nebraska.	New Jersey.	New York.	North Dakota.	Ohio.
1	Number of establishments	31	8	22	53	3	60
	Character of organization:						
2	Individual	15	1	10	31	1	18
3	Firm and limited partnership	5	....	9	15	1	25
4	Incorporated company	11	7	3	7	1	17
	Capital:						
5	Total	$7,844,054	$16,488,845	$1,033,847	$7,309,162	$104,371	$5,224,226
6	Land	$392,756	$823,209	$110,000	$725,365	$10,500	$274,665
7	Buildings	$1,663,141	$4,060,054	$253,000	$1,213,556	$30,750	$588,071
8	Machinery, tools, and implements	$1,059,749	$1,327,895	$182,421	$800,888	$11,900	$482,606
9	Cash and sundries	$4,728,408	$10,277,687	$488,426	$4,569,353	$51,221	$3,778,884
10	Proprietors and firm members	27	1	30	67	3	76
	Salaried officials, clerks, etc.:						
11	Total number	232	721	82	331	8	313
12	Total salaries	$244,475	$684,240	$72,226	$260,774	$8,760	$266,001
	Officers of corporations—						
13	Number	21	8	3	14	1	47
14	Salaries	$51,080	$27,816	$9,500	$32,380	$2,400	$71,926
	General superintendents, managers, clerks, etc.—						
15	Total number	211	713	79	317	7	266
16	Total salaries	$193,395	$656,424	$62,725	$228,394	$6,360	$194,076
	Men—						
17	Numbers	194	677	74	234	6	249
18	Salaries	$185,824	$632,867	$60,622	$194,457	$5,860	$187,189
	Women—						
19	Numbers	17	36	5	83	1	17
20	Salaries	$7,571	$23,557	$2,104	$33,937	$500	$6,886
	Wage-earners, including pieceworkers, and total wages:						
21	Greatest number employed at any one time during the year	4,036	6,997	394	1,719	35	1,959
22	Least number employed at any one time during the year	2,454	6,344	330	1,374	33	1,551
23	Average number	3,043	6,083	352	1,530	34	1,700
24	Wages	$1,416,680	$2,985,828	$186,737	$777,738	$15,977	$775,288
	Men, 16 years and over—						
25	Average number	2,920	5,596	350	1,442	33	1,652
26	Wages	$1,392,645	$2,858,466	$186,477	$752,662	$15,677	$762,404
	Women, 16 years and over—						
27	Average number	8	173	....	78	1	29
28	Wages	$2,160	$57,425	....	$23,332	$300	$8,556
	Children, under 16 years—						
29	Average number	115	314	2	10	....	19
30	Wages	$21,876	$70,937	$260	$1,744	....	$4,228
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
31	January	2,677	5,112	381	1,496	34	1,798
32	February	2,690	5,100	378	1,467	34	1,737
33	March	3,521	5,235	374	1,458	34	1,655
34	April	2,691	5,299	359	1,417	32	1,692
35	May	2,550	5,612	334	1,387	32	1,632
36	June	2,639	5,852	311	1,390	32	1,685
37	July	3,122	5,883	309	1,377	32	1,554
38	August	3,250	5,776	310	1,373	32	1,515
39	September	3,037	5,735	344	1,401	32	1,583
40	October	2,888	6,980	360	1,481	34	1,599
41	November	2,863	5,876	364	1,521	34	1,742
42	December	3,110	5,688	373	1,542	34	1,832
	Women, 16 years and over—						
43	January	7	138	....	57	1	29
44	February	7	139	....	58	1	29
45	March	7	165	....	69	1	29
46	April	14	170	....	69	1	29
47	May	8	146	....	70	1	29
48	June	10	152	....	92	1	29
49	July	10	171	....	88	1	29
50	August	17	156	....	89	1	29
51	September	16	187	....	90	1	29
52	October	3	245	....	82	1	29
53	November	....	193	....	83	1	24
54	December	....	215	....	67	1	29
	Children, under 16 years—						
55	January	109	278	3	10	....	24
56	February	115	282	3	10	....	24
57	March	130	286	3	10	....	20
58	April	119	315	3	10	....	16
59	May	107	316	2	10	....	15
60	June	116	369	2	10	....	19
61	July	122	321	2	10	....	19
62	August	123	363	2	10	....	16
63	September	116	336	2	10	....	16
64	October	104	304	....	10	....	15
65	November	114	304	2	10	....	24
66	December	107	300	3	10	....	24
	Miscellaneous expenses:						
67	Total	$350,599	$1,591,078	$97,274	$520,208	$8,975	$619,628
68	Rent of works	$8,005	$18,708	$7,585	$35,988	$720	$25,120
69	Taxes, not including internal revenue	$14,742	$43,862	$6,097	$29,843	$430	$24,262
70	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$327,352	$1,528,508	$83,592	$452,597	$7,026	$569,246
71	Contract work	$500	....	....	$1,680	$800	....
	Materials used:						
72	Total cost	$38,391,243	$62,838,752	$5,443,255	$16,980,708	$198,175	$17,006,794
	Slaughtered—						
73	Beeves, number	334,562	526,545	4,410	45,986	1,700	77,325
74	Cost	$14,589,993	$24,418,087	$207,600	$2,005,655	$65,000	$2,994,655
75	Sheep, number	245,407	723,355	55,449	33,683	900	38,337
76	Cost	$1,008,852	$3,075,686	$277,466	$137,231	$3,400	$142,703
77	Hogs, number	1,828,753	2,732,074	255,858	1,095,543	12,500	1,273,822
78	Cost	$18,816,386	$27,833,464	$2,381,151	$8,564,588	$121,400	$11,100,887
79	Calves, number	17,690	5,154	7,414	20,771	400	17,891
80	Cost	$120,856	$57,678	$74,516	$164,620	$4,000	$146,460
81	All other animals, cost	11,725	56,674	12,173	2,000	....	900
82	Dressed meat, purchased, fresh or partly cured, cost	$1,842,384	$4,426,618	$2,266,059	$5,294,941	....	$1,141,022
83	Fuel	$155,874	$354,495	$23,919	$73,298	$875	$83,854

PACKING, WHOLESALE: BY STATES, 1900—Continued.

Oregon.	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Utah.	Virginia.	Washington.	West Virginia.	Wisconsin.	All other states and territories.[1]	
9	68	6	8	12	5	3	14	3	11	5	1
2	28	....	2	1	1	1	2	1	2	1	2
3	31	4	2	3	4	1	6	1	5	1	3
4	9	2	4	8	....	1	6	1	4	3	4
$760,448	6,009,347	$727,850	$651,740	$1,232,267	$83,902	$156,500	$941,786	$313,000	$3,784,216	$121,721	5
$189,021	$700,563	$9,800	$45,300	$53,871	$22,369	$34,000	$38,100	$22,000	$268,882	$4,000	6
$238,500	$1,291,502	$17,400	$119,589	$244,329	$7,000	$23,000	$127,500	$55,000	$525,152	$26,803	7
$115,356	$675,700	$25,700	$129,227	$222,952	$10,772	$21,500	$125,942	$33,000	$425,330	$46,372	8
$217,571	$3,341,582	$674,950	$357,624	$711,115	$43,761	$78,000	$650,244	$203,000	$2,564,852	$44,546	9
9	101	9	5	6	10	4	15	3	17	3	10
41	349	16	15	49	6	17	79	16	122	12	11
$47,130	$289,165	$17,636	$17,365	$61,797	$2,472	$13,140	$73,328	$11,800	$144,833	$7,270	12
9	9	5	9	10	....	3	3	5	10	3	13
$16,400	$19,200	$8,000	$12,500	$20,800	....	$4,940	$6,120	$6,000	$35,000	$3,000	14
32	340	11	6	39	6	14	76	11	112	9	15
$30,730	$269,965	$9,636	$4,865	$40,997	$2,472	$8,200	$67,208	$5,800	$109,833	$4,270	16
30	323	11	6	38	5	14	72	11	105	9	17
$29,930	$264,053	$9,636	$4,865	$40,467	$2,172	$8,200	$65,438	$5,800	$105,735	$4,270	18
2	17	....	....	1	1	....	4	....	7	....	19
$800	$5,912	....	....	$540	$300	....	$1,770	....	$4,098	....	20
219	7,457	211	349	535	40	57	253	92	1,672	149	21
145	1,261	183	109	345	31	30	195	75	1,119	117	22
172	1,383	199	156	414	34	42	209	84	1,361	75	23
$87,821	$733,932	$102,424	$60,945	$179,505	$14,978	$17,884	$135,896	$42,646	$560,808	$34,688	24
166	1,364	196	152	394	34	42	207	76	1,359	75	25
$86,441	$728,961	$101,588	$60,776	$173,438	$14,978	$17,884	$134,996	$40,642	$560,433	$34,688	26
1	12	....	4	19	....	....	2	6	2	....	27
$480	$3,395	....	$170	$5,867	....	....	$900	$1,620	$375	....	28
5	7	3	....	1	....	....	....	2	....	....	29
$900	$1,576	$836	....	$200	....	....	....	$384	....	....	30
166	1,399	188	197	457	34	57	216	83	1,552	73	31
166	1,386	188	180	483	33	52	214	73	1,407	64	32
150	1,377	191	139	473	32	42	216	73	1,339	66	33
136	1,320	194	118	447	34	42	210	69	1,268	64	34
136	1,319	196	122	408	34	34	230	77	1,271	59	35
166	1,292	193	122	349	35	34	207	77	1,305	52	36
185	1,301	195	137	341	34	30	196	77	1,287	122	37
185	1,339	199	76	326	35	32	198	77	1,172	126	38
162	1,368	199	90	352	33	32	199	69	1,176	73	39
172	1,388	204	116	357	33	37	198	74	1,339	64	40
191	1,409	200	247	370	31	51	204	84	1,545	61	41
187	1,473	201	278	366	38	56	201	84	1,649	75	42
1	11	....	....	22	....	....	2	6	1	....	43
1	10	....	....	21	....	....	2	6	1	....	44
1	11	....	....	23	....	....	2	6	1	....	45
1	11	....	....	19	....	....	2	6	2	....	46
1	15	....	....	18	....	....	2	6	2	....	47
1	16	....	....	17	....	....	2	6	2	....	48
1	14	....	....	17	....	....	2	6	2	....	49
1	14	....	....	17	....	....	2	6	2	....	50
1	16	....	....	18	....	....	2	6	2	....	51
1	10	....	3	14	....	....	2	6	1	....	52
1	11	....	23	19	....	....	2	6	1	....	53
1	11	....	26	24	....	....	2	6	1	....	54
5	7	3	....	1	....	....	....	2	....	....	55
5	7	3	....	....	....	....	....	2	....	....	56
5	6	3	....	....	....	....	....	2	....	....	57
5	7	3	....	2	....	....	....	2	....	....	58
5	7	3	....	1	....	....	....	2	....	....	59
5	6	3	....	1	....	....	....	2	....	....	60
5	7	3	....	1	....	....	....	2	....	....	61
5	7	3	....	2	....	....	....	2	....	....	62
5	6	4	....	2	....	....	....	2	....	....	63
5	6	4	....	1	....	....	....	2	....	....	64
5	7	4	....	....	....	....	....	2	....	....	65
5	7	4	....	....	....	....	....	2	....	....	66
$35,768	$372,368	$43,794	$25,268	$66,749	$5,075	$2,588	$66,166	$4,623	$405,689	$6,439	67
$3,026	$34,842	$10,373	$347	$5,120	$1,800	....	$9,033	....	$21,362	$916	68
$4,754	$26,167	$802	$1,513	$5,070	$611	$988	$3,804	$1,575	$10,015	$533	69
$27,988	$309,074	$32,619	$23,258	$56,559	$2,664	$1,600	$53,319	$3,048	$374,212	$4,990	70
....	$2,285	....	$150	....	....	....	....	....	....	....	71
$1,359,361	$15,128,096	$2,164,400	$1,453,128	$3,170,536	$291,477	$477,230	$3,736,658	$1,133,954	$11,850,136	$524,500	72
14,451	40,916	....	8,988	24,375	4,707	1,800	33,197	4,670	45,470	7,490	73
$549,650	$1,945,583	....	$243,015	599,514	$160,418	$36,000	$1,454,260	$200,200	$1,720,361	182,120	74
47,819	85,235	....	4,200	6,649	9,104	50	106,676	2,560	36,502	4,510	75
$158,520	$333,228	....	$12,700	$18,311	$35,092	$150	$357,647	$8,460	$140,047	$16,270	76
21,862	751,057	133,200	115,572	208,270	1,750	32,000	61,284	79,120	947,176	24,550	77
$213,040	$6,443,115	$1,459,300	$1,060,324	$1,886,067	$15,000	$271,200	$660,788	$785,010	$8,627,543	$257,550	78
1,661	31,927	....	1,900	7,544	710	300	6,055	760	21,323	460	79
$12,470	$294,746	....	$10,900	$60,205	$5,980	$1,600	$65,095	$4,404	$137,298	$2,200	80
$10,364	$25,663	....	$60	$21	....	....	$5,691	....	$14,467	....	81
$294,621	$5,286,548	$559,300	$73,757	$178,738	$59,099	$130,000	861,068	$117,950	161,402	$21,000	82
$12,639	$76,731	$8,625	$14,145	$53,858	$800	$2,210	$10,160	$4,200	$54,025	$13,150	83

[1] Includes establishments distributed as follows: Alabama, 1; Arkansas, 1; New Hampshire, 1; South Dakota, 1; Wyoming, 1.

		Missouri.	Nebraska.	New Jersey.	New York.	North Dakota.	Ohio.
	Materials used—Continued.						
	Total cost—Continued.						
84	Rent of power and heat	$60		$720	$1,602		$585
85	Mill supplies	$20,197	$18,172	$3,067	$11,874	$200	$14,793
86	All other materials	$1,726,119	$2,414,452	$133,794	$529,110	$3,000	$1,131,764
87	Freight	$98,797	$183,436	$62,790	$95,889	$300	$249,171
	Products:						
88	Total value	$42,229,127	$71,018,339	$6,199,795	$19,624,187	$256,160	$19,609,304
	Beef—						
89	Sold fresh, pounds	160,844,314	305,918,049	2,517,020	21,923,500	1,055,000	35,044,020
90	Value	$11,630,514	$22,509,745	$184,536	$1,512,187	$62,625	$2,530,900
91	Canned, pounds	2,220,000	10,156,391		577,980		1,200,000
92	Value	$140,000	$564,854		$42,430		$78,500
93	Salted or cured, pounds	17,978,683	11,945,633	245,600	6,266,142		4,692,000
94	Value	$1,076,431	$773,966	$32,540	$574,825		$240,740
95	Mutton, sold fresh, pounds	9,960,098	32,979,157	3,451,000	1,695,180	43,500	1,341,055
96	Value	$758,171	$2,696,984	$261,285	$161,828	$3,915	$138,546
97	Veal, sold fresh, pounds	1,312,989	812,589	729,160	1,854,640	51,000	1,473,318
98	Value	$134,121	$67,029	$74,616	$161,963	$4,590	$137,784
	Pork—						
99	Sold fresh, pounds	101,936,224	84,101,389	10,253,710	43,203,960	380,000	44,603,599
100	Value	$6,580,427	$5,604,322	$802,974	$3,013,211	$24,400	$3,240,261
101	Salted, pounds	93,266,664	201,807,678	7,776,468	25,931,082	100,000	23,135,649
102	Value	$4,869,923	$11,958,021	$522,538	$1,688,843	$9,000	$1,589,237
103	Hams, pounds	33,844,254	66,273,113	15,008,818	44,533,108	400,000	38,046,139
104	Value	$2,986,608	$6,321,300	$1,463,123	$4,354,399	$42,250	$3,538,830
105	Smoked bacon, sides, and shoulder, pounds	52,392,149	78,409,619	18,868,525	51,749,929	400,000	53,168,262
106	Value	$3,810,491	$5,894,728	$1,557,289	$3,830,833	$39,650	$4,173,926
107	Sausage, fresh or cured, pounds	10,285,213	21,323,639	6,258,444	15,899,263	166,000	14,391,065
108	Value	$593,989	$1,483,558	$461,033	$1,222,909	$11,500	$1,026,000
109	All other meat, sold fresh, pounds				520,000		218,080
110	Value				$54,700		$19,308
111	Refined lard, pounds	40,548,889	79,188,586	8,567,664	26,519,781	135,000	29,513,654
112	Value	$2,310,669	$4,889,132	$533,536	$1,745,221	$8,250	$1,892,866
113	Neutral lard, pounds	11,425,517	15,612,418	1,450,833	2,747,900		2,863,300
114	Value	$610,124	$986,368	$87,050	$162,346		$210,850
116	Oleomargarine oil, gallons	1,434,787	2,302,914		34,490		76,000
116	Value	$857,419	$1,382,115		$17,245		$38,000
117	Other oils, gallons	367,529	419,004		31,448		
118	Value	$158,736	$128,998		$15,846		
119	Fertilizers, tons	18,695	15,369	2,486	2,160		4,004
120	Value	$347,309	$250,808	$57,815	$32,730		$58,630
121	Hides, number	352,142	520,469	11,660	66,757	2,100	95,204
122	Pounds	19,191,547	31,148,539	337,275	2,686,700	127,800	4,463,867
123	Value	$2,101,925	$2,903,001	$32,602	$258,129	$11,770	$426,709
124	Wool, pounds			134,000			
125	Value			$41,700			
126	All other products, value	$3,262,270	$2,603,360	$87,158	$774,292	$37,210	$266,717
127	Custom work, value				$260	$1,000	$1,500
	Weight of animals slaughtered:						
	Beeves—						
128	Gross weight, on hoof	334,627,509	592,062,734	4,618,000	49,369,500	1,965,000	74,660,494
129	Net weight, dressed	181,543,627	333,371,242	2,517,020	27,377,550	1,055,000	41,334,495
	Sheep—						
130	Gross weight, on hoof	19,621,258	65,415,617	4,670,729	3,308,550	81,000	2,832,662
131	Net weight, dressed	9,956,592	31,577,511	2,451,787	1,685,580	43,500	1,436,055
	Hogs—						
132	Gross weight, on hoof	418,360,473	688,491,252	46,423,868	207,408,826	3,100,000	257,312,059
133	Net weight, dressed	336,661,166	521,602,090	36,904,312	164,681,514	2,395,000	202,425,850
	Calves—						
134	Gross weight, on hoof	2,069,482	1,042,237	1,143,700	2,901,440	66,000	2,608,550
135	Net weight, dressed	1,218,468	681,349	729,692	1,890,520	51,000	1,473,816
	Comparison of products:						
136	Number of establishments reporting for both years	27	7	18	45	3	47
137	Value for census year	$39,063,955	$60,570,054	$5,548,500	$17,884,235	$256,160	$18,148,971
138	Value for preceding business year	$33,240,844	$50,667,334	$5,250,024	$16,262,632	$238,612	$16,549,564
	Power:						
139	Number of establishments reporting	27	7	19	45	2	54
140	Total horsepower	6,210	8,379	766	2,481	26	3,305
	Owned—						
	Engines—						
141	Steam, number	51	39	27	68	2	90
142	Horsepower	4,980	7,160	738	2,276	26	3,152
143	Gas or gasoline, number				2		
144	Horsepower				39		
145	Electric motors, number	129	49		6		9
146	Horsepower	1,230	1,219		135		128
147	Other power, number						
148	Horsepower						
	Rented—						
149	Electric, horsepower			28	30		25
150	Other kind, horsepower				1		
151	Furnished to other establishments, horsepower				12		
	Establishments classified by number of persons employed, not including proprietors and firm members:						
152	Total number of establishments	31	8	22	53	3	60
153	No employees						
154	Under 5	3	1	3	8	1	14
155	5 to 20	14		10	25	1	22
156	21 to 50	6	1	7	9	1	14
157	51 to 100	2		2	8		6
158	101 to 250	2	1				3
159	251 to 500	2			2		
160	501 to 1,000	1	2		1		1
161	Over 1,000	1	3				

PACKING, WHOLESALE: BY STATES, 1900—Continued.

Oregon.	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Utah.	Virginia.	Washington.	West Virginia.	Wisconsin.	All other states and territories.[1]	
$409	$1,550	...	...	$100	$720	...	$276	...	$54	...	84
$1,259	$12,180	$1,370	$925	$3,330	$78	$220	$2,250	$530	$3,645	$1,860	85
$9,691	$475,494	$47,455	$32,865	$355,944	$14,040	$22,050	$39,016	$13,200	$606,783	$17,350	86
$96,698	$233,258	$88,350	$4,447	$14,448	$250	$13,900	$280,408	...	$384,511	$13,000	87
$1,638,480	$17,826,697	$2,410,466	$1,671,218	$3,904,491	$343,444	$559,620	$4,293,953	$1,337,578	$13,601,125	$602,247	88
7,583,840	26,472,771	...	3,681,960	10,796,352	2,616,450	535,000	17,482,389	2,540,000	23,796,779	2,503,000	89
$552,507	$2,147,302	...	$255,587	$588,996	$171,348	$31,300	$1,324,314	$186,700	$1,588,571	$183,200	90
...	42,400	...	...	...	...	...	...	...	62,186	...	91
...	$4,240	...	...	...	...	...	...	...	$5,445	...	92
502,500	2,515,208	...	14,400	2,000	144,210	5,000	1,921,260	...	848,796	1,000	93
$38,175	$191,168	...	$720	$300	$11,409	$250	$139,825	...	$59,067	$60	94
2,300,600	3,764,546	...	217,000	266,414	600,680	3,000	4,999,681	88,600	1,552,963	209,367	95
$164,780	$373,415	...	$14,000	$22,040	$34,197	$210	$374,885	$7,965	$128,859	$18,685	96
198,410	2,870,742	...	217,500	973,612	209,690	18,000	771,500	48,100	1,755,872	37,714	97
$18,210	$321,085	...	$11,850	$67,542	$21,516	$1,720	$70,370	$4,173	$162,654	$2,760	98
781,520	31,287,251	10,352,400	2,635,511	5,133,863	386,534	628,000	6,227,071	2,368,500	24,740,494	1,005,000	99
$62,897	$2,520,200	$699,970	$168,931	$333,958	$26,503	$46,320	$477,800	$166,195	$1,459,627	$86,025	100
1,467,400	12,184,548	7,434,000	7,531,817	6,806,344	34,800	2,783,000	646,400	630,000	73,557,159	340,500	101
$102,322	$898,910	$439,660	$525,719	$396,894	$2,821	$196,810	$55,440	$37,100	$4,337,065	$26,810	102
1,501,564	44,629,801	4,628,350	2,981,400	5,289,601	35,280	1,044,560	6,412,300	5,122,400	25,775,477	755,901	103
$162,564	$4,207,412	$419,027	$280,816	$481,106	$4,386	$101,460	$714,883	$511,616	$2,228,503	$77,000	104
2,094,147	36,610,835	5,637,076	2,813,853	11,849,398	176,500	1,150,000	6,229,400	3,651,600	9,448,637	1,003,055	105
$190,720	$2,800,348	$360,105	$198,096	$833,340	$15,259	$97,000	$497,666	$256,812	$675,487	$87,100	106
404,891	15,412,150	2,183,700	281,500	2,085,953	154,709	280,000	934,905	427,000	7,630,689	303,450	107
$33,266	$1,233,816	$158,048	$16,243	$123,939	$12,805	$21,000	$73,151	$24,870	$554,324	$22,640	108
46,000	634,720	374,500	17,000	539,400	32,375	...	7,600	100,000	200,983	70,000	109
$5,400	$54,603	$26,215	$800	$30,680	$4,775	...	$760	$5,000	$18,467	$4,200	110
1,018,732	26,805,932	3,936,200	1,804,200	4,334,111	60,504	850,000	1,621,000	1,846,000	19,260,924	492,000	111
$95,752	$1,733,624	$245,625	$106,801	$282,661	$5,290	$55,500	$152,575	$110,900	$1,073,302	$36,350	112
2,500	5,340	...	636,900	2,141,216	...	43,340	25,000	...	2,690,051	13,333	113
$150	$200	...	$44,672	$133,993	...	$2,600	$1,500	...	$162,544	$800	114
...	494,372	...	...	...	...	...	...	...	48,322	...	115
...	$244,687	...	...	...	...	...	...	...	$24,048	...	116
3,085	16,933	...	...	976,840	...	...	4,200	...	3,931	22,500	117
$1,446	$6,500	...	...	$195,548	...	...	$2,480	...	$1,651	$7,200	118
327	3,101	...	380	653	...	...	3,780	200	3,237	100	119
$5,616	$88,016	...	$5,785	$6,424	...	...	$92,400	$3,000	$48,324	$1,450	120
19,983	72,793	...	12,518	31,908	5,417	2,100	39,252	5,430	66,793	7,690	121
861,140	2,758,319	...	467,400	1,379,101	246,850	84,000	2,123,930	248,400	2,866,255	338,600	122
$79,301	$268,959	...	$36,803	$118,067	$23,728	$6,412	$202,670	$22,032	$294,889	$28,530	123
200,000	...	...	...	...	...	...	...	...	653	...	124
$40,000	...	...	...	...	...	...	...	...	$110	...	125
$85,376	$721,637	$61,816	$16,496	$289,103	$9,408	$38	$111,835	$1,215	$798,038	$19,065	126
...	$10,575	...	...	...	...	...	$1,500	...	$150	$482	127
15,089,880	44,473,101	...	7,308,000	21,258,700	4,938,450	1,260,000	37,423,700	4,670,000	44,025,536	5,942,000	128
8,002,690	24,579,381	...	3,696,360	10,670,800	2,744,225	540,000	20,199,020	2,540,000	24,642,678	2,986,000	129
4,673,340	6,312,444	...	420,000	566,995	882,790	5,000	10,532,195	164,000	3,112,334	431,500	130
2,327,550	3,095,789	...	217,000	288,554	483,616	3,000	5,076,471	88,500	1,572,645	210,680	131
4,823,660	138,934,778	33,300,000	22,599,650	41,669,304	404,000	6,940,000	12,584,380	17,339,000	218,651,563	6,122,000	132
3,830,992	110,715,354	27,212,000	17,419,640	32,959,805	311,250	4,788,000	10,268,509	13,834,000	175,720,972	3,964,500	133
297,854	4,421,841	...	360,000	1,697,621	100,500	30,000	1,080,920	77,300	2,392,520	59,000	134
198,410	2,606,030	...	217,500	987,234	67,000	18,000	749,050	48,100	1,788,364	34,400	135
7	60	6	6	6	5	2	11	2	9	3	136
$852,453	$16,471,756	$2,410,466	$1,423,838	$2,163,097	$343,444	$247,620	$3,845,963	$1,294,263	$13,538,280	$330,327	137
$749,963	$14,733,450	$2,222,278	$1,130,553	$1,846,478	$309,428	$225,380	$3,174,046	$1,246,905	$14,772,714	$263,673	138
7	62	6	4	12	5	2	8	3	11	4	139
299	4,271	248	660	1,796	35	186	460	376	2,071	562	140
9	102	9	6	22	4	5	60	9	27	10	141
267	4,030	248	550	1,589	20	185	418	329	2,041	562	142
...	3	...	...	3	...	...	...	2	...	...	143
...	34	...	...	49	...	...	...	27	...	...	144
2	11	...	1	7	...	...	...	2	1	...	145
30	198	...	10	155	...	...	...	20	25	...	146
...	...	...	...	...	...	...	...	...	...	...	147
...	...	...	...	...	...	...	...	...	...	...	148
2	...	...	...	2	15	...	42	...	6	...	149
...	...	...	...	...	...	...	...	...	...	...	150
...	...	...	...	...	...	...	...	...	...	...	151
9	68	6	8	12	5	3	14	3	11	6	152
...	...	...	...	...	...	...	...	...	...	...	153
...	12	1	...	2	3	...	1	1	...	1	154
5	25	2	4	4	1	1	6	1	3	2	155
3	22	1	2	2	1	2	6	...	2	1	156
...	8	2	1	1	...	...	1	1	2	1	157
1	...	...	1	3	...	...	...	...	2	...	158
...	1	...	...	...	...	...	...	...	1	...	159
...	...	...	...	...	...	...	...	...	1	...	160
...	...	...	...	...	...	...	...	...	...	...	161

[1] Includes establishments distributed as follows: Alabama, 1; Arkansas, 1; New Hampshire, 1; South Dakota, 1; Wyoming, 1.

In connection with these tables, the fact should be noted that in New York, Pennsylvania, and New Jersey, states showing a decrease in value of products for the last decade, the value of products of establishments engaged in slaughtering only considerably exceeded, in 1900, the value of products of the establishments conducting packing operations. On the other hand, in Illinois, Kansas, Nebraska, Missouri, and Indiana, the packing industry led the slaughtering industry by a large margin. The figures are significant. They illustrate the importance of the demand of the market, in the large eastern cities, for fresh meat for local consumption, although a considerable proportion of the meat from eastern establishments is exported. The immense proportion of the western packing trade shows the local demand was inconsiderable as compared with the amounts necessary to supply the demand in other states and foreign countries.

Table 7.—COMBINED SLAUGHTERING AND MEAT PACKING: QUANTITY AND COST OF MATERIALS USED, 1890 AND 1900, WITH PER CENT OF INCREASE.

	1900	1890	Per cent of increase.
Total cost	$683,583,577	$480,962,211	42.1
Beeves slaughtered:			
Number	5,530,911	5,422,044	2.0
Cost	$247,365,812	$193,348,810	27.9
Sheep slaughtered:			
Number	9,190,490	6,178,449	48.8
Cost	$37,137,542	$24,358,179	52.5
Hogs slaughtered:			
Number	30,654,333	22,349,451	37.2
Cost	$278,736,961	$207,228,609	34.5
All other animals slaughtered:			
Cost	$7,916,399	$5,246,661	50.9
Dressed meat:			
Cost	$54,715,496	$25,674,343	113.1
Fuel	$2,747,606	$1,569,396	75.1
Rent of power and heat	$30,946	$25,240	22.6
All other materials, including mill supplies and freight	$54,932,815	$23,510,973	133.6

A comparative summary between 1890 and 1900, of quantities and cost of materials used, is presented in Table 7. The value of "all other animals slaughtered" shows an increase of 50.9 per cent. This item consisted almost wholly of poultry, and affords evidence of the extent to which this phase of slaughtering has increased among the concerns engaged in the slaughtering of cattle, hogs, and sheep. The total for the value of hogs killed amounted to $278,736,961, an increase of 34.5 per cent in the decade. During the same period, the number of hogs killed increased in a greater ratio than their value, showing a decreased value for the single hog. The number of cattle killed increased only 2 per cent, while the cost increased 27.9 per cent. The number of sheep killed increased 48.8 per cent, while the value increased 52.5 per cent, showing an increase in the cost of the single sheep. The value of dressed meat purchased increased from $25,674,343 to $54,715,496, or 113.1 per cent, showing the extent to which establishments engaged in packing only increased. This item is largely a duplication of the value reported of the animals slaughtered. The increase in the cost of fuel of 75.1 per cent was due principally to the more general use and improvement of the cold storage and refrigeratory processes, and the introduction of electric transportation in plants of some of the larger concerns. The increase of 133.6 per cent in the cost of all other materials was caused in part by the cost of materials needed in the more extended utilization of the "waste" materials, and the materials used in box factories, plants for the manufacture of tin cans and cases, etc., the increasing pressure of competition forcing the establishments to manufacture many of the articles previously purchased from outside concerns. This table shows that the cost of cattle per animal increased from $35.66 to $44.72, and the cost of the single sheep from $3.94 to $4.05, while that of the single hog decreased from $9.27 to $9.09.

Table 8 is a comparative summary between 1890 and 1900, of the quantities and value of products, with the percentage of increase.

Table 8.—COMBINED SLAUGHTERING AND MEAT PACKING: QUANTITY AND VALUE OF PRODUCTS, 1890 AND 1900, WITH PER CENT OF INCREASE.

	1900	1890	Per cent of increase.
Total value	$785,562,433	$561,611,668	39.9
Beef, sold fresh:			
Pounds	2,920,458,297	2,708,319,960	7.8
Value	$211,068,934	$152,591,963	38.3
Beef, canned:			
Pounds	112,449,021	133,428,456	[1]15.7
Value	$9,167,531	$8,950,582	2.4
Beef, salted or cured:			
Pounds	137,589,303	576,289,731	[1]76.1
Value	$9,661,834	$23,318,414	[1]58.6
Mutton, sold fresh:			
Pounds	404,183,601	267,353,788	51.2
Value	$32,963,219	$21,998,023	49.8
Pork, sold fresh:			
Pounds	1,223,038,988	1,125,648,541	8.7
Value	$84,019,387	$66,719,585	25.9
Pork, salted:			
Pounds	1,375,524,758	1,264,956,237	8.7
Value	$88,674,016	$77,737,470	14.1
Hams:			
Pounds	787,526,973	529,387,213	48.8
Value	$73,793,012	$48,732,908	51.4
Smoked bacon, sides, and shoulders:			
Pounds	985,722,212	666,229,376	48.0
Value	$74,873,847	$44,664,041	67.6
Sausage, fresh or cured:			
Pounds	292,164,075	149,281,545	95.7
Value	$21,472,413	$9,298,335	130.9
Refined lard:			
Pounds	891,438,417	536,485,829	66.2
Value	$52,620,348	$33,401,563	57.5
Neutral lard:			
Pounds	129,345,282	104,986,465	23.2
Value	$8,588,350	$6,740,246	27.4
Oleomargarine oil:			
Gallons	19,111,120	16,600,652	15.1
Value	$11,482,542	$12,202,117	[1]5.9
Other oils:			
Gallons	8,245,569	4,427,555	86.2
Value	$3,440,358	$3,590,012	[1]4.2
Fertilizers:			
Tons	168,510	115,400	46.0
Value	$3,300,132	$2,343,777	40.8
Hides:			
Number	6,281,952	5,346,919	17.5
Pounds	336,527,907	384,481,326	[1]12.5
Value	$33,925,911	$21,245,782	59.7
Wool:			
Pounds	13,182,146	11,127,851	18.5
Value	$3,335,824	$2,009,133	66.0
All other products, including custom work	$63,174,775	$26,067,717	142.3

[1] Decrease.

Two notable features of this table are the decrease in the quantity and value of the salted and cured beef, and the increase in the value of "all other products," due to the increase in the production and value of the the so-called by-products. Salted beef, while it has decreased both in quantity and in total value, yet has increased in value per pound, as is indicated by the fact that the percentage of value did not fall so fast as did the percentage of quantity produced. The value of "all other products" has increased from $26,067,717 to $63,174,775, or 142.3 per cent. Compared with the rate of increase in the total value of all products of 39.9 per cent, it increased very nearly three and one-half times as fast. Of the increase of $223,950,765 in the value of all products, the increase of $37,107,058 in the value of "all other products" constituted 16.6 per cent, or very nearly one-sixth. The production of beef, sold fresh, is so large as to be almost incomprehensible—2,920,458,297 pounds were produced in 1900, an increase of 212,138,337 pounds, or 7.8 per cent, over 1890. The value of this beef increased in greater proportion, advancing from an average price of 5.6 cents per pound in 1890 to 7.2 cents per pound in 1900, or 28.6 per cent. Of canned beef, 20,979,435 fewer pounds were canned in 1900 than in 1890, while the value increased by $216,949. Beef, salted or cured, suffered a decline in production of 438,700,428 pounds, falling from 576,289,731 pounds to 137,589,303 pounds, or 76.1 per cent. The decrease in value was $13,656,580, or 58.6 per cent. Of mutton sold fresh, there was a gain of 136,829,813 pounds, or 51.2 per cent. The value of the fresh mutton increased $10,965,196, or 49.8 per cent. The quantity of pork sold fresh and of pork salted each increased 8.7 per cent. The values of these items, however, show considerable variation, the value of the fresh pork increasing 25.9 per cent, and of the pork salted 14.1 per cent. Both show an increased value per pound.

The production of hams increased 258,139,760 pounds, or 48.8 per cent, while the increase in value was $25,060,104, or 51.4 per cent. The production of smoked bacon, sides, and shoulders increased 48 per cent, and the value 67.6 per cent. In 1900 both the production of these and their value exceeded the production and value of hams. The production of sausage, fresh and cured, almost doubled in quantity during the decade, increasing 95.7 per cent, while the gain in value was 130.9 per cent. The quantity of both refined and neutral lard shows a large percentage of increase, indicating, when compared with the production of fresh and salt pork, that a greater portion of the carcass was being devoted to lard than formerly. This is due probably to the fact that lard is considered one of the most valuable products of the hog. The production of oleo oil increased 15.1 per cent in quantity, but fell 5.9 per cent in value. While this decrease in value was largely due to increased production, caused by improved methods of production, yet it is not possible to ascribe the whole decrease to this fact, since the price of this oil is fixed in Rotterdam, the greatest oleo market in the world, where American oleo oil is brought into competition with that from Germany, the Netherlands, and other nations. Under "other oils" the production increased 86.2 per cent, while the value fell 4.2 per cent. The value of fertilizers also fell, while the quantity of production increased. The number of hides increased, although their total weight fell off, showing a decrease in the weight of the average hide, while their value increased 59.7 per cent. The value of the wool increased in a much larger proportion than did the quantity, the value increasing 66 per cent and the quantity 18.5 per cent. This product of 13,182,146 pounds of pulled wool amounted to 35.6 per cent of the 37,000,000 pounds of pulled wool produced in the United States during the calendar year of 1900, as estimated by the National Association of Wool Manufacturers.

Table 9 is interesting in showing the extent to which this industry has tended to group itself about certain centers, and the relative importance of these centers.

TABLE 9.—SUMMARY, CITIES HAVING A PRODUCT VALUED AT $1,000,000 AND OVER: 1900.

	Allegheny, Pa.	Baltimore, Md.	Boston, Mass.	Buffalo, N. Y.	Chicago, Ill.	Cincinnati, Ohio.	Cleveland, Ohio.	Dayton, Ohio.
Number of establishments	8	73	6	24	38	27	10	10
Capital	$1,497,666	$1,344,953	$40,915	$5,173,694	$67,137,569	$2,893,064	$1,827,288	$242,925
Salaried officials, clerks, etc., number	52	57	14	203	4,010	98	173	12
Salaries	$57,800	$44,724	$8,996	$146,523	$4,233,994	$103,830	$135,886	$9,900
Wage-earners	438	508	34	928	25,345	856	577	147
Wages	$233,028	$233,898	$23,030	$436,869	$12,875,676	$414,621	$235,023	$75,881
Miscellaneous expenses	$111,546	$99,546	$14,006	$342,878	$13,829,825	$437,889	$175,132	$10,332
Materials used:								
Total cost	$3,338,805	$6,257,558	$1,144,276	$10,026,676	$218,241,331	$8,806,652	$6,759,023	$959,661
Beeves slaughtered, number	13,521	15,357	12,325	63,451	1,666,847	62,267	13,949	8,363
Cost	$643,079	$665,122	$606,125	$2,591,030	$78,347,641	$1,879,390	$886,059	$312,515
Sheep slaughtered, number	40,529	184,480	19,530	248,093	2,873,440	50,200	12,782	3,289
Cost	$152,686	$787,620	$52,546	$882,962	$12,583,093	$136,744	$63,910	$10,551
Hogs slaughtered, number	182,295	564,035	.....	624,915	6,966,960	588,327	532,909	69,001
Cost	$1,638,782	$3,408,829	.....	$5,490,289	$72,041,592	$5,331,026	$4,519,927	$594,041
All other animals slaughtered, cost	$81,137	$269,580	$220,184	$284,854	$1,114,460	$187,770	$30,692	$8,643
Dressed meat, cost	$445,456	$843,107	$234,000	$285,616	$21,006,384	$1,076,700	$26,052	$2,760
All other materials	$377,665	$283,300	$31,421	$491,925	$33,148,161	$195,022	$1,232,383	$31,151

TABLE 9.—SUMMARY, CITIES HAVING A PRODUCT VALUED AT $1,000,000 AND OVER: 1900—Continued.

	Allegheny, Pa.	Baltimore, Md.	Boston, Mass.	Buffalo, N. Y.	Chicago, Ill.	Cincinnati, Ohio.	Cleveland, Ohio.	Dayton, Ohio.
Products:								
Total value	$3,996,807	$7,066,461	$1,329,010	$11,601,167	$256,527,949	$10,370,177	$7,514,470	$1,097,525
Beef—								
Sold fresh, pounds	8,258,977	6,984,180	6,214,500	30,504,150	843,262,243	23,998,890	8,141,940	4,335,220
Value	$653,258	$570,764	$638,576	$2,058,750	$61,964,934	$1,507,763	$821,170	$292,590
Salted or cured, pounds	59,700	307,820		1,500,000	67,860,743	4,650,000		32,000
Value	$3,150	$24,959		$105,000	$5,062,662	$234,850		$4,790
Canned, pounds				500,000	76,296,560	1,200,000		
Value				$35,000	$6,446,283	$78,500		
Mutton—								
Sold fresh, pounds	1,369,520	6,966,000	703,200	9,379,720	137,228,651	1,460,850	626,318	123,915
Value	$153,486	$768,860	$58,614	$770,826	$11,053,224	$125,965	$62,631	$9,113
Pork—								
Sold fresh, pounds	6,261,038	10,276,713		24,843,910	345,967,335	24,732,702	15,814,790	1,181,600
Value	$506,182	$795,207		$1,737,751	$24,416,666	$1,745,133	$1,223,916	$90,247
Salted, pounds	2,507,806	7,694,909		12,939,640	464,500,797	9,248,127	13,380,522	97,000
Value	$165,385	$550,783		$813,946	$32,293,588	$618,446	$939,101	$6,965
Hams, pounds	6,868,842	10,969,340	2,000,000	15,253,572	215,263,955	23,137,011	11,631,435	1,756,120
Value	$695,134	$1,135,283	$180,000	$1,399,099	$21,562,171	$2,076,895	$1,099,415	$168,050
Smoked bacon, sides, and shoulders, pounds	5,403,251	18,218,089	500,000	28,916,752	159,607,524	23,927,418	24,171,198	2,427,480
Value	$508,763	$1,371,110	$40,000	$2,008,615	$12,688,911	$1,687,498	$2,082,889	$178,907
Sausage, fresh or cured, pounds	4,698,460	9,455,752	780,000	6,556,300	91,756,941	6,133,780	5,452,045	619,100
Value	$320,136	$647,538	$51,000	$443,215	$7,588,254	$422,669	$418,747	$35,661
Refined lard, pounds	5,565,171	4,440,261	100,000	13,417,215	316,745,272	17,786,463	7,160,443	1,938,500
Value	$363,805	$289,882	$70,000	$917,459	$18,124,463	$1,099,945	$484,693	$140,057
Neutral lard, pounds		5,196,552		2,347,900	44,785,883	633,300	2,000,000	150,000
Value		$319,666		$141,346	$3,534,183	$38,000	$160,000	$7,500
Oleo oil, gallons	494,372			34,490	8,671,660	76,000		
Value	$244,687			$17,245	$5,227,763	$38,000		
Other oils, gallons	3,100	5,000		27,648	4,335,991			
Value	$1,550	$2,000		$14,726	$1,990,360			
Fertilizers, tons	2,520	690	250	2,312	39,852	2,206	1,616	125
Value	$79,297	$8,600	$2,500	$34,870	$898,455	$33,433	$23,307	$1,100
Hides, number	23,037	56,237	38,223	100,089	1,779,578	87,038	16,725	9,580
Pounds	833,530	1,167,330	873,230	3,968,057	104,873,510	3,479,270	797,817	561,950
Value	$90,843	$93,860	$78,820	$353,460	$10,773,897	$328,692	$79,551	$40,771
Wool, pounds		5,460		518,826	8,389,307			
Value		$1,385		$103,765	$1,935,373			
All other products, including custom work	$211,131	$486,564	$209,501	$646,094	$30,966,762	$334,388	$119,050	$121,774

	Denver, Colo.	Detroit, Mich.	East St. Louis, Ill.	Indianapolis, Ind.	Jersey City, N. J.	Kansas City, Kans.	Louisville, Ky.	Milwaukee and Cudahy, Wis.
Number of establishments	7	16	3	7	13	8	12	7
Capital	$833,618	$1,184,776	$3,183,288	$3,807,246	$473,485	$16,114,601	$1,218,426	$3,578,690
Salaried officials, clerks, etc., number	27	61	156	136	27	1,771	52	116
Salaries	$36,496	$59,581	$138,259	$128,834	$26,882	$1,579,436	$45,739	$140,333
Wage-earners	171	338	2,159	1,943	183	7,713	449	1,293
Wages	$103,274	$177,856	$985,497	$783,226	$130,707	$3,381,510	$189,417	$630,483
Miscellaneous expenses	$33,184	$70,587	$305,694	$218,989	$58,342	$1,919,411	$100,312	$385,102
Materials used:								
Total cost	$2,404,458	$3,628,440	$25,370,543	$17,400,330	$5,872,946	$65,082,581	$3,828,486	$11,405,186
Beeves slaughtered, number	26,715	19,648	361,873	77,595	17,530	918,206	13,088	45,442
Cost	$1,095,817	$633,105	$13,842,581	$3,825,588	$960,540	$37,811,089	$482,242	$1,720,449
Sheep slaughtered, number	41,513	37,410	254,060	22,607	269,957	635,656	8,507	36,139
Cost	$204,363	$124,845	$929,861	$72,983	$1,065,717	$2,294,133	$19,496	$138,363
Hogs slaughtered, number	91,866	295,728	1,134,662	1,221,748	490,607	2,599,841	474,915	899,374
Cost	$838,452	$2,554,579	$9,212,843	$10,083,574	$2,861,294	$21,402,061	$3,157,874	$8,217,533
All other animals slaughtered, cost	$25,300	$20,140	$271,264	$51,279	$345,543	$289,385	$12,058	$149,185
Dressed meat, cost	$209,990	$158,000	$297,863	$2,450,977	$465,630	$526,077	$50,000	$141,353
All other materials	$30,536	$137,771	$816,131	$915,929	$174,222	$2,760,836	$106,816	$1,038,303
Products:								
Total value	$2,858,947	$4,047,749	$27,676,818	$18,781,442	$6,243,217	$73,787,771	$4,444,978	$13,045,979
Beef—								
Sold fresh, pounds	15,000,250	9,241,600	185,903,693	44,869,495	11,391,650	447,087,633	5,142,439	23,682,779
Value	$1,090,318	$613,189	$11,301,559	$2,775,363	$932,505	$30,692,151	$362,082	$1,575,321
Salted or cured, pounds	25,000			855,855		8,915,600	588,834	828,796
Value	$1,250			$124,098		$636,280	$39,036	$58,267
Canned, pounds				86,976		14,034,995		52,186
Value				$8,722		$1,341,215		$5,445
Mutton—								
Sold fresh, pounds	2,146,245	1,381,000	10,229,819	960,360	11,290,773	24,260,625	260,276	1,532,303
Value	$178,179	$116,088	$740,319	$69,979	$860,116	$1,890,008	$20,615	$127,259
Pork—								
Sold fresh, pounds	6,240,000	10,237,200	58,281,492	8,518,426	48,273,851	79,695,358	4,043,610	23,632,494
Value	$382,300	$693,282	$3,868,464	$605,148	$3,108,578	$4,578,597	$299,978	$1,381,817
Salted, pounds	8,358,000	11,630,000	55,672,697	22,180,134	1,000,000	71,712,676	21,180,738	71,987,711
Value	$345,000	$727,400	$3,764,849	$1,317,137	$60,000	$4,375,466	$1,077,335	$4,242,598
Hams, pounds	2,360,000	7,336,000	8,417,044	32,365,020	1,500,000	53,040,207	10,490,435	24,687,987
Value	$180,000	$545,060	$767,001	$2,617,900	$135,000	$4,488,458	$957,501	$2,124,199
Smoked bacon, sides, and shoulders, pounds	1,950,000	13,790,000	16,827,969	106,327,000	2,243,175	124,838,028	10,296,026	8,069,373
Value	$122,000	$968,200	$1,084,679	$7,357,196	$179,454	$8,575,144	$760,982	$558,053
Sausage, fresh or cured, pounds	2,057,800	2,962,500	2,641,619	4,044,370	500,000	21,670,287	3,859,556	7,219,189
Value	$123,624	$167,000	$158,694	$277,686	$30,000	$1,279,985	$271,087	$526,134
Refined lard, pounds	4,950,000	790,000	3,657,723	33,759,536	2,234,682	87,978,088	6,306,946	17,799,281
Value	$235,000	$60,300	$195,627	$2,061,668	$128,105	$4,746,010	$332,528	$972,153
Neutral lard, pounds			669,645	3,576,980		28,675,743	1,381,570	2,690,051
Value			$58,791	$260,350		$1,231,428	$90,050	$152,544
Oleo oil, gallons			1,089,041	24,800		1,928,813		48,322
Value			$679,809	$47,745		$1,204,905		$24,048
Other oils, gallons			49,200	100,000		1,268,691		3,931
Value			$20,034	$45,500		$586,487		$1,651
Fertilizers, tons	160	360	13,257	4,464		11,775	1,675	3,157
Value	$1,710	$5,400	$309,074	$65,623		$225,317	$23,256	$47,324
Hides, number	28,825	22,578	890,801	83,507	48,093	890,963	15,019	66,448
Pounds	1,700,680	1,055,790	23,118,317	5,301,425	1,472,980	49,935,565	798,077	2,828,135
Value	$120,812	$86,065	$2,170,981	$561,279	$127,357	$5,514,648	$82,063	$293,954
Wool, pounds						2,000		
Value						$375		
All other products, including custom work	$78,754	$66,765	$2,557,037	$586,048	$682,102	$2,521,297	$128,465	$955,212

TABLE 9.—SUMMARY, CITIES HAVING A PRODUCT VALUED AT $1,000,000 AND OVER: 1900—Continued.

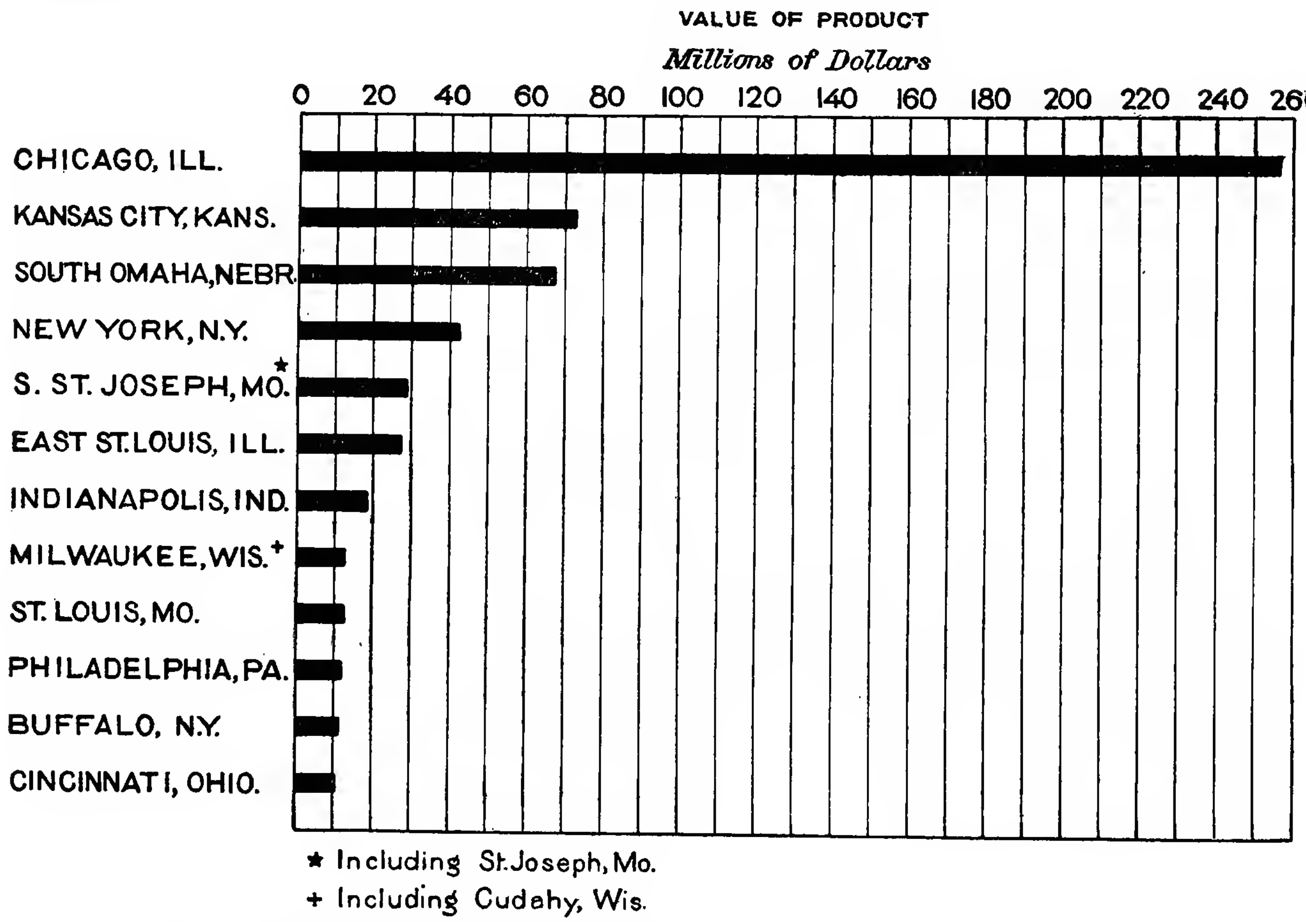
	Newark, N. J.	New York, N. Y.	Paterson, N. J.	Pawtucket, R. I.	Philadelphia, Pa.	Pittsburg, Pa.	Portland, Oreg.	Providence, R. I.	St. Joseph and South St. Joseph, Mo.
Number of establishments	10	52	3	3	58	5	4	3	5
Capital	$363,777	$9,267,261	$399,800	$501,430	$1,882,732	$786,810	$604,282	$252,720	$5,200,899
Salaried officials, clerks, etc., number	39	355	11	....	141	47	34	16	131
Salaries	$32,708	$410,854	$15,464	....	$111,925	$42,713	$39,790	$17,636	$106,001
Wage-earners	176	1,932	75	84	617	150	121	122	2,216
Wages	$94,993	$1,303,526	$41,562	$47,280	$372,610	$93,950	$54,026	$58,024	$980,749
Miscellaneous expenses	$40,276	$889,033	$30,966	$12,129	$221,674	$28,001	$29,700	$30,597	$190,650
Materials used:									
Total cost	$3,276,004	$38,013,877	$1,042,962	$1,045,754	$10,321,065	$1,779,600	$1,109,939	$1,155,026	$27,645,318
Beeves slaughtered, number	8,000	306,261	....	1,000	83,682	7,395	10,857	....	220,849
Cost	$165,000	$18,460,183	....	$35,000	$4,332,008	$409,711	$415,200	....	$10,198,052
Sheep slaughtered, number	28,000	1,218,925	4,409	....	152,896	21,072	42,459	....	216,548
Cost	$134,000	$5,014,732	$233,226	....	$673,280	$84,128	$139,400	....	$900,094
Hogs slaughtered, number	163,850	991,113	86,708	76,000	282,908	72,609	15,818	57,200	1,387,591
Cost	$1,684,808	$6,488,117	$645,213	$830,300	$2,337,626	$543,502	$155,400	$629,000	$14,322,513
All other animals slaughtered, cost	$92,000	$1,657,340	$45,773	$2,800	$268,493	$114,628	$5,450	....	$28,422
Dressed meat, cost	$1,090,656	$4,084,532	$56,300	$59,300	$2,277,645	$596,992	$286,021	$456,000	$467,564
All other materials	$109,540	$2,308,973	$62,440	$118,354	$432,013	$30,639	$108,465	$70,026	$1,728,673
Products:									
Total value	$3,537,896	$42,879,218	$1,370,486	$1,134,946	$12,020,462	$2,054,521	$1,306,996	$1,316,220	$29,704,973
Beef—									
Sold fresh, pounds	2,220,000	216,481,931	....	500,000	57,752,000	4,326,676	5,616,400	....	124,422,447
Value	$177,600	$17,523,685	....	$33,600	$4,988,255	$382,500	$398,301	....	$8,598,981
Salted or cured, pounds	90,000	8,420,240	50,000	....	1,933,433	....	500,000	....	3,220,000
Value	$16,000	$580,838	$5,500	....	$125,646	....	$38,000	....	$195,400
Canned, pounds	....	....	....	....	....	40,000	....	....	2,220,000
Value	....	....	....	....	....	$4,000	....	....	$140,000
Mutton—									
Sold fresh, pounds	1,160,000	51,524,941	1,898,000	....	6,877,098	698,565	2,100,400	....	8,841,712
Value	$113,000	$4,311,494	$215,080	....	$684,750	$76,758	$146,928	....	$637,572
Pork—									
Sold fresh, pounds	4,488,310	75,641,107	3,693,000	6,198,000	25,964,220	1,860,500	320,000	4,154,400	79,629,513
Value	$350,403	$5,067,432	$290,676	$406,840	$1,965,083	$140,380	$26,516	$294,130	$4,967,097
Salted, pounds	4,449,627	9,706,403	1,516,541	1,500,000	3,837,702	257,666	1,343,000	5,934,000	80,354,128
Value	$295,087	$530,577	$109,200	$93,000	$292,784	$47,400	$90,370	$346,660	$4,090,319
Hams, pounds	7,479,348	24,154,716	2,884,000	1,811,500	11,964,220	5,121,530	1,366,764	2,606,000	17,393,204
Value	$711,896	$2,389,390	$294,000	$180,150	$1,181,430	$497,320	$146,884	$212,900	$1,447,332
Smoked bacon, sides, and shoulders, pounds	12,485,488	20,822,653	1,488,762	3,293,500	9,245,491	2,972,811	1,845,147	2,007,000	31,991,549
Value	$1,026,927	$1,652,841	$127,600	$168,792	$707,174	$234,876	$169,400	$165,290	$2,178,331
Sausage, fresh or cured, pounds	4,040,509	7,768,101	692,000	598,500	5,347,447	601,667	349,891	1,585,200	1,366,773
Value	$293,209	$649,098	$55,400	$47,780	$444,980	$38,835	$28,265	$110,268	$80,041
Refined lard, pounds	4,654,864	12,804,781	2,379,000	1,777,400	8,656,106	1,863,153	913,132	2,158,800	26,716,200
Value	$279,444	$789,569	$154,890	$115,609	$572,292	$111,553	$87,035	$130,016	$1,457,135
Neutral lard, pounds	1,450,833	750,000	....	....	....	....	....	....	8,472,001
Value	$87,050	$42,000	....	....	....	....	....	....	$432,912
Oleo oil, gallons	....	1,626,609	....	....	....	....	....	....	1,084,787
Value	....	$936,819	....	....	....	....	....	....	$647,419
Other oils, gallons	....	137,767	....	....	8,333	4,000	3,085	....	342,229
Value	....	$60,029	....	....	$2,600	$2,000	$1,446	....	$154,146
Fertilizers, tons	160	3,221	326	300	153	140	187	....	11,377
Value	$2,405	$68,942	$5,410	$4,500	$2,873	$1,040	$2,815	....	$216,369
Hides, number	3,000	446,291	3,270	1,400	105,822	17,496	11,407	....	224,431
Pounds	270,000	21,699,599	35,875	65,000	5,195,530	527,930	558,900	....	13,376,391
Value	$18,900	$2,047,699	$3,587	$4,550	$425,466	$49,588	$57,065	....	$1,487,813
Wool, pounds	75,000	2,099,050	134,000	....	33,400	....	200,000	....	....
Value	$25,000	$681,710	$41,700	....	$7,600	....	$40,000	....	....
All other products, including custom work	$140,975	$5,447,095	$67,544	$81,125	$619,629	$468,271	$73,971	$56,956	$2,979,106

	St. Louis, Mo.	St. Paul, Minn.	San Francisco, Cal.	Seattle, Wash.	Sioux City, Iowa.	Somerville, Mass.	South Omaha, Nebr.	Washington, D. C.
Number of establishments	25	6	26	8	3	4	6	7
Capital	$2,608,249	$250,998	$2,305,362	$570,350	$1,209,695	$6,801,141	$15,657,418	$248,200
Salaried officials, clerks, etc., number	103	16	114	48	21	45	712	32
Salaries	$142,573	$11,390	$177,490	$44,990	$24,250	$70,618	$677,256	$15,784
Wage-earners	841	84	532	132	892	1,435	5,940	116
Wages	$448,287	$42,252	$323,931	$89,165	$471,944	$692,999	$2,915,732	$63,607
Miscellaneous expenses	$171,902	$21,097	$306,408	$45,751	$165,222	$314,036	$1,475,848	$19,935
Materials used:								
Total cost	$11,120,325	$989,749	$8,622,994	$2,666,655	$6,856,684	$14,233,788	$60,159,430	$2,013,827
Beeves slaughtered, number	123,113	9,200	102,815	18,132	54,372	18,948	629,435	14,975
Cost	$4,671,591	$325,800	$3,445,742	$834,216	$1,647,456	$643,182	$24,482,287	$763,275
Sheep slaughtered, number	35,179	13,225	501,645	65,275	6,506	371,832	723,605	17,850
Cost	$130,428	$62,500	$1,521,458	$213,100	$31,723	$1,360,420	$3,076,611	$88,675
Hogs slaughtered, number	464,075	50,476	138,328	44,880	505,764	900,490	2,473,723	127,300
Cost	$4,703,059	$380,507	$1,143,635	$495,520	$4,554,562	$9,004,900	$25,054,340	$914,000
All other animals slaughtered, cost	$145,534	$19,625	$301,645	$42,875	$3,480	$213,450	$177,102	$53,600
Dressed meat, cost	$1,243,320	$168,422	$1,636,477	$817,368	$191,368	$1,650,364	$4,426,518	$145,200
All other materials	$226,393	$32,895	$675,037	$263,576	$428,095	$1,461,472	$2,942,572	$49,077
Products:								
Total value	$12,943,376	$1,288,364	$9,991,599	$3,072,195	$8,982,896	$15,692,242	$67,889,749	$2,210,860
Beef—								
Sold fresh, pounds	40,086,867	4,780,000	56,630,253	9,715,200	18,991,479	8,795,200	302,040,449	8,128,300
Value	$3,301,408	$334,600	$3,468,632	$730,740	$1,351,029	$663,792	$22,575,825	$669,800
Salted or cured, pounds	14,758,683	....	2,402,348	921,250	1,305,205	....	11,925,633	400,000
Value	$881,031	....	$164,966	$69,825	$84,838	....	$771,966	$16,000
Canned, pounds	....	....	399,569	....	1,627,920	....	10,156,391	....
Value	....	....	$40,401	....	$85,466	....	$564,854	....
Mutton—								
Sold fresh, pounds	1,383,586	613,250	21,097,445	3,191,375	871,380	14,850,000	32,990,407	719,180
Value	$143,743	$61,103	$1,526,238	$232,750	$74,073	$1,188,000	$2,698,109	$69,278
Pork—								
Sold fresh, pounds	26,471,711	1,160,000	12,659,898	4,262,000	9,859,441	28,815,680	80,936,436	6,823,300
Value	$1,844,480	$79,300	$962,614	$402,960	$787,090	$2,305,254	$5,395,871	$555,965
Salted, pounds	12,656,870	100,000	1,493,450	262,400	36,947,224	4,000,000	179,456,388	1,093,357
Value	$763,454	$6,500	$124,453	$26,240	$2,402,019	$320,000	$10,729,379	$76,512
Hams, pounds	15,466,059	1,550,898	8,516,357	5,939,500	14,571,292	29,000,000	58,139,346	1,227,000
Value	$1,441,701	$260,870	$908,298	$667,593	$1,389,273	$2,000,000	$5,551,145	$125,647
Smoked bacon, sides, and shoulders, pounds	19,270,600	970,000	10,005,868	4,616,400	9,688,093	47,700,000	75,015,619	2,486,285
Value	$1,531,810	$57,200	$936,359	$445,595	$780,048	$4,240,944	$5,689,488	$214,179

TABLE 9.—SUMMARY, CITIES HAVING A PRODUCT VALUED AT $1,000,000 AND OVER: 1900—Continued.

	St. Louis, Mo.	St. Paul, Minn.	San Francisco, Cal.	Seattle, Wash.	Sioux City, Iowa.	Somerville, Mass.	South Omaha, Nebr.	Washington, D. C.
Products—Continued.								
Total value—Continued.								
Sausage, fresh or cured, pounds	9,146,940	505,000	702,375	604,500	3,031,639	9,004,900	21,321,139	2,141,500
Value	$527,498	$42,300	$57,257	$47,595	$180,902	$720,390	$1,483,458	$191,330
Refined lard, pounds	13,973,689	1,000,000	1,652,687	1,287,000	18,451,414	40,000,000	75,228,106	1,404,000
Value	$865,689	$70,000	$124,168	$126,825	$1,068,831	$2,400,000	$4,671,699	$106,780
Neutral lard, pounds	2,953,516				5,410,420		15,612,418	26,000
Value	$177,212				$351,677		$986,368	$1,820
Oleo oil, gallons	350,000				175,708	82,021	2,302,914	
Value	$210,000				$87,854	$31,250	$1,382,115	
Other oils, gallons	15,300	600	3,710	4,200			419,004	
Value	$4,590	$192	$2,188	$2,480			$128,998	
Fertilizers, tons	7,318	370	1,002	3,600	2,247	3,542	14,394	120
Value	$130,940	$5,110	$25,227	$90,000	$29,211	$66,600	$239,114	$2,160
Hides, number	142,186	10,900	118,135	21,757	55,067	61,698	526,484	37,015
Pounds	6,385,531	509,750	5,960,608	1,208,580	2,908,140	1,607,480	31,337,139	988,250
Value	$666,130	$36,655	$582,876	$120,987	$288,668	$149,117	$2,917,953	$83,977
Wool, pounds			18,000			1,450,000		
Value			$3,800			$442,250		
All other products, including custom work	$453,690	$334,534	$1,064,122	$108,605	$21,917	$1,164,645	$2,103,407	$97,412

Chicago led in value of products, as is shown in the diagram accompanying the table. After Chicago came Kansas City, then South Omaha, New York city, St. Joseph and South St. Joseph, Mo., East St. Louis, Indianapolis, Milwaukee and Cudahy, Wis., St. Louis, Philadelphia, Buffalo, and Cincinnati, in the order named. The relative importance of these cities, in the value of products, is shown in the following diagram:



In number of establishments Baltimore ranked first, with 73 establishments, followed by Philadelphia with 58, and New York city with 52, while Chicago, with 38, stood fourth. In the order of capital invested, wages paid, and number of wage-earners, the relative rank of the cities followed closely the same rank as under the value of production. The widest variations occurred in the average amount of capital invested and average value of product per establishment in the different cities. South Omaha had the largest average single establishment, with an average investment of $2,609,570, Kansas City's average capitalization per establishment was $1,889,325; Chicago's, $1,766,788; South St. Joseph's (with St. Joseph), $1,040,180. In the average value of products per establishment, South Omaha led with $11,314,958; Kansas City had $9,223,471; Chicago,

$6,750,736; and South St. Joseph (with St. Joseph), $5,940,995.

Table 10 presents the statistics of exports of live stock, and Table 11 the figures for the exports of meat products, as shown by the tables of the Bureau of Statistics for the fiscal years from 1890 to 1900, both inclusive. A comparison of Table 11 with Table 8, on page 22, shows the proportion of the total product that is sent abroad.

TABLE 10.—QUANTITY AND VALUES OF ANIMALS IMPORTED, AND OF DOMESTIC AND FOREIGN ANIMALS EXPORTED: 1890–1900.[1]

ARTICLES.	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890
Imports.											
Cattle, free:											
Number	1,045	624	577	204	734	14,956	312	174	132	2,740	3,932
Value	$202,615	$95,353	$76,631	$24,360	$15,091	$99,104	$5,349	$21,024	$27,077	$49,326	$72,831
Cattle, dutiable:											
Number	179,961	199,128	291,012	328,773	217,092	134,825	1,280	3,119	2,036	9,652	26,760
Value	$2,055,079	$2,225,009	$2,836,592	$2,565,497	$1,494,765	$666,749	$13,355	$24,658	$20,389	$53,652	$171,916
Sheep, free:											
Number	2,427	2,396	3,047	2,382	3,950	1,942	2,537	4,932	4,316	9,606	16,303
Value	$48,324	$46,132	$42,805	$32.640	$42,848	$30,885	$63,022	$111,197	$112,134	$127,221	$118,444
Sheep, dutiable:											
Number	379,365	343,515	389,267	403,251	318,742	289,519	240,031	454,552	376,498	336,159	377,491
Value	$1,316,702	$1,153,949	$1,063,517	$987,028	$810,682	$651,733	$725,159	$1,571,780	$1,328,396	$1,091,985	$1,149,765
Exports, domestic.											
Cattle:											
Number	397,286	389,490	439,255	392,190	372,461	331,722	359,278	287,094	394,607	374,679	394,836
Value	$30,635,153	$30,516,833	$37,827,500	$36,357,451	$34,560,672	$30,603,796	$33,461,922	$26,032,428	$35,099,095	$30,445,249	$31,261,131
Hogs:											
Number	51,180	33,031	14,411	28,751	21,049	7,130	1,553	27,375	31,963	95,654	91,148
Value	$394,813	$227,241	$110,487	$295,998	$227,297	$72,424	$14,753	$397,162	$364,081	$1,146,630	$909,042
Sheep:											
Number	125,772	143,286	199,690	244,120	491,565	405,748	132,370	37,260	46,960	60,947	67,521
Value	$733,477	$853,555	$1,213,886	$1,531,645	$3,076,384	$2,630,686	$832,763	$126,394	$161,105	$261,109	$243,077
Exports, foreign.											
Cattle:											
Number	8,971	4,307	23	1	....	....	3	16	....	....	8
Value	$118,583	$63,770	$1,230	$50	....	....	$45	$690	....	....	$5,875
Sheep:											
Number	106	61	67	22	89	30	....	11	....	....	....
Value	$1,999	$875	$390	$92	$861	$256	....	$330	....	....	....

[1] Statistical Abstract of the United States Treasury Department, 1899–1900.

TABLE 11.—QUANTITY AND VALUE OF SLAUGHTERING AND MEAT PRODUCTS IMPORTED, AND OF DOMESTIC AND FOREIGN SLAUGHTERING AND MEAT PRODUCTS EXPORTED: 1890–1900.[1]

ARTICLES.	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890
Imports.											
Bones, crude	(2)	(2)	(2)	$224,039	$157,946	$306,049	$307,033	$360,573	$345,668	$322,009	$353,286
Bones, horns, and hoofs, unmanufactured	$830,063	$704,959	$492,544	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Bristles, crude, not sorted, bunched, or prepared, pounds	27,140	21,421	1,203	630	726	4,741	(2)	(2)	(2)	(2)	(2)
Value	$22,330	$12,399	$416	$385	$1,620	$1,892	(2)	(2)	(2)	(2)	(2)
Bristles, sorted, bunched, or prepared, pounds	2,503,018	1,835,156	1,533,887	1,347,270	1,571,804	1,296,753	892,520	1,598,818	1,495,003	1,404,832	1,261,609
Value	$2,130,537	$1,445,853	$1,248,703	$1,216,794	$1,433,728	$1,242,259	$929,231	$1,508,258	$1,455,058	$1,357,938	$1,286,219
Glue, pounds	5,577,082	5,358,063	4,103,814	4,926,620	6,276,926	4,751,048	4,132,524	6,170,162	5,541,776	5,501,142	5,715,210
Value	$537,492	$479,450	$428,507	$472,312	$555,979	$416,394	$400,240	$567,756	$495,519	$497,340	$471,820
Grease and oils, pounds	(2)	(2)	(2)	(2)	(2)	35,149,929	11,093,737	4,887,288	1,963,211	16,372,186	13,933,332
Value	$779,666	$696,674	$593,239	$984,332	$1,232,001	$1,336,388	$420,059	$692,781	$488,871	$703,021	$438,216
Hide cuttings, raw, and other glue stock	$1,223,521	$708,968	$408,262	$289,686	$279,692	$263,175	$280,062	$365,525	$303,202	$353,943	$348,440
Hides of cattle, pounds	163,865,165	130,396,020	126,243,595	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Value	$19,408,217	$13,621,946	$13,624,989	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Hoofs, horns, and parts of, unmanufactured	(4)	(4)	(4)	$150,134	$568,445	$268,800	$235,232	$554,902	$797,529	$587,444	$236,648
Meat products:											
Meat and meat extracts	$365,589	$263,845	$345,108	$601,808	$493,393	$479,336	$412,666	$558,284	$430,048	$521,322	$407,038
All other	$105,726	$109,647	$80,031	$49,484	$39,129	$5,244	$12,291	$16,717	$15,386	$66,385	$196,696
Sausages, bologna	$95,944	$93,714	$82,546	$76,303	$80,887	$93,188	$102,610	$98,659	$82,507	$77,664	$75,503
Sausage casings	$646,889	$622,949	$537,871	$542,817	$588,657	$419,345	$495,118	$583,217	$566,650	$572,817	$494,958
Exports of domestic.											
Bones, hoofs, horn, and horn tips, strips, and waste	$199,194	$195,759	$174,861	$280,140	$321,680	$288,084	$260,675	$319,848	$218,639	$335,710	$271,533
Glue, pounds	2,349,014	2,368,087	2,318,711	1,400,863	1,760,470	1,178,328	999,052	736,446	580,815	986,552	728,696
Value	$225,844	$222,072	$209,441	$132,581	$166,930	$114,493	$101,372	$74,722	$66,403	$110,292	$88,484
Grease, grease scraps, and all soap stock	$2,944,322	$2,576,507	$1,964,565	$2,070,111	$1,516,763	$904,071	$1,380,299	$1,067,723	$1,298,598	$2,038,886	$1,506,819
Hides and skins, other than fur, pounds	7,486,256	10,140,840	11,536,073	31,119,166	39,545,324	36,002,859	(2)	(2)	(2)	(2)	(2)
Value	$804,674	$929,117	$1,015,032	$2,388,530	$3,858,946	$2,310,323	$3,972,494	$1,497,003	$1,223,895	$1,333,655	$1,828,635
Hair, and manufactures of	$676,688	$503,712	$635,716	$517,469	$455,880	$505,029	$353,729	$459,648	$370,169	$394,544	$344,558
Oil, lard, gallons	738,724	917,007	775,102	961,407	833,935	553,421	681,081	486,812	901,575	1,092,448	1,214,611
Value	$337,260	$412,447	$305,825	$419,803	$426,401	$304,093	$449,571	$336.613	$496,601	$562,986	$663,343

[1] Statistical Abstract of the United States Treasury Department, 1899–1900.
[2] Not separately reported.
[3] Included with "hoofs, horns, etc."
[4] Included with "bones, hoofs, etc."

TABLE 11.—QUANTITY AND VALUE OF SLAUGHTERING AND MEAT PRODUCTS IMPORTED, AND OF DOMESTIC AND FOREIGN SLAUGHTERING AND MEAT PRODUCTS EXPORTED: 1890–1900[1]—Continued.

ARTICLES.	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890
Exports of domestic—Continued.											
Meat products:											
Beef products—											
Beef, canned, pounds	55,553,745	38,385,472	37,109,670	54,019,772	63,698,180	64,102,263	55,974,910	79,089,493	87,028,084	109,585,727	82,638.507
Value	$5,233,982	$3,503,293	$3,279,657	$4,656,308	$5,636,953	$5,720,933	$5,120,851	$7,222,824	$7,876,454	$9,068,906	$6,787,193
Beef, fresh, pounds	329,078,609	282,139,974	274,768,074	290,395,936	224,783,225	191,338,487	193,891,824	206,294,724	220,554,617	194,045,638	173,237,596
Value	$29,643,830	$23,545,185	$22,966,556	$22,653,742	$18,974,107	$16,832,860	$16,700,163	$17,754,041	$18,053,732	$15,322,054	$12,862,384
Beef, salted or pickled, pounds	47,306,513	46,564,876	44,314,479	67,712,940	70,709,209	62,473,326	62,682,667	58,423,963	70,204,736	90,286,979	97,508,419
Value	$2,697,340	$2,525,784	$2,368,467	$3,514,126	$3,976,113	$3,558,230	$3,572,054	$3,185,321	$3,987,829	$5,048,788	$5,250,068
Beef, other, cured, pounds	2,319,165	1,579,313	1,589,052	939,448	514,303	821,673	1,218,334	898,920	953,712	1,621,833	102,110
Value	$197,051	$145,996	$150,051	$83,701	$59,371	$73,569	$100,631	$87,776	$92,524	$147,518	$9,223
Tallow, pounds	89,030,943	107,361,009	81,744,809	75,108,834	52,759,212	25,864,300	54,661,524	61,819,153	89,780,010	111,689,251	112,745,370
Value	$4,398,204	$4,367,356	$3,141,653	$2,782,595	$2,323,764	$1,293,059	$2,766,164	$3,129,059	$4,425,630	$5,501,049	$5,242,158
Hog products—											
Bacon, pounds	512,153,729	562,651,480	650,108,933	500,399,448	425,352,187	452,549,976	416,657,577	391,758,175	507,919,830	514,675,557	531,899,677
Value	$38,975,915	$41,557,067	$46,380,918	$34,187,147	$33,442,847	$37,776,293	$38,338,843	$35,781,470	$39,334,933	$37,404,989	$39,149,635
Hams, pounds	196,414,412	225,846,750	200,185,861	165,247,302	129,036,351	105,494,123	86,970,571	82,178,154	76,856,559	84,410,108	76,591,279
Value	$20,416,367	$20,774,084	$18,987,525	$15,970,021	$12,669,763	$10,960,567	$9,845,062	$9,933,096	$7,757,717	$8,245,685	$7,907,125
Pork, canned, pounds	8,496,074	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Value	$658,402	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Pork, fresh, pounds	25,946,906	41,310,364	12,224,285	1,306,424	744,656	818,581	1,168,647	912,644	377,746	818,875	279,463
Value	$1,925,772	$2,722,661	$815,075	$94,816	$43,739	$60,660	$92,095	$79,317	$30,246	$56,358	$16,406
Pork, salted or pickled, pounds	133,199,683	137,197,200	88,133,078	66,768,920	69,498,373	58,266,893	63,576,881	52,459,722	80,336,481	81,317,364	79,788,868
Value	$8,243,797	$7,917,066	$4,906,961	$3,297,214	$3,973,461	$4,138,400	$5,067,773	$4,116,946	$4,792,049	$4,787,343	$4,753,488
Lard, pounds	661,813,663	711,259,851	709,344,045	568,315,640	509,534,256	474,895,274	447,566,867	365,693,501	460,045,776	498,343,927	471,083,598
Value	$41,939,164	$42,208,465	$39,710,672	$29,126,485	$33,589,851	$36,821,508	$40,089,809	$34,643,993	$33,201,621	$34,414,323	$33,455,520
Lard compounds and substitutes for (cottolene, lardine, etc.), pounds	25,852,685	22,144,717	21,343,028	16,261,991	1,649,923	444,045	524,390	(2)	(3)	(3)	(3)
Value	$1,475,064	$1,200,231	$1,118,659	$857,708	$102,279	$34,309	$39,693	$44,832	(3)	(3)	(3)
Casings for sausages	$2,307,571	$1,671,052	$1,821,519	$1,514,651	$1,771,680	$1,581,891	$1,280,514	$1,409,280	$878,675	$841,075	$697,772
Mutton, pounds	773,760	379,110	329,169	361,955	422,950	591,449	2,197,900	108,214	101,463	199,395	256,711
Value	$64,313	$29,427	$27,961	$28,341	$31,793	$47,832	$174,404	$9,175	$9,022	$18,969	$21,793
Oleo, the oil, pounds	146,739,681	142,390,492	132,579,277	113,506,152	103,276,756	78,098,878	123,295,895	113,939,363	91,581,703	80,231,035	68,218,098
Value	$10,503,856	$9,183,659	$7,904,413	$6,742,061	$8,087,905	$7,107,018	$11,942,842	$11,207,250	$9,011,889	$7,859,130	$6,476,258
Oleomargarine (imitation butter), pounds	4,256,067	5,549,322	4,328,586	4,864,351	6,063,699	10,100,897	3,898,950	3,479,322	1,610,837	1,986,743	2,585,926
Value	$416,544	$509,703	$386,297	$472,866	$587,269	$992,464	$475,003	$416,386	$195,687	$255,024	$297,264
All other meat products—											
Canned	$1,724,064	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
All other	$3,941,394	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Stearin, pounds	(4)	1,174,167	3,987,258	1,388,555	668,585	36,429	321,898	(2)	1,360,513	1,347,386	2,520,142
Value	(4)	$55,821	$188,579	$70,534	$34,289	$2,157	$17,938	$14,669	$66,470	$62,194	$103,043
Exports of foreign.											
Bones, crude	(2)	$4,168	$5,861	$91	(2)	$13,454	$4,007	$1,910	$1,908	$1,681	$1,053
Bristles, crude, not sorted, bunched, or prepared, pounds	446	4,321	40	(2)	(2)	3,593	(2)	(2)	(2)	(2)	(2)
Value	$220	$2,740	$18	(2)	(2)	$974	(2)	(2)	(2)	(2)	(2)
Bristles, sorted, bunched, or prepared, pounds	42,154	46,366	25,481	36,268	33,015	23,317	60,880	26,046	36,153	43,385	47,226
Value	$21,952	$19,150	$21,571	$36,096	$21,465	$16,468	$41,331	$24,092	$28,643	$34,608	$39,473
Glue, pounds	3,359	7,216	23,109	16,247	65,484	8,971	40,148	29,748	(2)	6,624	5,691
Value	$245	$579	$2,809	$1,486	$6,615	$865	$3,035	$1,908	$1,570	$706	$521
Grease	$3,699	$20,650	$4,247	$1,138	$4,807	$1,525	$8,578	$5,691	$678	$1,033	$2,556
Hide cuttings	$1,408	$2,477	(2)	$1,367	$440	$602	$96	(2)	(2)	(2)	(2)
Hoofs, horns, and parts of, unmanufactured	$1,315	(2)	(2)	$392	$147	$438	$129	(2)	(2)	(2)	(2)
Sausages, bologna	$28	$15	$24	$269	$234	$36	$54	$81	(2)	(2)	(2)
Meat products:											
Meats and meat extracts	$2,834	$15,464	$6,662	$6,963	$2,387	$1,980	$1,745	$4,012	$777	$4,360	$891
All other	$4,545	$61,075	$8,132	$1,304	$310	$205	$978	$116	$2	$73	$277
Hides and skins, other than fur:											
Cattle hides, pounds	2,330,290	3,548,455	7,057,057	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Value	$296,478	$432,460	$678,167	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)

[1] Statistical Abstract of the United States Treasury Department, 1899–1900.
[2] Not separately reported.
[3] Included with "lard."
[4] Included with "lard compounds."

HISTORICAL AND DESCRIPTIVE.[1]

The year 1493 witnessed the first importation of cattle to America, when it is said Columbus brought cattle, sheep, and hogs with him on his second voyage. The Portuguese took cattle to Newfoundland and Nova Scotia in 1553, where they increased rapidly.[2] Black cattle, swine, and sheep were introduced into Florida about 1565, and neat cattle into Canada by the French in 1608. In 1609 the English colony at Jamestown possessed between 500 and 600 hogs and some sheep. They were killed or carried off by the natives or eaten by the colonists in their destitution. Sir Ralph Lane brought cattle from the West Indies to Virginia in 1610, the slaughter of which was forbidden on pain of death. In 1611 Sir Thomas Gates arrived with a hundred or more cows and some swine. To this stock were added in 1613 a few obtained by a raid on the French settlements in Arcadia. In 1620 the cattle had increased to 500 and in 1649 to 20,000. They were early exported to New England, and many were killed to supply the

[1] For valuable data used in the preparation of this historical and descriptive sketch, acknowledgment is made to "Ice and Refrigeration," Volume 21, Nos. 1 to 6, July, 1901, to December, 1901, both inclusive; History of American Manufactures, by J. L. Bishop; Philip D. Armour in "One Hundred Years of American Commerce," Volume II, edited by Hon. Chauncey M. Depew; the Yearbooks of the United States Department of Agriculture; and the Statistical Annuals published by the Cincinnati Price Current.
[2] History of American Manufactures, by J. L. Bishop, Vol. I, page 427.

shipping from London, Bristol, Holland, and New England. By 1656 the sale of beef, pork, and bacon to the shipping and to the West Indies was a source of much profit.

In New England the first neat cattle, consisting of three heifers and a bull, were introduced into the Plymouth Colony by Edward Winslow in the spring of 1624. The number grew to about 200 in 1629.[1]

From that time cattle increased rapidly in number and rose in value. During the Indian wars live stock was a precarious property, but nevertheless continued to increase and furnished articles for exportation. The continued arrival of new settlers kept up the demand for cattle and maintained their price at from £20 to £30 a head. Their number increased rapidly, but they were too valuable for slaughter. As emigration decreased, stock was well diffused through New England, and the colonists became consumers and exporters of beef in considerable quantity. The West India Company imported domestic cattle for breeding into New Netherlands in 1625. In 1678, 400 cattle were killed in the city of New York, and in 1694 the number reached nearly 4,000.[2] Stock raising and the production of beef for the New York and Philadelphia markets, furnished a profitable industry for the settlers in New Jersey. In 1627 the Swedes were supplied with neat cattle by the Swedish West India Company.[3] In 1697 an Englishman, residing in Pennsylvania, stated that 20 fat bullocks besides many sheep, calves, and hogs were killed each week in Philadelphia, even in midsummer. A fat cow could be bought for £3 and salted beef and pork were regularly exported.[4] Before the Revolution great numbers of cattle were raised in Georgia, North Carolina, and South Carolina. They were raised at small cost, being allowed to run wild in the woods. Many farmers owned from 500 to 1,500 head each. Little beef was exported. The cattle were sold in the lean state and driven to Pennsylvania where they were fattened for market.[4]

The cattle of the Northern colonies were fewer in number, but owing to the severe climate received more attention, and greater care was bestowed in the selection of animals for breeding. On the frontier stock raising was an important factor, the cattle furnishing food and other necessities for the rough life of the pioneer. These herds of the colonies, with those brought to Spanish America, were the chief progenitors of the American cattle of to-day. Cattle raising followed the settlement of the country, and crossed the Alleghenies with the pioneers into the fertile valley of the Ohio.

The rise of slaughtering, and packing of meat in the United States as a distinct industry, dates back to 1818, when a packer is reported as conducting packing operations at Cincinnati. Slaughtering operations at Chicago began in 1823, but packing was not instituted until 1827. In that year a Chicago establishment packed some pork for a firm in Detroit, but the packing statistics of Chicago were of small account until 1850. It is said that 9,600 hogs were packed there in 1834, but it was not until 1861–62 that Chicago attained preeminence as a packing center. In the winter season of 1832–33, there were several establishments at Cincinnati, and in that season it is claimed that 85,000 hogs were slaughtered there. The development of the agricultural resources of the Ohio Valley cheapened the cost of raising stock, and the demands of the Southern and Eastern markets caused an increased production, particularly of hogs. These facilities for stock raising naturally caused the inauguration of packing operations, and small plants sprang up in the more important towns. At first these centers were confined closely to the towns upon the rivers, owing to the greater facility of transportation by water.

In those days the packing was confined almost exclusively to the curing and packing of hog products. Much of the slaughtering was done by farmers in the winter, who, after supplying their own demands, sold the remainder of the carcass to some neighboring storekeeper or small packer, who, in turn, cured the carcass for market. Curing operations were sometimes conducted on flatboats that floated down the rivers after the spring breakup to the larger cities on the Mississippi, particularly New Orleans, where the cured product was exchanged for sugar, molasses, rice, and other products of the Southern states. A large proportion of the pork, hams, etc., reaching New Orleans, was shipped to Baltimore, Philadelphia, New York, Boston, and other cities along the Atlantic coast. Cincinnati at this time was the chief center of the packing industry, owing to its location in the stock-raising region, and to its superior banking facilities, for the packing industry demanded that large sums be paid in ready cash. Again, it was often necessary to employ large gangs of laborers and coopers at short notice, thus making the location of a packing plant most advantageous where these demands could be most readily supplied. The necessities of the trade also demanded an ample supply of salt, and this could be obtained readily only at Cincinnati. An added advantage was found in the denser population that afforded a market for the surplus product. In 1844 there were 26 packing houses at Cincinnati; in 1853–54 the number had increased to 41, and in 1855–56, was 42. A large packing plant had been established at Louisville, Ky., prior to 1844. Other important packing places during the period were Columbus, Chillicothe, Circleville, and Hamilton, in

[1] History of American Manufactures, by J. L. Bishop, Vol. I, page 429 ff.
[2] Ibid., page 439.
[3] Ibid., page 444.
[4] Ibid., page 449.

Ohio; Lafayette, Lawrenceburg, Madison, Terre Haute, and Vincennes, in Indiana; Alton, Beardstown, Pekin, Peoria, and Quincy, in Illinois, and many places of lesser importance.[1] The volume of packing at Cincinnati during the decade prior to 1851–52 was 27 per cent of the total for the West. Cincinnati slaughtered 475,000 hogs in the packing year 1848–49. As settlement moved westward, the extension of the cornfields gave an impetus to stock raising, and the Western cities assumed increasing importance as slaughtering and packing centers.

About 20,000 hogs were killed at Chicago in 1850–51, and from that time the amount of business done in Chicago increased rapidly. The early fifties saw the beginning of railroad operations in the West. Naturally, this had a great influence on the packing business, and to this cause much of Chicago's prominence as a packing center may be traced. Up to this time St. Louis was unimportant as a packing center, and other prominent packing cities of to-day, such as Kansas City, South Omaha, and South St. Joseph, were unknown to the packing world. These cities did not assume importance until later. Cincinnati was the leading packing center in the United States until 1861–62, when Chicago took the lead, which it has retained. With its $256,527,949 worth of products during the census year of 1900, the city of Chicago stands as the chief center of the slaughtering and meat-packing industry of the United States. The preparation of animal food products at this point has come to be one of the greatest industrial and commercial enterprises that has been evolved by the American people. This has not been due to accident nor wholly to the alert and businesslike qualities of her citizens. It has been chiefly because of Chicago's location. Nature located Chicago. As early as 1673, Joliet saw that if a canal were cut through half a league of prairie, boats could pass from the lake of Illinois (Lake Michigan) into the St. Louis River (the Illinois, including the Des Plaines). A city possessing such a location, between the lakes and the great West, was naturally early seen to be a gateway of commerce, and Chicago became the center for the vast systems of transportation that converge there to-day and that include more than one-half of the railroad systems of the United States. The Union Stock Yards was founded in 1865, when 320 acres of land were purchased, and the yard opened in December, 1865. This plant is now worth at least $10,000,000, and on the square mile of land upon which the yards are located are the slaughtering and packing houses that, in 1900, reported a capital invested of over $67,000,000. More than 50,000 men found employment in and about the stock yards in 1900, in the packing establishments, and in the service necessary to the handling of the stock. Within the stock yards are 200 acres of yardage, 20 miles of street, 20 miles of water troughs, 75 miles of drainage and water pipes, and 150 miles of railroad track, which is the property of the stock-yards company, which also owns and operates the locomotives. The table below shows the number of cattle, hogs, and sheep, received, shipped, and slaughtered at Chicago, from 1870 to 1900, inclusive.

[1] Philip D. Armour, in One Hundred Years of American Commerce, Vol. II, page 384.

LIVE STOCK RECEIVED, SHIPPED, AND SLAUGHTERED IN CHICAGO, ILL.: 1870 TO 1900.[1]

YEARS.	HOGS.			CATTLE.			SHEEP.		
	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.
1870	1,693,158	924,453	768,705	532,964	391,709	141,255	349,853	116,711	233,142
1871	2,380,083	1,162,286	1,217,797	543,050	401,927	141,123	315,053	135,084	179,969
1872	3,252,623	1,835,594	1,417,029	684,075	510,025	174,050	310,211	145,016	165,195
1873	4,437,750	2,197,657	2,240,193	761,428	574,181	187,247	291,734	115,235	176,499
1874	4,268,379	2,330,361	1,928,018	843,966	622,929	221,037	333,655	180,555	153,100
1875	3,912,110	1,582,643	2,329,467	920,843	696,534	224,309	418,948	243,604	176,344
1876	4,190,006	1,131,635	3,058,371	1,096,745	797,724	299,021	364,095	195,925	168,170
1877	4,025,970	951,221	3,074,749	1,033,151	703,402	329,749	310,240	155,354	154,886
1878	6,339,654	1,266,906	5,072,748	1,083,068	699,108	383,960	310,420	156,727	153,693
1879	6,448,330	1,692,361	4,755,969	1,215,732	726,903	488,829	325,119	159,266	165,853
1880	7,059,355	1,394,990	5,664,365	1,382,477	886,614	495,863	335,810	156,518	179,292
1881	6,474,844	1,289,679	5,185,165	1,498,550	938,712	559,838	493,624	253,930	239,694
1882	5,817,504	1,747,722	4,069,782	1,682,530	921,009	661,521	628,887	314,200	314,687
1883	5,640,625	1,319,392	4,321,233	1,878,944	966,758	912,186	749,917	374,463	375,454
1884	5,351,967	1,392,615	3,959,352	1,817,697	791,884	1,025,813	801,630	290,352	511,278
1885	6,937,535	1,797,446	5,140,089	1,905,518	744,093	1,161,426	1,003,598	260,277	743,321
1886	6,718,761	2,090,784	4,627,977	1,963,900	704,675	1,259,225	1,008,790	266,612	742,178
1887	5,470,852	1,812,001	3,658,851	2,382,008	791,483	1,590.525	1,360,862	445,094	915,768
1888	4,921,712	1,751,829	3,169,883	2,611,543	968,385	1,643,168	1,515,014	601,241	913,773
1889	5,998,526	1,786,659	4,211,867	3,023,281	1,259,971	1,763,310	1,832,469	711,315	1,121,154
1890	7,663,828	1,985,700	5,678,128	3,484,280	1,260,309	2,223,971	2,182,667	929,854	1,252,813
1891	8,600,805	2,962,614	5,638,291	3,250,359	1,066,264	2,184,095	2,153,537	688,205	1,465,332
1892	7,714,435	2,926,145	4,788,290	3,571,796	1,121,675	2,450,121	2,145,079	483,368	1,661,711
1893	6,057,278	2,149,410	3,907,868	3,133,406	900,183	2,233,223	3,031,174	442,865	2,588,309
1894	7,483,228	2,465,058	5,018,170	2,974,363	950,738	2,023,625	3,099,625	333,398	2,766,227
1895	7,885,283	2,100,613	5,784,670	2,588,558	785,092	1,803,466	3,406,739	474,646	2,932,093
1896	7,659,472	1,896,312	5,763,160	2,600,476	818,326	1,782,150	3,590,655	561,239	3,029,416
1897	8,363,724	1,629,984	6,733,740	2,554,924	843,392	1,711,532	3,606,640	638,110	2,968,530
1898	9,166,095	1,340,544	7,825,551	2,480,897	865,642	1,615,255	3,589,439	543,425	3,046,014
1899	8,721,525	1,689,439	7,032,086	2,514,436	811,874	1,702,562	3,682,832	386,991	3,295,841
1900	8,696,097	1,452,183	7,243,914	2,729,046	934,649	1,794,397	3,548,885	487,254	3,061,631

[1] Compiled from data furnished by Cincinnati Price Current.

With the development of the country west of the Mississippi, St. Louis took its rise as a packing center. Covered with corn fields, the territory adjoining St. Louis is devoted largely to the live-stock industry, particularly the rising of hogs. The following table shows the growth of the slaughtering industry at St. Louis:

LIVE STOCK RECEIVED, SHIPPED, AND SLAUGHTERED IN ST. LOUIS, MO.: 1868 TO 1900.[1]

YEARS.	HOGS.			CATTLE.			SHEEP.		
	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.
1868	301,560	16,277	285,283	115,352	37,277	78,075	79,315	6,415	72,900
1869	344,848	39,076	305,772	124,565	59,867	64,698	96,626	12,416	84,210
1870	310,850	17,156	293,694	201,422	129,748	71,674	94,477	11,649	82,828
1871	633,370	113,913	519,457	199,527	130,018	69,509	118,899	37,465	81,434
1872	759,076	188,700	570,376	263,404	164,870	98,534	116,904	29,540	86,364
1873	973,512	224,873	748,639	279,678	180,662	99,016	86,434	18,902	67,532
1874	1,126,586	453,710	672,876	360,925	226,678	134,247	114,913	35,577	79,336
1875	628,569	126,729	501,840	335,742	216,701	119,041	125,679	37,784	87,895
1876	877,160	232,876	644,284	349,043	220,430	128,613	157,831	67,886	89,945
1877	896,319	314,287	582,032	411,969	251,566	160,403	200,502	87,569	112,933
1878	1,451,634	528,627	923,007	406,235	261,723	144,512	168,095	74,433	93,662
1879	1,762,724	686,099	1,076,625	420,654	226,255	194,399	182,648	88,083	94,665
1880	1,840,684	770,769	1,069,915	424,720	228,879	195,841	205,969	93,522	112,447
1881	1,672,153	889,909	782,244	603,862	293,092	210,770	334,426	170,395	164,031
1882	846,228	264,584	581,644	443,169	188,486	254,683	443,120	245,071	198,049
1883	1,151,785	609,388	542,397	405,090	249,523	155,567	398,612	217,370	181,242
1884	1,474,475	678,874	795,601	450,717	315,433	135,284	380,822	248,646	132,277
1885	1,455,535	789,487	666,048	386,320	233,249	163,071	362,858	233,391	129,467
1886	1,264,471	520,362	744,109	377,650	212,958	164,692	328,985	202,728	126,257
1887	1,052,240	324,735	727,505	464,828	277,406	187,422	417,425	287,018	130,407
1888	929,230	294,869	634,361	546,875	336,206	210,669	456,669	316,676	139,993
1889	1,120,930	420,930	700,000	508,190	297,879	210,311	358,495	255,375	103,120
1890	1,359,791	665,471	694,320	639,014	361,705	277,309	358,496	251,728	106,768
1891	1,380,569	704,378	676,191	779,449	464,794	314,655	402,989	277,886	125,103
1892	1,310,311	715,969	594,342	801,811	465,328	336,483	376,922	248,035	128,887
1893	1,105,108	575,846	529,262	903,257	473,966	429,291	397,725	231,476	166,249
1894	1,489,856	642,699	847,157	773,571	281,260	492,311	359,895	90,526	269,369
1895	1,440,342	605,480	834,862	851,275	272,856	578,419	510,660	119,148	391,512
1896	1,997,895	885 462	1,112,433	955,613	350,036	605,577	632,872	254,602	378,270
1897	2,065,283	837,895	1,227,388	960,763	366,127	594,636	660,380	212,243	448,137
1898	2,136,328	573,516	1,562,812	795,611	254,619	540,992	477,091	127,184	349,907
1899	2,147,144	678,067	1,569,077	766,032	224,177	541,855	432,566	97,722	334,844
1900	2,166,972	513,561	1,643,411	795,800	207,998	587,802	434,133	65,199	368,934

[1] Compiled from data furnished by Cincinnati Price Current.

Up to 1870 slaughtering at Kansas City was of relatively small importance. Cattle were driven overland from the Southwest, the journey often consuming as much as three months. At Kansas City they were loaded on cars for shipment to Eastern markets or driven overland to markets in the interior. In 1870 the Kansas City stock yards had their inception in a movement to afford better facilities for handling live stock at that point. As far back as 1873, three small packing houses were located at Kansas City, and in 1875, 48,492 cattle, 47,560 hogs, and 7,585 sheep were slaughtered there. In 1886, of the total number of animals received, 24.6 per cent of the cattle, 76.2 per cent of the hogs, and 51.8 per cent of the sheep were slaughtered; in 1900 these figures had grown to 56.7 per cent for cattle, 92.8 per cent for hogs, and 75.2 per cent for sheep. The stock yards are situated close to the business center of the city and occupy about 200 acres. The following figures show the number of animals slaughtered at Kansas City each year from 1875 to 1900, inclusive:

LIVE STOCK RECEIVED, SHIPPED, AND SLAUGHTERED IN KANSAS CITY, MO.: 1875 TO 1900.[1]

YEARS.	HOGS.			CATTLE.			SHEEP.		
	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.
1875	63,350	15,790	47,560	174,754	126,262	48,492	25,327	17,742	7,585
1876	153,777	26,264	127,513	183,378	120,340	63,038	55,045	22,460	32,585
1877	192,645	15,973	176,672	215,768	126,570	89,198	42,190	28,329	13,861
1878	427,777	91,671	336,106	175,344	131,761	43,583	36,700	30,483	6,217
1879	588,908	208,851	380,057	211,415	155,831	55,584	61,684	47,782	13,902
1880	676,477	152,920	523,557	244,709	194,421	50,288	50,611	36,285	14,326
1881	1,014,304	195,524	818,780	285,863	223,989	61,874	79,924	61,078	18,846
1882	963,036	191,325	771,711	439,671	359,012	80,659	80,724	62,652	28,072
1883	1,379,401	313,879	1,065,522	460,780	387,598	73,182	119,665	61,977	57,688
1884	1,723,586	590,133	1,133,453	533,526	443,001	90,525	237,964	105,973	131,991
1885	2,358,718	801,162	1,557,556	506,627	402,381	104,246	221,801	115,755	106,046
1886	2,264,484	538,005	1,726,479	490,971	370,350	120,621	172,659	83,234	89,425
1887	2,423,262	524,492	1,898,770	669,224	483,372	185,852	209,956	103,126	106,830
1888	2,008,964	413,937	1,595,047	1,056,086	682,622	373,464	351,050	169,932	181,118
1889	2,073,910	331,434	1,742,476	1,220,343	744,510	475,833	370,772	174,851	195,921
1890	2,865,171	558,227	2,306,944	1,472,229	923,552	548,677	535,869	336,207	199,662
1891	2,599,109	605,457	1,993,652	1,270,917	739,093	531,824	386,760	178,271	208,489
1892	2,397,477	591,623	1,805,854	1,479,078	810,010	669,068	438,268	219,230	219,038
1893	1,948,373	520,694	1,427,679	1,660,807	761,676	899,131	569,517	196,892	372,625
1894	2,547,077	496,804	2,050,273	1,689,193	764,592	924,601	589,555	196,061	393,494
1895	2,457,697	286,340	2,171,357	1,613,454	719,704	893,750	864,713	287,294	577,419
1896	2,605,575	341,699	2,263,876	1,714,532	819,799	894,733	993,126	303,693	689,433
1897	3,350,796	263,841	3,086,955	1,817,526	875,756	941,770	1,134,236	306,356	827,880
1898	3,672,909	373,219	3,299,690	1,757,964	851,186	906,778	980,303	330,865	649,438
1899	2,959,073	257,718	2,701,355	1,912,019	919,573	992,446	953,241	308,403	644,838
1900	3,094,139	223,963	2,870,176	1,969,718	853,303	1,116,415	860,449	216,272	644,177

[1] Compiled from data furnished by Cincinnati Price Current.

The rise of South Omaha as a slaughtering and packing center dates from 1884. The figures below show the development of the industry at this point:

LIVE STOCK RECEIVED, SHIPPED, AND SLAUGHTERED IN OMAHA, NEBR.: 1884 TO 1900.[1]

YEARS.[2]	HOGS.			CATTLE.			SHEEP.		
	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.	Received.	Shipped.	Slaughtered.
1884	1,863	500	1,363	86,898	81,955	4,943	4,188	1,273	2,915
1885	130,867	71,919	58,948	114,163	83,233	30,930	18,985	8,408	10,577
1886	390,487	187,369	203,118	144,457	73,120	71,337	40,195	17,728	22,467
1887	1,011,706	140,726	870,980	235,723	151,419	84,304	76,014	56,444	19,570
1888	1,283,600	333,228	950,372	340,469	206,064	134,405	158,503	118,208	40,295
1889	1,206,605	179,916	1,026,689	467,340	227,921	239,419	159,503	103,250	56,253
1890	1,673,314	275,638	1,397,676	606,699	283,880	322,819	156,186	94,464	61,722
1891	1,462,423	245,046	1,217,377	593,044	267,730	326,314	170,849	89,416	81,433
1892	1,705,687	381,723	1,323,964	738,186	282,092	456,094	185,457	83,445	102,012
1893	1,435,271	363,116	1,072,155	852,642	309,776	542,866	242,581	91,814	150,767
1894	1,904,238	400,640	1,503,698	829,171	311,627	517,544	252,218	115,764	136,454
1895	1,188,421	100,705	1,087,716	602,222	287,910	314,312	208,633	113,793	94,840
1896	1,197,638	78,790	1,118,848	570,515	235,421	335,094	333,332	131,454	201,878
1897	1,610,981	83,061	1,527,920	810,949	355,175	455,774	627,160	205,617	421,543
1898	2,101,387	172,024	1,929,363	812,244	322,194	490,050	1,085,136	483,171	601,965
1899	2,216,482	25,999	2,190,483	837,563	288,474	549,089	1,086,319	342,247	744,072
1900	2,200,926	36,996	2,163,930	828,204	274,479	553,725	1,276,775	652,234	724,541

[1] Compiled from data furnished by Cincinnati Price Current.

[2] Previous to 1897 the movement represents years ending with November.

The prominence that has been attained by South St. Joseph, Mo., in the slaughtering and packing industry was the result of a remarkable development between 1897 and 1900. The receipts at South St. Joseph for 1898, 1899, and 1900 were as follows:

YEARS.	Cattle.	Hogs.	Sheep.
1898	232,074	1,034,035	121,407
1899	294,950	1,401,794	258,432
1900	390,361	1,678,521	390,308

About eighty years ago, when packing was begun at Cincinnati, and even until the late sixties, packing was confined to the curing and salting of pork products and some barreling of beef. The barreling of beef was carried on in the West to a considerable extent and the products sent to the Eastern markets. Beef barreled in the Eastern cities was sent all over the world on board ship. The development in the packing of beef on a large scale has been due to the adoption of the various systems of artificial refrigeration within the last thirty years. No other one factor has had so much influence upon the meat industry. All meat curing depends for its success upon thorough chilling, properly conducted, of the carcass. Artificial refrigeration has practically lengthened the packing year from four months to twelve months, by rendering summer slaughtering possible. The importance of artificial refrigeration to the meat trade would be hard to overestimate. The most important step in the development of American beef as an article of commerce, was the invention of the refrigerator car by William Davis of Detroit. The patents were issued in 1868, and in September, 1869, the first cargo of fresh beef was shipped from Chicago to Boston. This was the commencement of a great industry in the United States, and the initial step toward the foreign trade. The cars now used by the great meat packers of the West are founded on the Davis patent of 1868.[1]

[1] Ice and Refrigeration, September, 1901, Vol. 21, No. 3, page 98.

The object of chilling and freezing meat is not only that it shall be preserved, but also that it be so frozen that it can be thawed, fresh and sweet, with its nutritive qualities intact. To attain this end, the problem is to chill the meat without driving the animal heat inward and thereby causing decay of the marrow and bone. With proper treatment in freezing, however, the quality of the meat need not be impaired. For fifteen to eighteen hours the temperature of the meat is kept at 36° F., and it is then chilled or refrigerated for twenty-four to thirty hours.

The canning of beef was attempted in Chicago in the sixties and enjoyed some growth, but the packers did not take it up on a large scale until 1879. Of late years the production of canned beef has fallen from 133,428,456 pounds in 1890 to 123,249,021 pounds in 1900, and the exports from 82,638,507 pounds in 1890 to 55,553,745 pounds in 1900.

Prior to 1875 the dressed beef trade was not of much importance. The invention of the refrigerator car and its improvement gave a great impetus to the industry. The exportation of fresh beef began in 1876 in a small way. In the early days of cattle raising in the West they were brought East on the hoof and slaughtered in local abattoirs. The journey of 1,500 to 2,000 miles East affected the physical condition of the animal to the extent that it caused the quality of the beef to deteriorate. The adoption of the refrigerator car made it possible to slaughter these cattle in the West, and the Western packers were quick to fill the demand created for the slaughter of these cattle, and ship the product East, thus preserving all the good qualities of the beef. To-day the Western packer competes with the local producer in the Eastern market, and his beef is in far better condition than when it came East on the hoof to be slaughtered at the end of a long, tiresome journey.

Until within comparatively late years little attempt was made to utilize the waste products of the abattoir. The blood was allowed to drain away, and the disposal of heads, feet, tankage, and other waste material was a source of expense, men being hired to cart it away and bury it. After a time industries grew up in the vicinity of the slaughtering establishments, using as their raw materials the waste product of the abattoir. Glue, tallow, soap, and fertilizers were among the articles so produced from the waste. With increasing competition the packing house gradually absorbed these industries, until the utilization of "waste" materials constituted a source of no little profit. The aim is that nothing shall be wasted. The large packing houses utilize the horns, hoofs, bones, sinews, hide trimmings, and the other so-called waste materials. From these are manufactured glue, gelatin, brewers' isinglass, curled hair, bristles, wool felt, hair felt, laundry soap and soap powders, toilet soaps, glycerin, anhydrous ammonia, fertilizers, dried blood (after the albumen is extracted), bone meal, cut bones, poultry food, albumen, neat's-foot oil, pepsin, knife handles, and many other things. Each large establishment has its chemical laboratory, where expert chemists are constantly seeking for new combinations to render more valuable and extensive the already long list of by-products.

It is obvious to even the most casual observer, that an industry putting out a product in a single year of over $785,000,000 is of the utmost importance to the people of the United States. It is essentially Western in its location and growth. The largest establishments are located in the Mississippi Valley. The states leading in the production of live stock for slaughter are west of the Mississippi. Indeed, a large part of the industrial welfare of the West may be said to be based upon the live-stock industry. The territory devoted to the raising of hogs on a large scale is coextensive with the corn belt. The corn crop, the hay crop, and the grasses take on an added value when converted into the form of meat products. The corn crop is the foundation upon which depends the live-stock industry, and this industry is coming more and more to be a question of corn supply. Sheep raising is confined chiefly to the upper Rocky Mountain states, owing to the fact that the successful raising of sheep depends upon the availability of pasturage. From this western stock-raising territory, the movement is northward and eastward to Chicago, Kansas City, South Omaha, St. Louis, South St. Joseph, and the other great slaughtering centers. The geographical movement of the slaughtering and packing area furnishes a view of the settlement and development of the West.

The advantages of the transportation facilities possessed by Chicago, backed with the wide area devoted to stock raising, spreading westward from Lake Michigan to the Rocky Mountains, give that city the lead in this industry. The tendency, however, is for the slaughtering centers to move still nearer the corn belt. The rise within recent years of Kansas City and South Omaha, and more lately of South St. Joseph, may be traced directly to this factor, and to the improved railroad facilities that followed any enlargement of the territory devoted to corn production. Within recent years, overpasturage on many of the Western grazing lands has caused the number of cattle to decrease. Increasing attention devoted to sheep raising, too, has caused a crowding of the cattle, and settlers have been crowding in and fencing the ranges. The place of the large herds that formerly ranged the plains during the entire year is being taken by the small herds that range the free grazing lands in the summer and are carefully pastured and fed during the winter. A loss of one-third of the herd from exposure was a common thing under the old conditions, but under the new system this element of loss is almost wholly removed. Greater attention is being paid to breeding, and almost fabulous prices have been paid for high-class animals for breeding purposes. Another comparatively new development is the extension of the feeding or fattening operations for market. The conversion of the surplus corn into beef, pork, and mutton, yields a large profit to the feeder. Poor-grade stock is bought in the fall, fattened during the winter, and later is sent back to market to be sold at a considerable advance.

The Union Stock Yards at Chicago present a monument to the opportunity and good business sense of the American people. To the stranger entering the yards for the first time, the scene is novel. He enters the main entrance beneath an iron arch bearing an inscription that informs him that the territory within is the "Union Stock Yards, chartered 1865." Once within, factories, pens, and viaducts surround him on every side. Noise and confusion reign everywhere, but the apparent confusion is well ordered; and, considering the immense number of animals that are constantly being handled, the wonder is that they are handled with so much facility. On every hand is heard the "hi-yah" of the drovers and the deep lowing of the cattle. Everywhere is movement.

The stock arrives at the yard in the night or early morning, often after a long, hard ride of hundreds of miles. The company owning the stock yards owns also the transportation facilities within the yards, and, as the animals come in, they are given into charge of the company, which become responsible for both the cargo and the freight, attending to all matters of ownership, consignment, and fees. The company remains responsible for the stock until all charges are paid and the stock delivered to the broker or buyer. The live-stock broker has become a necessity; he is the medium of understanding between the buyer and the seller, and by him all difficulties are adjusted. Through him the seller knows exactly what it will cost to have his stock shipped, fed, watered, and sold. As soon as possible after the arrival at the yard, the herds are driven to pens, fed, and watered, and after that the selling begins. Owners, buyers, sellers, agents of the packing houses, and commission men mingle in the excitement of the market. The examination and weighing of the animals follow the sale. An official statement of the weight is given the seller. The animals are then driven to the slaughterhouse. The worry and exhaustion of the cattle, occasioned by the long ride, have heated them so much that a period, generally of about twenty-four hours, is given to allow their temperature to cool to the normal point. Hogs, however, are not allowed this respite, but are sprinkled and immediately driven to a large solid wheel, with chains fastened at intervals along the rim. With these chains the hog is shackled by one hind leg. The wheel revolves, slowly raising the squealing porker. As he gets near the top, the hog is detached automatically from the wheel, and a hook attached to a sloping rail carries the victim to the butcher. With a swift motion, almost mechanical because of its long practice, the throat is cut lengthways, and the carcass is run along a short distance to allow the blood to drain out, which is drawn off and used largely in the manufacture of fertilizers. After a short time has been allowed for this draining, the carcass is plunged into a bath of scalding water. It is then brought automatically to a table, across which it is dragged through a scraping machine by an endless chain. This machine does the work better than it could be done by hand, leaving the bristles in much better condition. It does its work very thoroughly, its blades being mounted on cylinders coming in contact with every part of the body. To insure perfect results, the body is then gone over by hand scrapers, after which the carcass is thoroughly washed with a hose. Next the head is nearly severed, the gambrels are cut, and the body suspended by them from the rail.

The body is then opened and dressed, the leaf lard is removed, the head is taken off, the tongue removed, and, lastly, the body is split in two. All this is done at the rate of 20 hogs per minute. Thence the two halves go to the chill room, where they remain about twenty-four hours, until after the animal heat has left the body and it is thoroughly chilled. After this the sides are run to the cutting tables. In the cutting, too, many changes have taken place since the early days. Formerly the only cuts were hams, sides, shoulders, and cuts for barreled pork. In this connection Mr. Philip D. Armour said: "To-day (1895) the variety of cuts is bewildering to an outsider. The world to-day is the packer's market, and he has to study the peculiarities and preferences of each country, and even each county. The idiosyncrasies in the cutting and curing of home-killed bacon is reflected to-day in our cuts. Wiltshires, Cumberlands, Staffordshires, Yorkshires, etc., are only a few of such distinguishing styles."[1] A hog dresses about 80 per cent of its live weight, about 20 per cent being offal. Fresh meat comprises about 10 per cent of the dressed hog, and the other 90 per cent is cured. From the cutting room the various parts intended for curing are sent by chutes to the curing rooms, where some cuts lie for at least sixty days in dry salt, and the shoulders, sides, hams, etc., intended for smoking lie for a like period in vats of sweet pickle. After these pieces intended for smoking have lain in pickle for five to eight weeks (the time required and the strength of the pickle varying according to the size of the cut), they are removed to the soaking tank and soaked for about twenty-four hours, in order that the heavier salting toward the surface of the cut may be brought to a uniformity with the center. From here the hams go to the trimming table, whence they are taken to the smokehouse, where they are smoked for about twenty-four hours. They then go to the storeroom, or the department where the hams and bacon are branded and labeled, and some are covered with canvas.

The manufacture of sausage brings to the packer greater profit for the amount of meat used than any other part of the hog. Sausage is made of trimmings which are the remnants of everything. Material for sausage comes from the ham-trimming department, from the butcher's bench at the market stall, from the killing room, and from the beef houses, particularly where the heads and hoofs are trimmed. The meat is chopped, mixed, and stuffed by machinery. The spices, such as sage, pepper, salt, ginger, and mustard, are mixed with the meat prior to its passage through the chopping machine, in order that it may be more thoroughly mixed. The ginger and mustard are added to counteract the action of the fatty greases on the stomach. From the chopping table the meat goes to a mixing trough to be mixed with large quantities of water necessary to make the mass sufficiently pliable that the casings may be filled with little difficulty. Here potato flour is also added to give consistency to the material. At this point the constituent parts are 40 per cent meat and spice, 40 per cent potato flour, and 20 per cent water. The potato meal neutralizes the taste of the pork, and the spices keep the stomach right.

The intestines, from which the casings are made, are one of the most valuable products of the hog. The labor involved in preparing them for commercial use is much greater than that demanded in the preparation of any other part of the hog. In some packing houses the old plan of doing the work entirely by hand, cleaning the intestines by turning them inside out and scraping with knife blades, still obtains, but in all the larger houses this work is done by a machine of marvelous rapidity, and it does its work more thoroughly than is possible by hand. Stuffing is done by a machine composed of two large cylinders, one a steam cylinder, the other a sausage-stuffing cylinder, and a piston rod directly connected with the piston rod of the large cylinder. The steam cylinder is of such an area that with 80 pounds steam pressure we have 190 pounds of pressure to the square inch in the stuffing cylinder. This causes sufficient pressure to force the sausage from

[1] One Hundred Years of American Commerce, Vol. II, page 386.

the small orifice at the bottom of the cylinder, to which is attached a tube over which the sausage casings are slipped, and the pressure when the cylinder is filled is sufficient to fill the skins at a speed of a mile a minute. From this machine the sausages are delivered at a table at which stand several men who tie them in links. This process done, the sausage is ready for marketing.

Lard is another important product of the hog. The packer divides it into two kinds—leaf lard and steam lard. Leaf lard comes from the surplus fat that accumulates in the hog, incased in a skin somewhat similar to that inclosing the intestines, only of frailer fabric. From the hog this leaf is washed and then goes to the rendering kettle. The leaf is cut into strips about three inches wide which is again cut into squares about three inches long. This cutting has to be done with much care, for mangling the leaf is detrimental to the production of good lard. The kettle is generally an open-jacketed one with a space for steam between the two parts of the kettle. A heavy shaft suspended through the kettle horizontally has arms attached which pass close to the bottom. This shaft in revolving keeps the mass in constant motion. This kettle holds about 10 tierces, and is kept constantly full, the steam being turned on in the jacketed space at a pressure of about 15 pounds and a temperature of about 222° F. The water taken on in washing the leaf first arises as vapor, and continues to vaporize as long as any water is left. After a time the surface begins to sink, showing that some of the leaf has melted, and the shaft and stirrers are started and the temperature is raised to about 250° F. Cut leaf is added from time to time to keep the kettle full, so that it is full of lard to the brim when the rendering is completed. After about five hours the cooking is finished, and the steam is turned off. A small amount of salt is thrown into the kettle, and after an hour of settling the lard is drawn off from the bottom through an opening over which there is a fine screen of wire cloth. From here the lard is run to an open tank where it cools to a temperature of 160° F., when it is drawn into tin pails of about 20 quarts each, and from these filled into packages of wood or tin, and placed in a room where a blast of air of a temperature of about 40° to 45° is blown over it. The rapid cooling causes a shrinkage on the surface and gives a crinkled effect that was formerly believed to be an indication of its purity. The color of leaf lard is creamy. Nearly everything to-day enters into leaf lard from leaf to belly trimmings. Much leaf lard is made into neutral oil. This oil is free from animal smell and taste.

Stock for making steam lard comes from all sources and every grade of hog products, from the feet trimmings, or feet themselves, to the skull or head bones. The rendering is done in tight iron cylinders from 30 to 72 inches in diameter and from 6 to 16 feet deep, generally suspended through one floor with a discharge at the bottom of about 12 inches in diameter, and an inle opening on the top of about 16 inches in diameter. Both these openings are covered. The pressure of steam used varies. After the rendering is completed and the steam pressure removed, the tank is allowed to settle. The refuse, such as bones and flesh tissue, sinks to the bottom of the tank, and is used in making fertilizers; above appears a layer of water, and above this, in turn, is the lard. The lard is drawn off into large steam jacketed kettles holding 20 to 30 tierces each. These kettles are then heated to above the boiling point of water. This is the refining process, and is continued until the water in the lard ceases to rise as vapor from the kettle. As soon as the water is evaporated the lard settles and is pumped into a large cooler before it is prepared for shipment. The failure to remove all the water in this process of refining is the cause of rancid or spoiled lard.

In the manufacture of fertilizers it is a serious question to reduce the offensiveness of the odor arising from the gases to the smallest possible degree. The odors penetrate every crack and corner, and leave their characteristic taste and smell everywhere. For this reason the building in which the fertilizer operations are conducted is situated at a distance from the other buildings of the plant. The material from which fertilizer is made is derived from various sources, chiefly from the rendering and cooking tanks. Fertilizer is a compound, and contains large amounts of ammonia and nitrates, and its value depends upon the amount of these constituents. Fertilizer material is generally cooked on the top floor of the building, and after being thoroughly cooked it is passed through a drying press. The material is pressed in order to reduce the water and save steam in drying, and to secure any grease possible, which adds nothing to the fertilizing properties. The drying presses are usually square boxes, about 16 inches long, 12 inches wide, and 3 inches deep, and are operated either by hydraulic power or by a screw press. After pressing, a rapid drying is given the material at a temperature of over 260° F., a revolving rapidly being necessary to prevent burning. Several different kinds of drying machines are in use. After drying, the fertilizer is put in bags, in which condition it is shipped to the manufacturer of fertilizer compounds.

In killing cattle, a day is generally allowed them to recover their normal temperature after the excitements of their journey. After they have cooled, the cattle are driven up an incline to the top of a 4 or 5 story building, into a long, narrow lane of a width sufficient to allow only two cattle to stand abreast. As the two animals in the lead reach the end of the lane, a partition is lowered behind them. This process is repeated for the next pair, and so on to the end of the lane. As soon as the line is secured, a man wielding a heavy hammer traverses a platform that runs along outside near the top of the lane, and with a swinging blow, which strikes the animal between and above the eyes, fells the cattle. The side of the lane is then raised, the floor of the lane tilted, and the carcasses are precipitated upon the slaughtering floor. Next the body is shackled by the hind legs, hoisted and hooked to a rail, along which it slides to the butcher, who, with a quick thrust, severs the large vein of the neck. A pan is quickly shoved in to collect the blood, and the floor is arranged so that whatever quantity of the blood may escape the pan is drained into a large tank. Next the carcass is headed, lowered to the floor, and adjusted in such manner that the hide may be removed most easily. In this operation, in the larger establishments, the division of labor is carried to a high degree. Each workman engaged in removing the hide cuts only a certain portion, and the amount done by each is surprisingly small, but this is compensated for in the additional quickness with which the work is accomplished. Next the beef is sent to the chill room, where it is refrigerated about forty-eight hours, when that which is intended for sale as fresh meat is run to the loading platforms, divided into fore and hind quarters, and loaded into refrigerator cars for shipment to all points of the United States and to foreign countries. The killing of sheep differs little from the killing of cattle.

The meat used in canning is generally cow beef, and of an inferior grade. It is cooked in huge kettles and is handled with pitchforks. As soon as cooked, it is pressed into cans, which are capped, soldered, sealed, and inspected by steaming to ascertain if any air holes remain. These holes are closed, and the cans are washed, painted, and labeled, when they are ready for shipment to any climate, since, being airtight, they are proof against climatic changes.

Not the least interesting features of the large packing house are the auxiliary plants that have grown up, such as the tin shop where the cans are made, the box factory where boxes for shipment are manufactured, and the car shops where the refrigerator cars are built and repaired.

MEAT INSPECTION.

The reputation of American meats in the markets of the world depends upon the care and thoroughness with which the meat is inspected. This inspection is conducted by the Bureau of Animal Industry of the Department of Agriculture, and the cost of the work is borne by the Government.

On arrival at the stock yards all animals intended for slaughter are subjected to an ante-mortem examination by a Government inspector. Any animal that is found to be diseased, or not fit for human food, is condemned and marked by having a metal tag, stamped "U. S.—Condemned," placed in its ear. These condemned animals are killed under the supervision of an employee of the Bureau of Animal Industry, whose duty it is to see that the products of such animals are rendered in such manner that they shall not be fit for human food. At the time of slaughter all animals are again examined, and if found to be diseased, the carcass is marked with a yellow condemnation tag, and removed and rendered so that no part of it can be placed on sale for food. Provision is made to insure the proper rendering of the condemned carcasses by requiring the return to the inspector of a numbered stub removed from the tag of condemnation at the time the rendering is done. This insures the proper rendering of the carcasses. Only those carcasses and meats are inspected that are intended for interstate or export trade.

Each article of food made from inspected carcasses must bear a label on which appears the official number by which the establishment is known to the Department of Agriculture, and a statement to the effect that the article has been inspected according to law. A copy of this label is filed with the Department of Agriculture at Washington to serve as a mark of identification that the products to which it has been attached were properly inspected. Each package shipped has stenciled upon it "For export" or "Interstate trade," as the case may be, and, further, the official number of the establishment, the number of pieces or pounds in the package, and the trade-mark of the firm. Upon such packages the official of the Department pastes meat-inspection stamps, which are immediately canceled, certifying to the wholesomeness of the product, and its fitness for food. These stamps must be obliterated as soon as the package is opened.

Live stock intended for export are examined at certain designated stock yards, and again at the ports of export. The Department of Agriculture has also representatives at certain foreign ports.

The importance that meat inspection has attained is shown in the table below. The work began in 1891 and has grown steadily since that time. The following table illustrates the growth:

NUMBER OF ANIMALS INSPECTED AT SLAUGHTER FOR ABATTOIRS HAVING INSPECTION, FISCAL YEARS 1891 TO 1900.

Fiscal year.	Number of abattoirs.	Number of cities.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	9	6	83,889	....	....	....	....	83,889
1892	28	12	3,167,009	59,089	583,361	....	....	3,809,459
1893	37	16	3,922,079	92,947	870,512	....	....	4,885,538
1894	46	17	3,861,594	96,331	1,020,764	7,648,146	....	12,626,835
1895	55	19	3,704,042	116,093	1,428,601	13,616,539	....	18,865,275
1896	102	26	3,985,484	256,905	4,629,796	14,250,191	....	23,122,376
1897	128	33	4,242,216	273,124	5,209,161	16,808,771	....	26,533,272
1898	135	35	4,418,738	244,330	5,496,904	20,893,199	....	31,053,171
1899	138	41	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	148	45	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188

In 1881 Germany, France, and other continental nations of Europe forbade the importation of American pork, alleging that it was unhealthful, being infected with trichinæ. By these measures the trade was crushed, and for ten years afterwards nearly every market on the Continent was closed to American pork. Notwithstanding considerable opposition to governmental inspection, the work was undertaken in 1892, when 38,152,874 pounds for export were inspected. The amount inspected has constantly increased. The microscopic inspection of pork is performed largely by women. The following extract from the regulations of the Bureau of Animal Industry shows the method of operation:

When the slaughtered hog is passed into the cooling room of said establishment, the inspector in charge, or his assistants, will take from each carcass three samples of muscle—one from the "pillar of the diaphragm," one from the psoas muscle, and the other from the inner aspect of the shoulder, and also from the base of the tongue when that organ is retained for exportation; and said samples will be placed in small tin boxes, and a numbered tag will be placed upon the carcass from which said samples have been taken, and a duplicate of said tag will be placed in the box with said samples. The small boxes will be placed in a large tin box provided with a lock. The boxes containing the samples from the hogs in the cooling room so tagged will be taken to the microscopist for such establishment, who shall thereupon cause a microscopic examination of the contents of each box containing samples to be made, and shall furnish a written report to the inspector, giving the result of said microscopic examination, together with the numbers of all carcasses affected with trichinæ. The samples of pork microscopically examined shall be classified as follows:

Class A. Samples in which there are no signs of trichinæ, living or dead, calcified cysts, or other bodies or substances having any resemblance to trichinæ or trichinæ cysts.

Class B. Samples in which there are disintegrated trichinæ or trichinæ cysts, calcified trichinæ or trichinæ cysts, or bodies having any resemblance thereto.

Class C. Samples in which there are living or dead trichinæ bodies not disintegrated.

All carcasses coming within Class C are removed from the cooling room and disposed of by tanking, or they may be rendered into edible lard at a temperature of 150° F., or made into cooked meat products if the temperature is raised to the boiling point a sufficient time to cook thoroughly the interior of the pieces. Carcasses belonging to Class B are rejected for shipment to countries requiring inspection and certification. In all this work (the microscopic examination, the cutting up of carcasses, the marking of parts, and the keeping of records) the most careful and painstaking efforts are maintained. The result is that the pork exported to countries which require inspection, is not only absolutely free from trichinæ, but has never been affected by these parasites. The amount of affected pork under Class B and Class C is less than 2 per cent of the whole amount examined microscopically.[1]

Table 12 presents the detailed combined statistics for slaughtering, wholesale, not including meat packing; and slaughtering and meat packing, wholesale, as reported at the Twelfth Census.

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[1] Yearbook, Department of Agriculture, 1899, page 459 ff.

TABLE 12.—COMBINED SLAUGHTERING AND MEAT

		United States.	California.	Colorado.	Connecticut.	Delaware.	District of Columbia.
1	Number of establishments	921	58	14	12	4	7
	Character of organization:						
2	Individual	416	22	3	5	2	5
3	Firm and limited partnership	286	20	2	4	2	2
4	Incorporated company	219	16	9	3	...	...
	Capital:						
5	Total	$189,198,264	$3,913,081	$1,380,518	$562,564	$234,420	$248,200
6	Land	$12,135,034	$497,074	$162,800	$77,000	$23,000	$49,000
7	Buildings	$34,504,130	$780,960	$509,700	$156,385	$35,000	$38,000
8	Machinery, tools, and implements	$20,139,843	$501,711	$104,000	$65,710	$41,760	$67,800
9	Cash and sundries	$122,419,257	$2,133,336	$604,018	$263,469	$134,660	$93,400
10	Proprietors and firm members	1,062	64	7	13	7	9
	Salaried officials, clerks, etc.:						
11	Total number	10,227	180	48	37	22	32
12	Total salaries	$10,123,247	$254,567	$60,896	$36,662	$13,610	$15,784
	Officers of corporations—						
13	Number	371	17	16	2	...	...
14	Salaries	$1,064,686	$40,920	$28,236	$5,000	...	...
	General superintendents, managers, clerks, etc.—						
15	Total number	9,856	163	32	35	22	32
16	Total salaries	$9,058,561	$213,647	$32,660	$31,662	$13,610	$15,784
	Men—						
17	Number	8,913	156	31	31	19	32
18	Salaries	$8,530,484	$209,897	$32,540	$29,582	$12,420	$15,784
	Women—						
19	Number	943	7	1	4	3	...
20	Salaries	$528,077	$3,750	$120	$2,080	$1,190	...
	Wage-earners, including pieceworkers, and total wages:						
21	Greatest number employed at any one time during the year	86,215	1,058	295	400	37	127
22	Least number employed at any one time during the year	61,035	870	243	370	37	103
23	Average number	68,534	925	261	380	37	116
24	Wages	$33,457,013	$544,659	$170,744	$174,239	$20,398	$63,607
	Men, 16 years and over—						
25	Average number	63,922	915	259	378	36	114
26	Wages	$32,239,847	$538,611	$170,244	$173,829	$20,242	$62,931
	Women, 16 years and over—						
27	Average number	2,945	10	2	2	...	2
28	Wages	$853,813	$6,048	$500	$410	...	$676
	Children, under 16 years—						
29	Average number	1,667	...	...	...	1	...
30	Wages	$363,353	...	...	...	$156	...
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
31	January	64,917	917	270	393	36	119
32	February	63,735	906	267	393	36	112
33	March	63,111	919	280	385	36	115
34	April	61,151	920	272	364	36	112
35	May	62,240	932	258	360	36	111
36	June	61,800	900	243	362	36	111
37	July	62,515	899	241	364	36	111
38	August	62,872	905	246	364	36	111
39	September	62,998	912	249	379	36	114
40	October	65,752	934	252	388	36	113
41	November	67,393	912	265	388	36	118
42	December	68,586	927	262	392	36	115
	Women, 16 years and over—						
43	January	2,964	9	2	2	...	2
44	February	2,892	8	2	2	...	2
45	March	2,768	7	2	2	...	2
46	April	2,678	7	2	1	...	2
47	May	2,605	8	2	1	...	2
48	June	2,431	7	2	1	...	2
49	July	2,725	8	2	2	...	2
50	August	2,990	10	2	2	...	2
51	September	3,177	17	2	2	...	2
52	October	3,325	19	2	1	...	2
53	November	3,412	15	2	1	...	2
54	December	3,373	8	2	1	...	2
	Children, under 16 years—						
55	January	1,591	...	...	...	1	...
56	February	1,595	...	...	...	1	...
57	March	1,620	...	...	...	1	...
58	April	1,531	...	...	...	1	...
59	May	1,563	...	...	...	1	...
60	June	1,660	...	...	...	1	...
61	July	1,739	...	...	...	1	...
62	August	1,774	...	...	...	1	...
63	September	1,751	...	...	...	1	...
64	October	1,673	...	...	...	1	...
65	November	1,814	...	...	...	1	...
66	December	1,793	...	...	...	1	...
	Miscellaneous expenses.						
67	Total	$24,060,412	$441,210	$56,384	$76,721	$9,899	$19,935
68	Rent of works	$614,430	$32,482	$4,115	$1,240	$3,120	$5,600
69	Taxes, not including internal revenue	$827,450	$17,032	$6,925	$6,747	$685	$750
70	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$22,606,910	$390,046	$45,344	$68,734	$6,094	$11,785
71	Contract work	$11,622	$1,650	...	...	...	$1,800
	Materials used:						
72	Total cost	$683,583,577	$13,555,445	$3,721,610	$3,143,590	$442,389	$2,013,827
	Slaughtered—						
73	Beeves, number	5,530,911	174,113	34,934	408	5,105	14,975
74	Cost	$247,365,812	$6,017,762	$1,429,817	$16,240	$102,500	$763,275
75	Sheep, number	9,190,490	695,058	65,088	20,707	2,050	17,850
76	Cost	$37,137,542	$2,197,362	$287,843	$74,835	$4,200	$88,675
77	Hogs, number	30,654,333	228,675	160,210	254,781	17,800	127,300
78	Cost	$278,736,961	$1,939,208	$1,504,397	$2,548,174	$229,440	$914,000
79	Calves, number	899,748	28,531	3,770	11,620	228	6,240
80	Cost	$7,356,560	$280,958	$38,440	$92,792	$1,636	$53,600
81	All other animals, cost	$559,839	$165,021	$5,895	$8,080	...	...
82	Dressed meat, purchased fresh or partly cured, cost	$54,715,496	$1,897,969	$363,870	$132,000	$98,300	$145,200
83	Fuel	$2,747,606	$69,305	$18,013	$19,410	$2,061	$9,058
84	Rent of power and heat	$30,946	$3,228	$375	...	...	...
86	Mill supplies	$337,456	$3,672	$2,180	$1,585	$113	$842
86	All other materials	$48,373,654	$416,019	$43,320	$169,047	$1,425	$6,395
87	Freight	$6,221,705	$514,951	$27,460	$81,427	$2,714	$32,782

PACKING, BY STATES AND TERRITORIES: 1900.

Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
7	64	36	27	14	28	11	82	22	29	20	1
4	9	15	10	3	21	7	64	11	16	11	2
2	22	12	5	2	4	2	16	4	10	7	3
1	33	9	12	9	3	2	2	7	3	2	4
$115,827	$71,229,262	$8,860,284	$6,851,353	$16,486,177	$1,326,976	$132,680	$1,548,488	$11,314,075	$1,438,351	$1,355,011	5
$16,700	$3,418,355	$476,886	$178,050	$793,228	$100,460	$8,400	$163,315	$1,182,832	$164,695	$71,160	6
$29,026	$10,560,418	$1,767,647	$1,232,053	$2,668,200	$171,850	$34,750	$402,500	$2,377,016	$207,065	$246,940	7
$24,802	$6,945,234	$1,451,377	$515,075	$1,678,762	$216,133	$5,530	$218,835	$1,323,138	$119,396	$132,192	8
$45,300	$50,305,255	$5,164,474	$4,426,175	$11,355,987	$838,533	$84,000	$763,838	$6,431,090	$957,195	$904,729	9
8	62	40	19	9	31	12	108	21	29	27	10
34	4,226	303	193	1,841	62	6	68	220	71	125	11
$20,235	$4,424,285	$314,603	$197,376	$1,631,866	$51,799	$2,840	$48,804	$250,296	$66,661	$102,709	12
4	79	22	14	12	5	...	2	5	9	...	13
$4,000	$362,440	$80,200	$36,720	$53,690	$10,500	...	$700	$25,500	$20,500	...	14
30	4,147	281	179	1,829	57	6	66	215	62	125	15
$16,235	$4,061,845	$234,403	$160,656	$1,578,176	$41,299	$2,840	$48,104	$224,796	$46,161	$102,709	16
30	3,825	260	167	1,523	67	4	64	196	55	109	17
$16,235	$3,855,511	$224,444	$155,619	$1,402,816	$41,299	$2,416	$47,184	$214,422	$42,601	$96,269	18
...	322	21	12	306	...	2	2	19	7	16	19
...	$206,334	$9,959	$5,037	$175,360	...	$425	$920	$10,374	$3,560	$7,440	20
143	31,946	4,004	3,470	9,505	594	95	649	3,014	530	1,060	21
82	24,594	3,271	2,449	7,030	494	36	549	2,507	414	578	22
104	27,861	3,697	2,887	8,117	511	38	597	2,748	456	668	23
$32,440	$14,044,838	$1,565,752	$1,208,167	$3,575,049	$214,271	$17,900	$276,413	$1,318,077	$230,637	$303,977	24
102	25,792	3,157	2,643	7,170	507	37	584	2,724	453	650	25
$32,115	$13,462,377	$1,455,428	$1,163,421	$3,330,631	$213,711	$17,600	$273,819	$1,311,395	$230,137	$299,105	26
1	1,473	387	29	661	4	1	10	13	2	9	27
$75	$427,203	$101,499	$9,906	$190,802	$560	$300	$2,118	$3,582	$450	$3,000	28
1	596	53	215	286	...	...	3	11	1	9	29
$250	$155,258	$8,825	$34,840	$58,616	...	...	$476	$3,100	$50	$1,872	30
125	26,359	3,290	2,966	6,846	575	35	605	2,910	512	717	31
125	26,270	3,188	2,649	6,778	523	35	605	2,793	452	647	32
123	25,595	2,994	2,585	6,514	494	35	684	2,742	442	609	33
94	24,818	2,977	2,536	6,656	479	31	577	2,677	427	687	34
90	25,012	2,999	2,641	6,842	480	31	571	2,571	422	604	35
91	24,654	3,122	2,742	7,033	479	19	576	2,554	424	611	36
85	24,714	3,182	2,632	7,042	492	62	564	2,653	412	601	37
83	25,154	3,146	2,484	7,261	492	76	558	2,651	451	592	38
81	25,003	3,143	2,371	7,676	474	42	573	2,683	458	631	39
114	26,522	3,360	2,433	7,925	481	39	595	2,763	466	672	40
109	27,412	3,217	2,702	7,878	547	19	614	2,821	486	704	41
111	27,996	3,265	2,977	7,686	669	18	605	2,869	485	819	42
1	1,543	366	25	685	11	2	11	14	2	3	43
1	1,534	358	25	685	6	2	11	13	2	3	44
1	1,621	344	25	513	1	2	11	13	2	3	45
1	1,409	346	26	525	1	2	11	12	2	3	46
1	1,303	362	32	549	1	2	10	12	2	3	47
1	1,050	401	33	572	1	1	10	14	2	3	48
...	1,209	472	34	616	1	1	10	14	2	8	49
...	1,454	459	33	652	1	1	10	14	2	11	50
...	1,510	409	31	795	1	1	10	14	2	10	51
...	1,632	386	31	810	1	1	10	14	2	14	52
...	1,736	374	27	826	11	1	10	14	2	24	53
...	1,767	367	25	754	11	1	10	14	2	23	54
2	570	42	292	205	...	...	3	12	1	7	55
3	682	39	281	200	...	...	3	11	1	9	56
2	690	39	167	221	...	...	3	9	1	8	57
1	564	37	172	239	...	...	3	11	1	9	58
...	551	45	180	281	...	...	3	10	1	11	59
...	530	53	181	320	...	...	3	12	1	16	60
...	583	78	181	361	...	...	3	11	1	14	61
...	603	74	182	345	...	...	3	9	1	11	62
...	611	62	182	356	...	...	3	10	1	12	63
...	634	65	172	318	...	...	3	12	1	2	64
...	653	54	287	314	...	...	3	11	1	4	65
4	681	48	297	267	...	...	3	9	1	6	66
$11,234	$14,211,396	$530,956	$441,986	$2,008,771	$105,694	$6,819	$109,017	$591,102	$87,291	$90,796	67
$920	$73,264	$3,636	$4,130	$45,180	$2,660	$802	$13,757	$10,508	$1,421	$4,901	68
$1,389	$276,440	$48,402	$20,176	$108,870	$7,272	$661	$10,130	$77,877	$11,362	$7,386	69
$8,925	$13,861,692	$478,918	$417,680	$1,849,721	$95,734	$5,356	$83,630	$502,687	$74,508	$78,009	70
...	...	...	...	...	$28	...	$1,500	$30	...	$500	71
$483,695	$246,713,309	$38,608,841	$21,556,644	$67,908,960	$4,444,621	$457,031	$7,109,079	$28,040,069	$4,770,640	$6,823,255	72
10,606	2,057,059	358,585	77,846	927,339	20,698	2,790	19,837	33,244	33,299	52,700	73
$225,140	$93,289,543	$19,305,705	$2,512,385	$38,165,058	$744,682	$107,060	$811,472	$1,305,157	$1,223,256	$1,900,341	74
2,800	3,139,160	363,837	13,686	636,832	11,807	48,565	185,580	407,466	52,360	93,717	75
$5,450	$18,558,698	$1,623,135	$60,106	$2,297,746	$31,051	$161,853	$792,120	$1,493,278	$177,638	$412,120	76
25,995	8,291,706	1,950,370	1,922,698	2,849,648	502,856	2,925	665,735	1,876,245	341,815	422,325	77
$165,000	$82,979,678	$13,705,362	$17,521,295	$23,530,278	$3,449,723	$30,250	$4,065,829	$19,854,761	$2,991,475	$3,623,396	78
1,725	149,450	12,943	4,291	36,720	5,207	3,469	39,532	73,288	6,884	6,219	79
$6,140	$1,378,384	$107,327	$30,093	$294,454	$35,800	$24,139	$267,600	$462,634	$54,220	$50,589	80
$2,425	$70,959	$100	$250	...	$3,064	$70,080	$15,140	...	...	$8,080	81
$60,800	$21,373,908	$2,646,377	$415,891	$683,879	$64,900	$54,000	$873,757	$2,154,746	$161,675	$500,293	82
$2,400	$715,397	$84,948	$141,866	$338,467	$28,330	$1,076	$51,025	$149,510	$23,095	$42,440	83
...	$7,520	$200	...	$300	...	...	$360	$4,876	...	$400	84
$1,200	$134,849	$14,513	$19,032	$13,785	$1,250	$60	$5,007	$15,135	$1,660	$3,490	85
$1,790	$32,604,766	$873,959	$851,190	$2,554,042	$85,771	$3,513	$153,239	$1,209,763	$120,301	$270,475	86
$13,350	$599,607	$247,215	$4,536	$30,956	$50	$5,000	$133,530	$1,390,209	$17,320	$11,631	87

		United States.	California.	Colorado.	Connecticut.	Delaware.	District of Columbia.
	Products:						
88	Total value	$785,562,433	$15,717,712	$4,343,983	$3,663,393	$521,076	$2,210,860
	Beef—						
89	Sold fresh, pounds	2,920,458,297	93,818,021	20,789,680	224,000	1,750,900	8,128,300
90	Value	$211,068,934	$5,972,469	$1,501,233	$15,825	$129,415	$669,800
91	Canned, pounds	112,449,021	868,382	16,000			
92	Value	$9,167,531	$61,450	$1,440			
93	Salted or cured, pounds	137,589,303	2,512,762	66,900	450,000	37,781	400,000
94	Value	$9,661,834	$173,381	$5,814	$45,000	$5,045	$16,000
95	Mutton, sold fresh, pounds	404,183,601	29,605,967	3,138,745	745,252	156,750	719,180
96	Value	$32,963,219	$2,173,934	$270,729	$85,899	$16,375	$69,278
97	Veal, sold fresh, pounds	85,565,207	3,964,808	417,000	929,650	59,460	454,500
98	Value	$7,812,714	$326,705	$39,940	$103,008	$6,901	$45,515
	Pork—						
99	Sold fresh, pounds	1,223,038,988	18,315,565	10,454,600	7,054,510	973,900	6,823,300
100	Value	$84,019,387	$1,424,794	$663,687	$514,237	$99,684	$555,965
101	Salted, pounds	1,375,524,758	2,558,691	9,500,000	4,800,000	522,000	1,093,357
102	Value	$88,674,016	$205,574	$413,580	$333,500	$41,700	$76,512
103	Hams, pounds	787,526,973	11,982,749	4,650,000	8,434,000	782,000	1,227,000
104	Value	$73,793,012	$1,304,450	$400,460	$815,240	$78,760	$125,647
105	Smoked bacon, sides, and shoulders, pounds	985,722,212	14,253,894	3,227,000	11,820,000	601,000	2,486,285
106	Value	$74,873,847	$1,368,837	$230,010	$887,800	$42,320	$214,179
107	Sausage, fresh or cured, pounds	292,164,075	1,404,497	2,535,400	2,651,700	157,000	2,141,500
108	Value	$21,472,413	$115,473	$153,866	$167,000	$11,860	$191,330
109	All other meat, sold fresh, pounds	80,408,211	2,295,977	200,000			200,000
110	Value	$7,813,078	$191,283	$13,600			$10,000
111	Refined lard, pounds	891,438,417	3,998,612	7,672,000	6,163,334	968,000	1,404,000
112	Value	$52,620,348	$314,137	$417,480	$390,400	$70,080	$106,780
113	Neutral lard, pounds	129,345,282	182,500	6,000	750,000		26,000
114	Value	$8,588,350	$16,483	$480	$59,000		$1,820
115	Oleomargarine oil, gallons	19,111,120					
116	Value	$11,482,542					
117	Other oils, gallons	8,245,569	5,275				
118	Value	$3,440,358	$2,699				
119	Fertilizers, tons	168,510	1,570	190	2,918	30	120
120	Value	$3,300,132	$37,328	$2,030	$80,860	$450	$2,160
121	Hides, number	6,281,952	201,444	38,284	12,078	5,333	37,015
122	Pounds	336,527,907	10,221,863	2,128,330	131,106	308,000	988,250
123	Value	$33,925,911	$960,324	$162,397	$17,015	$17,466	$83,977
124	Wool, pounds	13,182,146	117,710	18,200			
125	Value	$3,335,824	$23,742	$1,110			
126	All other products, value	$47,407,679	$1,035,549	$64,916	$148,609	$1,020	$39,277
127	Custom work, value	$141,304	$9,100	$1,211			$2,620
	Weight of animals slaughtered:						
	Beeves—						
128	Gross weight, on hoof, pounds	5,913,498,606	183,495,244	36,268,850	347,200	3,072,000	16,067,500
129	Net weight, dressed, pounds	3,225,610,438	95,496,093	19,733,370	224,000	1,536,350	8,725,000
	Sheep—						
130	Gross weight, on hoof, pounds	770,975,202	62,196,830	6,356,085	1,242,520	159,500	1,430,000
131	Net weight, dressed, pounds	392,496,033	30,697,588	3,237,502	745,252	80,125	718,250
	Hogs—						
132	Gross weight, on hoof, pounds	6,684,658,916	41,417,984	38,534,200	54,947,643	4,697,000	17,417,500
133	Net weight, dressed, pounds	5,209,480,364	32,673,745	31,024,500	45,379,142	3,774,400	14,050,200
	Calves—						
134	Gross weight, on hoof, pounds	126,052,830	7,684,361	662,700	1,388,750	36,932	835,900
135	Net weight, dressed, pounds	80,515,202	3,964,767	417,000	948,650	20,732	454,500
	Comparison of products:						
136	Number of establishments reporting for both years	727	40	8	11	3	7
137	Value for census year	$737,183,413	$12,500,319	$3,354,897	$3,649,648	$383,966	$2,210,860
138	Value for preceding business year	$683,263,317	$12,336,329	$2,839,500	$3,257,439	$365,493	$2,171,844
	Power:						
139	Number of establishments reporting	610	24	14	6	3	7
140	Total horsepower	95,169	1,212	854	360	121	487
	Owned—						
	Engines—						
141	Steam, number	1,204	27	24	7	4	13
142	Horsepower	83,545	1,098	834	360	121	472
143	Gas or gasoline, number	25	2				
144	Horsepower	435	16				
145	Water wheels, number	1		1			
146	Horsepower	5		5			
147	Electric motors, number	571					1
148	Horsepower	10,161					15
149	Other power, number	4					
150	Horsepower	95					
	Rented—						
151	Electric, horsepower	575	90	15			
152	Other kind, horsepower	353	8				
153	Furnished to other establishments, horsepower	211					
	Establishments classified by number of persons employed, not including proprietors and firm members:						
154	Total number of establishments	921	58	14	12	4	7
155	No employees	8			2		
156	Under 5	266	14	2	4	1	2
157	5 to 20	340	31	7	3	2	
158	21 to 50	167	8	3	1	1	5
159	51 to 100	60	3	1			
160	101 to 250	31	1	1	2		
161	251 to 500	14	1				
162	501 to 1,000	16					
163	Over 1,000	19					

PACKING, BY STATES AND TERRITORIES: 1900—Continued.

Georgia.	Illinois.	Indiana.	Iowa.	Kansas.	Kentucky.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	
$591,227	$287,922,277	$43,862,273	$26,695,044	$77,411,883	$5,177,167	$553,742	$8,046,359	$31,633,483	$5,337,417	$7,810,555	88
3,726,000	1,042,234,306	219,166,574	30,678,342	451,975,433	8,429,607	1,658,500	8,965,180	17,960,150	16,467,625	26,659,666	89
$238,380	$74,321,711	$16,476,761	$2,125,028	$31,030,096	$614,540	$112,370	$724,664	$1,365,198	$1,184,398	$1,682,902	90
6,200	76,296,560	5,343,207	1,627,920	14,034,995		1,800	6,000				91
$312	$6,446,283	$395,116	$85,466	$1,341,215		$180	$600				92
56,000	67,917,743	1,538,988	1,305,205	8,967,600	601,334		308,620	1,116,500	17,285	807,115	93
$4,800	$5,066,362	$172,930	$84,838	$540,960	$40,036		$25,039	$62,000	$1,185	$56,449	94
122,000	148,003,635	15,911,670	1,169,736	24,309,545	440,016	2,643,664	7,026,200	16,207,400	1,925,618	4,585,842	95
$8,990	$11,842,741	$1,413,522	$98,094	$1,894,220	$36,164	$219,789	$774,885	$1,311,978	$159,952	$359,456	96
115,000	17,673,896	1,155,508	457,581	3,869,293	388,102	279,660	2,521,000	5,173,540	674,400	640,910	97
$9,330	$1,489,318	$107,383	$39,972	$282,981	$36,009	$28,168	$261,945	$408,934	$60,815	$55,439	98
1,414,000	411,376,731	29,262,285	31,774,211	86,242,483	6,822,730	493,333	12,019,713	44,507,608	12,036,427	17,354,988	99
$107,800	$28,774,485	$1,985,006	$2,337,221	$5,069,007	$523,398	$38,900	$923,647	$3,526,689	$821,545	$1,047,107	100
782,000	522,096,362	30,704,461	135,513,117	78,884,690	21,371,238	202,500	8,799,909	57,884,374	12,496,900	23,819,650	101
$53,740	$36,179,893	$1,819,740	$9,403,836	$4,814,529	$1,091,135	$12,600	$628,383	$3,785,017	$780,964	$1,362,540	102
230,000	228,284,156	42,658,638	39,741,810	57,996,957	10,662,435	220,000	12,830,500	57,134,534	8,388,230	5,920,898	103
$23,900	$22,746,703	$3,552,687	$3,565,663	$4,940,298	$974,201	$23,200	$1,316,703	$4,719,658	$632,490	$667,570	104
220,000	185,240,920	117,787,185	30,781,171	138,485,250	10,680,870	140,000	20,184,869	92,227,868	15,069,779	7,713,147	105
$17,800	$14,434,759	$8,222,656	$2,399,670	$9,657,119	$791,864	$10,400	$1,527,278	$8,108,673	$1,056,797	$571,336	106
647,000	96,536,421	8,532,981	8,917,759	24,936,703	4,316,631	65,000	10,310,052	22,800,805	3,670,757	3,579,898	107
$42,187	$7,881,854	$579,760	$562,596	$1,469,400	$309,149	$4,450	$709,038	$1,674,512	$212,985	$275,740	108
832,000	57,936,886	5,732,510	6,800	6,439,044	42,684		52,000	21,086	160,000	2,456,636	109
$45,840	$6,159,827	$373,351	$390	$412,267	$1,779		$5,021	$1,265	$10,000	$271,634	110
92,000	326,707,241	45,091,290	63,086,918	91,966,141	7,276,846	173,000	6,965,261	68,843,633	2,146,566	8,248,174	111
$5,840	$18,699,882	$2,777,373	$3,590,506	$4,970,291	$401,670	$11,300	$456,922	$4,220,098	$152,203	$507,922	112
25,400	45,455,528	3,583,150	7,354,874	24,037,743	1,381,570		5,396,552	1,000,000	138,317		113
$1,512	$3,596,474	$260,829	$491,049	$1,255,208	$90,050		$331,666	$60,000	$9,682		114
	9,760,701	1,146,483	175,708	1,928,813				82,021			115
	$5,907,572	$750,628	$87,854	$1,204,905				$31,250			116
	4,385,191	176,583	273,709	1,268,691			5,000			157,633	117
	$2,010,394	$84,906	$98,517	$586,487			$2,000			$76,821	118
175	53,614	8,909	6,926	26,118	1,687		595	5,099	430	1,465	119
$2,840	$1,212,619	$143,011	$84,279	$504,080	$23,376		$8,690	$88,810	$6,245	$21,306	120
11,081	2,206,337	371,538	81,820	900,732	25,905	5,925	61,169	106,492	40,243	59,269	121
438,840	128,702,573	23,550,614	4,278,686	50,421,335	1,233,773	182,900	1,414,620	2,609,300	1,897,918	3,051,526	122
$28,189	$13,092,560	$2,645,605	$420,183	$5,556,195	$114,571	$16,056	$113,220	$237,662	$165,857	$294,752	123
3,600	8,389,307			2,000	1,000	121,240	5,460	1,450,000			124
$1,200	$1,935,373			$375	$200	$27,810	$1,385	$442,250			125
$2,817	$26,116,008	$2,100,759	$218,657	$1,868,672	$129,025	$49,519	$189,823	$1,576,606	$81,299	$558,068	126
$750	$7,559	$250	$1,325	$13,578			$45,450	$13,983	$1,000	$1,515	127
8,788,000	2,179,139,406	409,620,551	81,065,710	974,623,827	18,909,167	2,760,100	18,995,400	32,181,970	41,458,810	54,989,920	128
4,276,750	1,176,549,166	229,999,021	44,422,716	529,936,771	10,137,047	1,658,600	10,351,730	17,773,762	16,623,895	28,207,859	129
210,500	265,267,321	31,625,196	1,242,240	61,608,236	752,827	6,330,200	14,035,600	32,619,320	3,892,700	7,180,032	130
99,700	135,918,174	16,166,213	610,803	25,937,180	886,310	2,581,470	7,024,000	16,236,680	1,923,793	4,676,464	131
4,027,500	1,980,965,755	341,722,941	453,457,689	653,215,874	88,560,586	639,375	85,858,321	431,041,694	70,282,690	91,098,995	132
2,882,730	1,544,636,373	274,352,716	324,005,185	505,648,235	69,597,001	502,500	66,752,723	343,634,967	55,816,500	70,732,130	133
187,000	23,488,788	2,012,100	596,402	6,005,180	669,428	468,460	4,216,840	7,716,310	953,100	908,870	134
103,950	14,968,146	1,227,473	393,354	3,731,492	388,368	279,665	2,520,640	5,187,290	674,600	633,988	135
4	54	35	19	10	22	6	72	19	22	12	136
$264,449	$285,427,878	$43,813,289	$24,077,217	$76,372,001	$5,009,849	$366,066	$4,984,298	$31,163,279	$4,633,770	$6,663,616	137
$265,700	$261,506,516	$41,570,488	$24,902,235	$72,811,901	$4,419,179	$343,137	$4,855,508	$34,466,061	$4,019,306	$5,343,511	138
4	68	29	19	12	19	3	43	12	12	15	139
127	28,293	4,949	4,219	12,927	526	62	1,663	3,022	683	965	140
6	195	64	47	69	30	3	49	29	18	21	141
119	24,405	4,540	3,198	10,903	506	62	1,662	2,874	648	945	142
			1	10	1				1		143
			16	209	10				35		144
											145
											146
1	167	36	40	83	1		1	16		1	147
8	3,613	404	1,005	1,715	10		1	105		5	148
				3						1	149
				90						6	150
	260							18		10	151
	15	5		10				25			152
	145	1	10					30			153
7	64	36	27	14	28	11	82	22	29	20	154
						2	2		2		155
3	4	13	9	1	15	2	50	7	12	5	156
	24	11	6	4	7	5	21	4	7	12	157
2	15	7	5	3	4	2	7	4	6	1	158
2	6		2		1		2	1		1	159
	1	3	2	2				2	2		160
	2			1	1			2			161
	4		2					1		1	162
	8	2	1	3				1			163

TABLE 12.—COMBINED SLAUGHTERING AND MEAT

		Missouri.	Montana.	Nebraska.	New Jersey.	New York.	North Dakota.
1	Number of establishments	37	5	12	41	110	3
	Character of organization:						
2	Individual	18	3	3	21	59	1
3	Firm and limited partnership	7	....	2	17	34	1
4	Incorporated company	12	2	7	3	17	1
	Capital:						
5	Total	$7,944,033	$241,826	$16,524,895	$1,588,389	$15,357,075	$104,371
6	Land	$395,656	$7,600	$827,759	$135,533	$1,600,345	$10,500
7	Buildings	$1,663,341	$22,700	$4,064,454	$297,200	$3,623,981	$30,750
8	Machinery, tools, and implements	$1,091,504	$10,959	$1,330,495	$203,021	$1,658,568	$11,900
9	Cash and sundries	$4,793,532	$200,567	$10,302,187	$952,635	$8,474,181	$51,221
10	Proprietors and firm members	33	3	7	60	140	3
	Salaried officials, clerks, etc.:						
11	Total number	242	9	721	100	602	8
12	Total salaries	$253,775	$12,600	$684,240	$94,080	$584,386	$8,760
	Officers of corporations—						
13	Number	25	2	8	3	31	1
14	Salaries	$56,880	$5,000	$27,816	$9,500	$89,298	$2,400
	General superintendents, managers, clerks, etc.—						
15	Total number	217	7	713	97	571	7
16	Total salaries	$196,895	$7,600	$656,424	$84,580	$495,088	$6,360
	Men—						
17	Number	200	7	677	92	461	6
18	Salaries	$189,324	$7,600	$632,867	$82,476	$449,326	$5,860
	Women—						
19	Number	17	....	36	5	110	1
20	Salaries	$7,571	....	$23,557	$2,104	$45,762	$500
	Wage-earners, including pieceworkers, and total wages:						
21	Greatest number employed at any one time during the year	4,103	47	7,006	616	3,967	35
22	Least number employed at any one time during the year	2,509	32	5,350	525	3,352	33
23	Average number	3,102	37	6,090	658	3,099	34
24	Wages	$1,440,742	$33,693	$2,990,863	$331,825	$1,846,434	$15,977
	Men, 16 years and over—						
25	Average number	2,977	35	5,602	656	3,009	33
26	Wages	$1,416,457	$32,493	$2,862,441	$331,565	$1,820,954	$15,677
	Women, 16 years and over—						
27	Average number	8	2	173	....	79	1
28	Wages	$2,160	$1,200	$57,425	....	$23,636	$300
	Children, under 16 years—						
29	Average number	117	....	315	2	11	....
30	Wages	$22,125	....	$70,997	$260	$1,844	....
	Average number of wage-earners, including pieceworkers, employed during each month:						
	Men, 16 years and over—						
31	January	2,738	31	5,119	684	3,048	34
32	February	2,753	36	5,107	579	2,993	34
33	March	3,585	33	5,242	577	2,964	34
34	April	2,755	37	5,305	566	2,943	32
35	May	2,612	36	5,618	531	3,463	32
36	June	2,681	33	5,868	515	2,849	32
37	July	3,173	37	5,889	513	2,867	32
38	August	3,301	35	5,782	517	2,867	32
39	September	3,090	36	5,740	554	2,913	32
40	October	2,944	38	5,987	571	3,024	34
41	November	2,922	32	5,883	585	3,091	34
42	December	3,169	34	5,696	588	3,107	34
	Women, 16 years and over—						
43	January	7	....	138	....	67	1
44	February	7	3	139	....	68	1
45	March	7	3	165	....	69	1
46	April	14	3	170	....	69	1
47	May	8	3	146	....	83	1
48	June	10	2	152	....	92	1
49	July	10	2	171	....	88	1
50	August	17	2	166	....	89	1
51	September	16	2	187	....	90	1
52	October	3	2	245	....	82	1
53	November	....	2	193	....	83	1
54	December	....	2	216	....	67	1
	Children, under 16 years—						
55	January	111	....	279	3	11	....
56	February	117	....	283	3	11	....
57	March	132	....	287	3	11	....
58	April	121	....	316	3	11	....
59	May	109	....	317	2	11	....
60	June	118	....	370	2	11	....
61	July	124	....	322	2	11	....
62	August	125	....	364	2	11	....
63	September	118	....	337	2	11	....
64	October	106	....	306	2	11	....
65	November	116	....	305	2	11	....
66	December	109	....	301	3	11	....
	Miscellaneous expenses:						
67	Total	$364,267	$7,798	$1,591,516	$164,281	$1,274,634	$8,975
68	Rent of works	$12,305	$5,300	$18,708	$41,529	$114,215	$720
69	Taxes, not including internal revenue	$16,317	$888	$43,935	$7,055	$71,444	$430
70	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$336,145	$1,610	$1,528,873	$115,697	$1,086,496	$7,025
71	Contract work	$500	....	....	....	$2,379	$800
	Materials used:						
72	Total cost	$39,108,187	$821,070	$63,048,186	$12,849,902	$50,523,186	$198,175
	Slaughtered—						
73	Beeves, number	346,827	12,396	531,032	29,080	378,833	1,700
74	Cost	$14,968,243	$572,530	$24,533,887	$1,552,980	$21,492 495	$65,000
75	Sheep, number	252,015	23,092	723,520	380,406	1,487,157	900
76	Cost	$1,031,346	$91,063	$3,076,671	$1,585,683	$5,976,166	$3,400
77	Hogs, number	1,857,953	8,401	2,733,304	931,694	1,701,096	12,600
78	Cost	$19,076,986	$34,943	$27,846,114	$6,408,984	$12,566,633	$121,400
79	Calves, number	22,825	3,396	8,454	63,037	277,016	400
80	Cost	$163,931	$50,490	$121,878	$570,599	$2,203,940	$4,000
81	All other animals, cost	$11,726	$4,525	$56,674	$12,173	$3,600	....
82	Dressed meat, purchased fresh or partly cured, cost	$1,848,384	$25,000	$4,426,618	$2,266,069	$5,395,265	....
83	Fuel	$159,299	$2,450	$355,209	$24,587	$154,168	$875
84	Rent of power and heat	$60	....	....	$3,895	$2,002	....
85	Mill supplies	$20,507	$100	$18,222	$3,432	$32,374	$200
86	All other materials	$1,729,859	$6,820	$2,428,477	$136,854	$1,861,426	$3,000
87	Freight	$98,797	$33,149	$184,436	$284,656	$836,118	$300

PACKING, BY STATES AND TERRITORIES: 1900—Continued.

Ohio.	Oregon.	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Utah.	Virginia.	Washington.	West Virginia.	Wisconsin.	All other states and territories.[1]	
71	9	111	7	8	12	8	4	18	3	13	14	1
26	2	66	1	2	1	3	1	3	1	3	3	2
28	3	44	4	2	3	5	2	7	1	6	5	3
17	4	11	2	4	8	...	1	8	1	4	6	4
$5,355,626	$760,448	$6,548,577	$769,860	$651,740	$1,232,267	$117,027	$159,500	$1,014,086	$313,000	$3,811,616	$216,671	5
$296,840	$189,021	$764,863	$16,800	$45,300	$53,871	$26,969	$34,000	$50,200	$22,000	$269,082	$16,750	6
$720,621	$238,500	$1,441,202	$22,400	$119,589	$244,329	$16,000	$23,000	$141,400	$55,000	$531,652	$40,603	7
$504,781	$115,356	$728,684	$35,700	$129,227	$222,952	$15,297	$22,000	$131,242	$33,000	$426,430	$57,272	8
$3,833,384	$217,571	$3,613,828	$684,950	$357,624	$711,115	$58,761	$80,500	$691,244	$203,000	$2,684,452	$108,046	9
90	9	158	10	5	6	14	6	18	3	19	12	10
313	41	376	16	15	49	6	19	88	16	123	16	11
$266,001	$47,130	$317,153	$17,636	$17,365	$81,797	$2,472	$14,340	$81,116	$11,800	$145,333	$10,270	12
47	9	9	5	9	10	...	3	3	5	10	4	13
$71,926	$16,400	$19,200	$8,000	$12,500	$20,800	...	$4,940	$6,120	$6,000	$35,000	$4,500	14
266	32	367	11	6	39	6	16	86	11	113	11	15
$194,075	$30,730	$297,953	$9,636	$4,865	$40,997	$2,472	$9,400	$74,996	$5,800	$110,333	$5,770	16
249	30	348	11	6	38	5	16	80	11	106	11	17
$187,189	$29,930	$290,973	$9,636	$4,865	$40,457	$2,172	$9,400	$72,566	$5,800	$106,235	$5,770	18
17	2	19	...	...	1	1	...	5	...	7	...	19
$6,886	$800	$6,980	...	...	$540	$300	...	$2,430	...	$4,098	...	20
2,029	219	7,754	221	349	535	52	80	281	92	1,678	224	21
1,613	145	1,530	191	109	345	42	63	214	75	1,125	165	22
1,765	172	1,669	209	156	414	42	65	231	84	1,367	137	23
$811,398	$87,821	$920,190	$107,104	$60,945	$179,605	$18,653	$28,884	$156,531	$42,646	$563,208	$59,426	24
1,717	166	1,646	206	152	394	42	65	229	76	1,365	131	25
$798,514	$86,441	$914,467	$106,268	$60,775	$173,438	$18,653	$28,884	$155,631	$40,642	$562,833	$58,118	26
29	1	13	...	4	19	...	...	2	6	2	...	27
$8,656	$480	$3,895	...	$170	$5,867	...	...	$900	$1,620	$375	...	28
19	5	10	3	...	1	...	...	...	2	...	6	29
$4,228	$900	$1,828	$836	...	$200	...	...	...	$384	...	$1,308	30
1,861	166	1,681	196	197	457	40	80	238	83	1,558	132	31
1,799	166	1,669	198	180	483	39	75	236	73	1,413	123	32
1,717	150	1,657	201	139	473	39	65	241	73	1,345	124	33
1,654	136	1,600	204	118	447	46	65	233	69	1,274	114	34
1,694	136	1,604	206	122	408	46	57	253	77	1,277	108	35
1,649	156	1,578	203	122	349	42	57	229	77	1,311	102	36
1,618	185	1,580	205	137	341	41	58	216	77	1,293	178	37
1,679	185	1,618	209	76	326	42	55	218	77	1,178	176	38
1,647	162	1,653	209	90	352	40	55	220	69	1,182	129	39
1,669	172	1,672	214	115	357	40	60	219	74	1,345	124	40
1,811	191	1,691	210	247	370	38	74	225	84	1,551	120	41
1,901	187	1,755	209	278	366	45	85	223	84	1,660	134	42
29	1	12	...	...	22	...	...	2	6	1	...	43
29	1	11	...	...	21	...	...	2	6	1	...	44
29	1	12	...	...	23	...	...	2	6	1	...	45
29	1	12	...	...	19	...	...	2	6	2	...	46
29	1	16	...	...	18	...	...	2	6	2	...	47
29	1	17	...	...	17	...	...	2	6	2	...	48
29	1	15	...	...	17	...	...	2	6	2	...	49
29	1	16	...	...	17	...	...	2	6	2	...	50
29	1	17	...	...	18	...	...	2	6	2	...	51
29	1	11	...	3	14	...	...	2	6	1	...	62
24	1	12	...	23	19	...	...	2	6	1	...	53
29	1	12	...	26	24	...	...	2	6	1	...	54
24	5	10	3	...	1	...	...	...	2	...	7	55
24	5	10	3	...	...	...	...	...	2	...	7	56
20	5	9	3	...	...	...	...	...	2	...	7	67
16	6	10	3	...	2	...	...	...	2	...	4	58
16	5	10	3	...	1	...	...	...	2	...	4	69
19	6	9	3	...	1	...	...	...	2	...	4	60
19	5	10	3	...	1	...	...	...	2	...	7	61
16	6	10	3	...	2	...	...	...	2	...	5	62
16	5	9	4	...	2	...	...	...	2	...	7	63
16	5	9	4	...	1	...	...	...	2	...	7	64
24	5	10	4	...	...	...	...	...	2	...	7	66
24	5	10	4	...	...	...	...	...	2	...	7	66
$639,008	$35,768	$526,972	$44,736	$26,268	$66,749	$5,940	$3,988	$80,008	$4,623	$408,991	$12,779	67
$26,900	$3,026	$131,365	$10,373	$347	$5,120	$1,950	$800	$10,423	...	$21,902	$1,711	68
$25,192	$4,754	$29,401	$1,014	$1,513	$5,070	$811	$1,088	$4,284	$1,675	$10,197	$1,378	69
$586,916	$27,988	$363,921	$33,349	$23,258	$56,559	$3,179	$2,100	$65,301	$3,048	$376,892	$9,690	70
...	...	$2,285	...	$160	...	...	...	...	...	...	...	71
$17,927,953	$1,359,361	$21,601,810	$2,246,780	$1,453,128	$3,170,536	$385,353	$637,730	$4,252,435	$1,133,954	$11,889,624	$1,183,352	72
98,636	14,461	130,073	1,000	8,988	24,376	6,920	4,800	39,869	4,670	46,499	27,225	73
$3,629,833	$549,650	$6,497,257	$35,000	$243,015	$599,514	$230,040	$111,000	$1,713,165	$200,200	$1,751,321	$701,314	74
70,739	47,819	231,556	...	4,200	6,649	12,809	6,050	132,756	2,560	36,787	14,912	75
$224,559	$158,520	$971,583	...	$12,700	$18,311	$48,134	$21,150	$459,307	$8,460	$140,925	$44,465	76
1,283,597	21,862	881,821	133,200	115,672	208,270	2,370	37,000	72,149	79,120	947,614	35,726	77
$11,189,787	$213,040	$6,977,465	$1,469,300	$1,060,324	$1,886,067	$21,673	$298,200	$782,828	$785,010	$8,630,609	$336,332	78
31,971	1,661	51,610	400	1,900	7,544	1,166	6,300	7,271	760	21,973	2,047	79
$247,280	$12,470	$445,811	$2,800	$10,900	$60,205	$10,194	$36,500	$75,569	$4,404	$140,548	$16,235	80
$900	$10,364	$87,663	...	$50	$21	...	...	$7,283	...	$14,467	$1,300	81
$1,143,022	$294,621	$5,518,048	$559,300	$73,757	$178,738	$59,099	$130,000	$861,168	$117,950	$161,402	$29,500	82
$87,709	$12,639	$86,801	$9,825	$14,146	$53,858	$1,090	$2,210	$12,625	$4,200	$54,225	$15,290	83
$621	$409	$5,550	...	...	$100	$720	...	$276	...	$54	...	84
$15,135	$1,259	$13,225	$1,420	$925	$3,330	$113	$220	$2,295	$530	$8,645	$2,151	85
$1,132,956	$9,691	$504,794	$90,635	$32,865	$355,944	$14,040	$23,050	$39,295	$13,200	$607,458	$18,275	86
$256,151	$96,698	$493,613	$88,500	$4,447	$14,448	$250	$15,400	$298,634	...	$384,870	$18,500	87

[1] Includes establishments distributed as follows: Alabama, 2; Arkansas, 2; New Hampshire, 1; North Carolina, 1; New Mexico, 2; Oklahoma, 2; South Dakota, 1; South Carolina, 1; Wyoming, 2.

TABLE 12.—COMBINED SLAUGHTERING AND MEAT

		Missouri.	Montana.	Nebraska.	New Jersey.	New York.	North Dakota.
	Products:						
88	Total value	$43,040,885	$934,640	$71,280,366	$14,046,217	$57,431,293	$256,160
	Beef—						
89	Sold fresh, pounds	165,944,314	7,406,667	307,786,549	18,794,370	252,508,996	1,055,000
90	Value	$11,993,514	$557,785	$22,627,020	$1,510,941	$20,045,478	$62,625
91	Canned, pounds	2,220,000	...	10,156,391	...	677,980	...
92	Value	$140,000	...	$564,854	...	$42,430	...
93	Salted or cured, pounds	17,978,683	...	11,945,633	245,600	10,659,190	...
94	Value	$1,076,431	...	$773,966	$32,540	$796,594	...
95	Mutton, sold fresh, pounds	10,238,198	1,142,048	32,991,157	17,021,273	61,858,172	43,500
96	Value	$782,605	$100,395	$2,698,184	$1,343,451	$5,163,001	$3,915
97	Veal, sold fresh, pounds	1,728,989	659,954	1,832,589	5,387,285	25,179,357	51,000
98	Value	$178,041	$60,302	$145,809	$593,610	$2,404,942	$4,590
	Pork—						
99	Sold fresh, pounds	106,701,224	1,128,716	84,632,189	76,518,271	107,996,721	380,000
100	Value	$6,848,627	$80,891	$5,618,922	$5,068,390	$7,340,461	$24,400
101	Salted, pounds	93,266,664	60,000	201,807,678	7,776,468	25,933,082	100,000
102	Value	$4,869,923	$3,500	$11,958,021	$522,538	$1,689,003	$9,000
103	Hams, pounds	33,844,254	100,000	66,273,113	15,008,818	44,534,108	400,000
104	Value	$2,986,608	$10,000	$6,321,300	$1,463,123	$4,354,499	$42,250
105	Smoked bacon, sides, and shoulders, pounds	52,392,149	150,000	78,409,619	18,868,525	51,749,929	400,000
106	Value	$3,810,491	$13,600	$5,894,728	$1,557,289	$3,830,833	$39,650
107	Sausage, fresh or cured, pounds	10,525,213	50,000	21,323,639	6,282,944	15,906,163	166,000
108	Value	$608,389	$3,000	$1,483,558	$462,783	$1,223,422	$11,500
109	All other meat, sold fresh, pounds	...	59,030	...	...	615,500	...
110	Value	...	$5,903	...	...	$61,430	...
111	Refined lard, pounds	40,879,889	50,000	79,188,586	10,217,992	28,424,802	135,000
112	Value	$2,337,329	$3,000	$4,889,182	$624,929	$1,860,723	$8,250
113	Neutral lard, pounds	11,425,517	...	15,612,418	1,450,833	3,097,900	...
114	Value	$610,124	...	$986,368	$87,050	$183,346	...
115	Oleomargarine oil, gallons	1,434,787	...	2,302,914	...	1,660,999	...
116	Value	$857,419	...	$1,382,115	...	$954,064	...
117	Other oils, gallons	357,529	...	419,004	...	169,215	...
118	Value	$158,736	...	$128,998	...	$75,875	...
119	Fertilizers, tons	18,695	...	15,414	2,599	5,605	...
120	Value	$347,309	...	$251,258	$61,207	$104,532	...
121	Hides, number	369,652	15,675	528,256	72,773	590,824	2,100
122	Pounds	19,907,122	734,350	31,446,074	2,395,855	26,522,241	127,800
123	Value	$2,166,640	$65,216	$2,927,334	$205,278	$2,475,993	$11,770
124	Wool, pounds	...	...	...	209,000	2,625,676	...
125	Value	...	...	...	$66,700	$787,269	...
126	All other products, value	$3,268,699	$31,148	$2,628,449	$443,680	$4,017,429	$37,210
127	Custom work, value	...	...	$300	$2,708	$19,969	$1,000
	Weight of animals slaughtered:						
	Beeves—						
128	Gross weight, on hoof, pounds	344,967,509	13,491,800	595,799,734	32,958,500	454,610,406	1,965,000
129	Net weight, dressed, pounds	187,003,877	7,424,061	335,239,742	18,794,370	256,806,333	1,055,000
	Sheep—						
130	Gross weight, on hoof, pounds	20,128,958	2,111,660	65,439,617	31,580,539	118,315,491	81,000
131	Net weight, dressed, pounds	10,233,772	1,146,361	31,589,511	16,023,060	62,420,947	43,500
	Hogs—						
132	Gross weight, on hoof, pounds	424,200,473	1,438,345	688,752,252	137,389,968	293,470,401	3,100,000
133	Net weight, dressed, pounds	341,621,166	1,081,281	521,808,890	105,693,132	232,766,404	2,395,000
	Calves—						
134	Gross weight, on hoof, pounds	2,754,732	958,750	2,320,237	6,839,130	36,359,275	66,000
135	Net weight, dressed, pounds	1,635,618	658,981	1,701,349	4,487,817	25,286,369	51,000
	Comparison of products:						
136	Number of establishments reporting for both years	28	...	8	33	94	3
137	Value for census year	$39,340,555	...	$60,590,054	$12,972,596	$49,417,751	$256,160
138	Value for preceding business year	$33,427,844	...	$50,684,334	$12,917.463	$45,157,316	$238,612
	Power:						
139	Number of establishments reporting	31	2	9	26	61	2
140	Total horsepower	6,386	55	8,411	940	4,147	26
	Owned—						
	Engines—						
141	Steam, number	55	2	41	29	107	2
142	Horsepower	5,136	55	7,192	783	3,827	26
143	Gas or gasoline, number	...	...	...	...	2	...
144	Horsepower	...	...	...	...	39	...
145	Water wheels, number	...	...	...	...	...	...
146	Horsepower	...	...	...	...	...	...
147	Electric motors, number	131	...	49	...	11	...
148	Horsepower	1,245	...	1,219	...	250	...
149	Other power, number	...	...	...	...	...	...
150	Horsepower	...	...	...	...	...	...
	Rented—						
151	Electric, horsepower	5	...	...	28	30	...
152	Other kind, horsepower	...	...	...	129	1	...
163	Furnished to other establishments, horsepower	...	...	...	...	25	...
	Establishments classified by number of persons employed, not including proprietors and firm members:						
154	Total number of establishments	37	5	12	41	110	3
155	No employees	...	...	...	...	...	...
156	Under 5	6	1	5	9	24	1
157	5 to 20	17	3	...	19	49	1
158	21 to 50	6	1	1	10	17	1
159	51 to 100	2	...	...	3	13	...
160	101 to 250	2	...	1	...	1	...
161	251 to 500	2	...	...	...	3	...
162	501 to 1,000	1	...	2	...	3	...
163	Over 1,000	1	...	3	...	...	...

PACKING, BY STATES AND TERRITORIES: 1900—Continued.

Ohio.	Oregon.	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Utah.	Virginia.	Washington.	West Virginia.	Wisconsin.	All other states and territories.[1]	
$20,660,780	$1,638,480	$25,238,772	$2,503,466	$1,671,218	$3,904,491	$453,456	$748,620	$4,892,857	$1,337,578	$13,649,750	$1,374,953	88
43,652,450	7,583,840	84,181,747	500,000	3,681,960	10,795,352	3,670,450	1,785,000	21,418,889	2,540,000	24,282,329	10,348,100	89
$3,116,193	$552,507	$7,069,719	$33,600	$255,587	$588,996	$244,269	$106,300	$1,611,064	$186,700	$1,622,676	$734,170	90
1,200,000	....	42,400	....	....	....	....	....	....	....	52,186	....	91
$78,500	....	$4,240	....	....	....	....	....	....	....	$5,445	....	92
4,692,000	502,500	2,515,208	....	14,400	2,000	144,210	5,000	1,921,250	....	851,296	8,500	93
$240,740	$38,175	$191,168	....	$720	$300	$11,409	$250	$139,825	....	$59,317	$560	94
2,277,155	2,300,600	9,604,293	....	217,000	266,414	696,830	303,000	6,298,881	88,500	1,564,703	670,667	95
$212,592	$164,780	$979,064	....	$14,000	$22,040	$48,594	$27,210	$479,529	$7,965	$129,923	$49,966	96
2,464,318	198,410	4,371,144	24,000	217,500	973,612	259,040	418,000	936,150	48,100	1,806,512	234,939	97
$234,817	$18,210	$465,386	$1,680	$11,850	$67,542	$25,917	$36,720	$82,930	$4,173	$157,079	$16,753	98
46,226,099	781,520	45,896,941	10,352,400	2,535,511	5,133,863	499,034	918,000	6,887,071	2,368,500	24,797,944	2,358,600	99
$3,354,714	$62,897	$3,488,370	$699,970	$158,931	$333,958	$33,835	$69,520	$612,120	$166,195	$1,463,007	$181,107	100
23,135,649	1,467,400	12,184,548	7,434,000	7,531,817	5,806,344	34,800	2,783,000	646,400	530,000	73,557,159	450,500	101
$1,589,237	$102,322	$898,910	$439,660	$525,719	$396,894	$2,821	$195,810	$55,440	$37,100	$4,337,065	$37,810	102
38,046,139	1,501,564	44,629,801	4,628,350	2,981,400	5,289,601	35,280	1,044,560	6,412,300	5,122,400	25,775,477	756,901	103
$3,538,830	$162,564	$4,207,412	$419,027	$280,816	$481,106	$4,385	$101,460	$714,883	$511,616	$2,228,503	$77,000	104
53,168,262	2,094,147	36,610,835	5,637,075	2,813,853	11,849,398	176,500	1,150,000	5,229,400	3,651,600	9,448,637	1,003,056	105
$4,173,926	$190,720	$2,800,348	$360,105	$198,096	$833,340	$15,259	$97,000	$497,665	$256,812	$675,487	$87,100	106
14,397,065	404,891	15,412,150	2,183,700	281,500	2,085,953	154,709	330,000	973,905	427,000	7,630,689	424,450	107
$1,026,540	$33,265	$1,233,816	$158,048	$16,243	$123,939	$12,805	$25,000	$76,451	$24,870	$554,324	$33,260	108
242,080	46,000	1,634,720	374,500	17,000	539,400	32,375	....	30,000	100,000	200,983	91,000	109
$21,408	$5,400	$128,603	$26,215	$800	$30,580	$4,775	....	$2,552	$5,000	$18,467	$5,688	110
29,535,529	1,018,732	26,805,932	3,936,200	1,804,200	4,334,111	60,504	910,000	1,657,000	1,846,000	19,260,924	570,000	111
$1,894,541	$95,752	$1,733,624	$245,625	$105,801	$282,661	$5,290	$59,100	$155,355	$110,900	$1,073,302	$42,100	112
2,863,300	2,500	5,340	....	636,900	2,141,216	....	43,340	25,000	....	2,690,051	13,333	113
$210,850	$150	$200	....	$44,572	$133,993	....	$2,600	$1,500	....	$152,544	$800	114
76,000	....	494,372	....	....	....	....	....	....	....	48,322	....	115
$38,000	....	$244,687	....	....	....	....	....	....	....	$24,048	....	116
....	3,085	16,933	....	....	976,840	....	....	4,200	....	3,931	22,750	117
....	$1,446	$5,500	....	....	$195,548	....	....	$2,480	....	$1,651	$7,300	118
4,006	327	3,108	300	380	553	....	300	3,780	200	3,237	160	119
$58,646	$5,615	$88,099	$4,500	$5,785	$6,424	....	$3,000	$92,400	$3,000	$48,324	$2,050	120
130,595	19,983	181,533	1,400	12,518	31,908	8,086	11,100	47,140	5,430	68,472	19,892	121
5,728,737	861,140	8,203,766	65,000	467,400	1,379,101	355,400	284,000	2,510,962	248,400	2,892,705	838,220	122
$514,759	$79,301	$725,637	$4,550	$36,803	$118,067	$32,790	$18,412	$232,968	$22,032	$299,905	$63,427	123
....	200,000	33,400	....	....	....	....	....	5,000	....	553	....	124
....	$40,000	$7,600	....	....	....	....	....	$700	....	$110	....	125
$354,987	$85,376	$964,814	$110,486	$15,495	$289,103	$11,307	$6,238	$132,995	$1,215	$798,423	$31,101	126
$1,500	....	$10,575	....	....	....	....	....	$2,000	....	$150	$4,761	127
91,545,994	15,089,880	145,774,881	1,000,000	7,308,000	21,258,700	7,081,450	3,760,000	45,111,700	4,670,000	45,006,397	20,415,000	128
49,942,925	8,002,690	82,466,657	500,000	3,696,360	10,670,800	3,798,225	1,790,000	24,240,640	2,540,000	25,130,728	10,857,000	129
4,564,862	4,673,340	18,392,144	....	420,000	555,995	1,273,290	605,000	13,130,595	164,000	3,141,084	1,348,520	130
2,372,155	2,327,550	9,188,267	....	217,000	288,554	680,766	303,000	6,374,671	88,500	1,586,895	672,020	131
259,277,309	4,823,560	152,253,593	33,300,000	22,699,650	41,569,304	643,160	6,440,000	14,757,380	17,339,000	218,728,230	6,790,544	132
204,072,350	3,830,992	120,725,044	27,212,000	17,419,640	32,959,805	423,750	5,188,000	12,003,909	13,834,000	175,778,422	5,204,533	133
4,310,650	297,854	6,987,046	48,000	360,000	1,697,621	164,724	330,000	1,303,820	77,300	2,473,520	373,050	134
1,572,916	198,410	4,197,992	24,000	217,500	987,234	116,360	418,000	914,822	48,100	1,844,004	240,125	135
58	7	93	7	5	5	6	3	12	2	10	9	136
$19,200,447	$852,453	$23,168,503	$2,503,466	$1,423,838	$2,163,097	$377,133	$436,620	$4,049,557	$1,294,263	$13,563,520	$697,998	137
$17,610,819	$749,963	$21,024,890	$2,313,878	$1,130,553	$1,846,478	$346,712	$395,380	$3,321,256	$1,246,905	$14,792,474	$584,293	138
61	7	67	6	4	12	7	2	10	3	11	9	139
3,418	299	4,605	273	560	1,795	69	185	474	376	2,071	619	140
96	9	106	10	5	22	6	5	52	9	27	15	141
3,262	267	4,188	273	550	1,589	54	185	432	329	2,041	619	142
....	....	3	....	....	3	....	....	....	2	....	....	143
....	....	34	....	....	49	....	....	....	27	....	....	144
....	....	....	....	....	....	....	....	....	....	....	....	145
....	....	....	....	....	....	....	....	....	....	....	....	146
9	2	11	....	1	7	....	....	....	2	1	....	147
128	30	198	....	10	155	....	....	....	20	25	....	148
....	....	....	....	....	....	....	....	....	....	....	....	149
....	....	....	....	....	....	....	....	....	....	....	....	150
28	2	25	....	....	2	15	....	42	....	5	....	151
....	....	160	....	....	....	....	....	....	....	....	....	152
....	....	....	....	....	....	....	....	....	....	....	....	153
71	9	111	7	8	12	8	4	18	3	13	14	154
....	....	....	....	....	....	....	....	....	....	....	....	155
20	....	40	1	....	2	3	....	2	1	2	5	156
27	5	39	3	4	4	4	1	9	1	3	7	157
14	3	22	1	2	2	1	3	6	....	2	1	158
6	....	8	2	1	1	....	....	1	1	2	1	159
3	1	1	....	1	3	....	....	....	....	2	....	160
....	....	1	....	....	....	....	....	....	....	1	....	161
1	....	....	....	....	....	....	....	....	....	1	....	162
....	....	....	....	....	....	....	....	....	....	....	....	163

[1] Includes establishments distributed as follows: Alabama, 2; Arkansas, 2; New Hampshire, 1; North Carolina, 1; New Mexico, 2; Oklahoma, 2; South Dakota, 1; South Carolina, 1; Wyoming, 2.

O

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 218. WASHINGTON, D. C. July 1, 1902.

AGRICULTURE.

WISCONSIN.

Hon. William R. Merriam,
Director of the Census.

Sir: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Wisconsin, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Wisconsin June 1, 1900, numbered 169,795 and were valued at $686,147,660. Of this amount, $155,604,970, or 22.7 per cent, represents the value of buildings, and $530,542,690, or 77.3 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $29,237,010, and of live stock $96,327,649. These values, added to that of farms, give $811,712,319, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $157,445,713, of which amount $69,303,364, or 44.0 per cent, represents the value of animal products, and $88,142,349, or 56.0 per cent, the value of crops, including forest products cut or produced on farms. The "total value of farm products" for 1899 exceeds that for 1889 by $86,455,068, or a gain of 121.8 per cent, but a part of this increase is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $41,583,750, leaving $115,861,963 as the gross farm income for that year. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Wisconsin, in 1899, it was 14.3 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Wisconsin.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN WISCONSIN.

GENERAL STATISTICS.

Wisconsin has a total land area of 54,450 square miles, or 34,848,000 acres, of which 19,862,727 acres, or 57.0 per cent, are included in farms.

The general surface is that of a swell of land between three notable depressions, Lake Michigan, Lake Superior, and the Mississippi River. The summit of the swell lies about 30 miles from Lake Superior and from this point there is a rapid descent northward. To the southeast and southwest there are gentler declines separated by a low swell extending southward into Illinois.

The soils of the state are varied. In the northern and western parts there is a sandy loam or loamy clay, permanent and fertile. In the southwest the decomposition of underlying limestone forms a soil highly fertile and easily tilled. From considerable deposits of Potsdam sandstone in the central portion, a soil of relatively low fertility is derived.

NUMBER AND SIZE OF FARMS.

Table 1 gives, by decades since 1850, the number of farms, the total and average acreage, and the percentage of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	169,795	19,862,727	11,246,972	8,615,755	117.0	56.6
1890	146,409	16,787,988	9,793,931	6,994,057	114.7	58.3
1880	134,322	15,353,118	9,162,528	6,190,590	114.3	59.7
1870	102,904	11,715,321	5,899,343	5,815,978	113.8	50.4
1860	69,270	7,893,587	3,746,167	4,147,420	113.9	47.5
1850	20,177	2,976,658	1,045,499	1,931,159	147.5	35.1

The number of farms reported June 1, 1900, was more than eight times as great as the number reported in 1850, and 16.0 per cent greater than in 1890. The total acreage in farm land is nearly seven times as great as fifty years ago. Owing to the fact that from 1850 to 1870 the number of farms increased more rapidly than the total farm area, the average size of farms decreased; since 1870 there has been a slight increase. The percentage of farm land improved, which previous to 1880 reported a steady gain, has decreased since that date, but the loss between 1890 and 1900 is doubtless the result of the use of a more strict definition of the term "improved land" by the Twelfth than by any preceding census.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$811,712,319	$686,147,660	$29,237,010	$96,327,649	$157,445,713
1890	560,475,894	477,524,507	19,167,010	63,784,377	70,990,645
1880	419,865,346	357,709,507	15,647,196	46,508,643	72,779,496
1870[2]	359,964,310	300,414,064	14,239,364	45,310,882	[3]78,027,032
1860	154,683,386	131,117,164	5,758,847	17,807,375	....
1850	35,067,516	28,528,563	1,641,568	4,897,385	....

[1] For the year preceding that designated.
[2] Values for 1870 were reported in depreciated currency; to reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

Since 1850 the total value of farm property has increased $776,644,803, and in the last ten years $251,236,425, or 44.8 per cent. The increase in the value of land, improvements, and buildings, in the last decade, was $208,623,153, or 43.7 per cent; in that of implements and machinery, $10,070,000, or 52.5 per cent; in that of live stock, $32,543,272, or 51.0 per cent. The value of farm products for 1899 exceeds that reported for 1889 by $86,455,068, or 121.8 per cent. Part of this increase, and of that in implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous census years.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	169,795	166,323	19,862,727	11,246,972	$530,542,690	$155,604,970	$29,237,010	$96,327,649	$115,861,963	$10,468,610	$294,320
Adams	1,842	1,798	303,585	125,064	2,425,910	896,890	232,330	658,877	882,956	50,180	300
Ashland	489	487	66,187	13,611	561,030	243,400	55,480	170,990	241,203	16,970	690
Barron	3,004	2,934	320,659	117,407	3,938,960	1,165,030	317,920	952,153	1,056,386	65,460	4,620
Bayfield	465	457	51,827	8,022	328,030	148,810	31,400	107,338	123,070	12,060	120
Brown	3,660	3,677	285,074	175,096	8,313,700	2,984,120	653,960	1,480,198	1,693,003	99,840	12,370
Buffalo	2,242	2,204	408,938	190,607	6,143,840	1,755,390	452,700	1,640,637	1,700,043	150,970	9,820
Burnett	1,198	1,197	165,149	32,626	842,140	391,460	99,240	337,363	349,366	49,080	340
Calumet	2,233	2,207	199,918	142,061	8,779,930	2,664,240	600,020	1,280,848	1,663,588	118,870	13,030
Chippewa	3,050	3,018	382,714	177,658	4,808,440	1,714,930	437,800	1,266,517	1,352,134	99,240	1,650
Clark	3,456	3,355	325,755	120,964	6,376,800	2,011,460	479,300	1,463,104	1,304,210	68,870	1,510
Columbia	3,439	3,313	475,124	314,329	14,323,860	3,586,190	648,120	2,504,755	2,842,733	270,740	6,990
Crawford	2,104	1,995	332,476	142,983	4,115,810	1,200,570	306,210	1,186,040	1,257,924	67,000	1,350
Dane	6,346	6,161	741,654	552,028	30,555,380	8,314,450	1,183,360	5,040,715	7,058,339	701,680	25,520
Dodge	4,994	4,902	534,049	415,926	29,414,140	7,110,620	1,065,660	3,694,765	6,007,178	635,980	8,380
Door	2,209	2,163	225,830	109,666	3,584,180	1,344,390	273,930	825,145	1,014,125	65,840	5,590
Douglas	257	254	29,111	5,234	482,070	128,090	23,470	88,569	106,785	7,220	20
Dunn	3,221	3,116	431,078	218,067	5,255,710	1,726,950	417,200	1,348,143	1,435,604	110,010	3,510
Eau Claire	2,066	2,031	279,839	167,618	4,219,710	1,406,160	320,190	993,394	1,202,655	139,180	5,940
Florence	191	187	19,749	4,312	166,790	62,850	21,470	52,896	94,292	20,620	....
Fond du Lac	4,326	4,255	448,561	346,171	21,467,670	5,840,420	937,410	3,028,629	4,022,893	337,410	6,180
Forest	59	49	6,594	1,573	70,710	18,090	7,570	16,985	16,908	3,210	20
Grant	4,219	4,142	687,675	411,077	17,697,640	3,846,270	780,530	3,980,832	3,996,123	280,140	15,200
Green	2,640	2,507	365,333	286,029	13,774,380	3,463,380	578,020	2,954,394	3,038,579	252,790	11,480
Green Lake	1,753	1,732	214,012	146,426	7,198,260	1,814,960	357,920	1,101,084	1,406,458	127,810	820
Iowa	2,547	2,491	468,768	268,334	11,213,730	2,306,030	471,120	2,834,101	2,557,961	186,380	2,040
Iron	83	76	10,795	2,320	91,020	30,100	8,510	30,539	39,104	6,860	120
Jackson	2,468	2,416	387,846	170,344	4,097,240	1,591,030	359,700	1,151,426	1,261,086	125,120	2,320
Jefferson	3,453	3,378	337,431	232,748	16,980,330	4,999,680	807,950	2,633,986	3,454,289	285,[illegible]00	7,090
Juneau	2,694	2,602	356,327	158,408	6,198,470	1,774,670	356,620	1,048,629	1,218,539	86,760	3,240
Kenosha	1,298	1,292	166,504	124,070	7,608,620	1,980,190	333,400	1,245,165	1,466,748	225,630	110
Kewaunee	2,193	2,158	205,624	136,282	4,655,440	1,748,870	380,020	977,876	1,119,539	47,410	3,900
La Crosse	1,912	1,877	280,105	156,472	5,780,900	1,945,460	364,650	1,207,814	1,521,423	170,310	6,680
Lafayette	2,501	2,407	389,060	287,735	13,717,920	2,815,050	487,820	2,994,761	2,876,785	216,790	2,710
Langlade	1,035	1,017	96,929	31,168	1,313,530	450,770	138,090	372,654	379,249	20,800	80
Lincoln	924	876	98,933	23,317	1,045,640	334,670	91,810	252,311	398,298	17,200	660
Manitowoc	4,073	4,024	363,133	249,691	12,805,060	4,736,560	788,410	1,945,056	2,622,107	270,050	11,540
Marathon	4,276	4,207	442,878	145,060	6,328,210	2,253,170	497,820	1,609,238	1,713,544	191,400	10,120
Marinette	1,300	1,260	126,241	47,126	1,682,910	597,490	169,840	399,856	441,507	42,880	1,300
Marquette	1,523	1,521	269,563	127,245	3,163,960	1,100,340	295,340	829,702	958,311	68,150	940
Milwaukee	2,576	2,545	125,404	100,989	22,612,650	4,039,350	593,990	1,127,632	2,220,260	263,790	11,900
Monroe	3,730	3,621	489,790	221,533	7,199,110	2,473,670	551,040	1,634,346	2,027,417	182,330	1,230
Oconto	2,241	2,172	212,292	91,273	3,514,170	1,223,700	320,670	833,269	834,744	62,050	1,710
Oneida	350	340	41,282	7,778	294,390	94,770	37,910	79,558	105,539	20,490	100
Outagamie	3,479	3,374	319,669	198,670	10,460,030	3,650,820	685,820	1,914,392	2,239,639	185,670	1,530
Ozaukee	1,728	1,713	141,539	109,054	8,031,680	2,270,840	358,250	836,958	1,222,335	98,430	1,570
Pepin	1,054	1,028	136,363	68,811	1,964,800	677,060	152,780	460,356	612,518	45,640	1,100
Pierce	3,323	3,229	333,641	192,371	6,835,360	1,975,240	478,760	1,443,834	1,873,744	130,390	3,920
Polk	2,907	2,860	318,791	117,238	3,746,940	1,356,770	311,010	1,043,287	1,025,116	64,860	1,220
Portage	3,172	3,116	393,857	189,396	5,305,400	1,809,120	405,700	1,056,934	1,450,432	119,010	4,690
Price	885	872	84,236	13,118	615,810	283,910	66,500	181,585	253,333	26,310	....
Racine	2,118	2,093	200,387	159,366	10,608,840	3,112,430	479,390	1,370,280	1,879,190	199,270	8,800
Richland	2,726	2,674	359,435	187,064	6,616,700	1,726,990	388,280	1,840,163	1,783,445	120,300	2,830
Rock	3,829	3,762	438,388	357,632	20,072,690	5,847,700	868,960	3,184,963	4,353,215	414,030	6,460
Saint Croix	3,143	3,070	392,227	272,843	7,706,700	2,327,810	520,920	1,467,321	1,820,148	236,290	4,030
Sauk	3,886	3,836	494,835	280,064	10,268,170	3,424,300	626,440	2,421,134	2,725,361	219,630	6,620
Sawyer	159	150	19,536	4,871	155,550	57,000	18,640	59,943	59,104	7,000	120
Shawano	3,140	3,100	327,454	135,322	5,655,140	1,886,140	475,080	1,290,958	1,396,025	123,650	1,960
Sheboygan	3,572	3,543	307,600	225,569	14,056,110	4,783,250	739,110	2,178,431	3,058,622	269,010	5,560
Taylor	1,168	1,157	103,565	23,392	1,127,050	444,400	105,860	305,781	305,056	5,400	220
Trempealeau	3,138	3,085	457,904	253,343	7,199,050	2,359,690	660,110	1,804,169	1,876,069	184,130	11,450
Vernon	4,235	4,139	493,162	256,524	8,481,350	2,482,820	662,870	2,029,759	2,356,560	160,950	3,520
Vilas	83	76	18,171	2,170	91,020	26,110	7,990	20,281	19,696	3,420	....
Walworth	2,754	2,724	341,092	244,419	16,461,050	4,764,250	676,260	2,698,675	3,305,503	418,770	3,290
Washburn	449	441	67,518	13,039	379,590	145,150	44,750	132,821	140,211	12,390	140
Washington	2,873	2,851	266,731	185,101	13,617,770	4,085,250	662,280	1,695,003	2,310,976	172,060	4,650
Waukesha	3,549	3,503	332,087	241,428	18,045,620	5,859,250	882,820	2,234,253	3,070,991	374,400	3,480
Waupaca	3,662	3,590	389,789	195,122	7,387,340	2,916,460	566,630	1,609,825	1,816,641	148,520	5,320
Waushara	2,739	2,653	373,842	211,874	5,552,210	2,028,690	469,840	1,211,398	1,759,178	162,140	1,930
Winnebago	2,773	2,749	267,976	201,572	11,407,040	3,669,870	682,720	1,811,569	2,233,350	273,060	5,830
Wood	2,369	2,266	271,537	91,966	3,909,710	1,234,440	273,210	782,398	795,164	61,170	940
La Pointe[1]	4	4	790	150	5,400	2,400	190	2,042	828	100	....
Menominee and Stockbridge[1]	37	37	1,860	1,134	44,550	16,230	3,480	9,674	8,612	1,140	....
Oneida[1]	311	307	44,049	7,867	586,630	57,890	27,640	47,172	28,912	....	....

[1] Indian reservation.

The number of farms increased in the last decade in nearly all counties, Dodge, Kewaunee, Manitowoc, and Ozaukee, however, reporting slight decreases. Aside from the counties undergoing territorial changes, only one, Waukesha, shows a decreased area of farming land. Decreases in improved acreage are reported for a few counties in the southern part of the state, but this decrease is probably due to a more strict definition of the term "improved land" by the Twelfth than by any preceding census. The average size of farms for the state is 117.0 acres, and varies from 48.7 acres in Milwaukee county to 184.0 acres in Iowa county. The largest farms are, as a rule, in the western part of the state, in the counties devoted to cereal and stock raising, and the smallest in the eastern counties, where dairying and diversified farming prevail.

All counties, except one, show marked increases since 1890 in the total value of farms. Ozaukee county alone reports a decrease in the value of implements and machinery. The increase in the value of live stock was general, all counties reporting considerable gains.

FARM TENURE.

Table 4 gives a comparative exhibit of farm tenure for 1880, 1890, and 1900. Tenants are divided into two groups: "Cash tenants," who pay a rental in cash or a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

The farms operated by owners are subdivided in Table 5 into groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	169,795	146,799	10,249	12,747	86.5	6.0	7.5
1890	146,409	129,681	7,209	9,519	88.6	4.9	6.5
1880	134,322	122,163	3,719	8,440	90.9	2.8	6.3

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	169,795	136,820	7,733	855	1,391	10,249	12,747
White	169,275	136,335	7,723	852	1,391	10,243	12,731
Colored	520	485	10	3	....	6	16
Indian	462	447	5	1	....	2	7
Negro	58	38	5	2	....	4	9

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	80.6	4.6	0.5	0.8	6.0	7.5
White	100.0	80.5	4.6	0.5	0.8	6.1	7.5
Colored	100.0	93.3	1.9	0.6	....	1.1	3.1

In the period from 1880 to 1900 the total number of farms increased 26.4 per cent, and in the last decade, 23,386, or 16.0 per cent. Since 1890 the number of farms operated by owners has increased 13.2 per cent; by cash tenants, 42.2 per cent; and by share tenants, 33.9 per cent. The percentages in Table 4 show that the gain in the number of owners has been slower than that of tenants. The increase in the number of cash tenants and the change in the relative per cent of cash and share tenants is the result of a growing sentiment on the part of both landlord and tenant in favor of the cash payment system, and indicates greater independence and financial responsibility on the part of the tenant class as a whole.

In 1900, 99.7 per cent of the farms of the state were operated by white farmers and 0.3 per cent by colored farmers. Of the white farmers, 85.6 per cent own all or a part of the farm land they operate, and 14.4 per cent operate farms owned by others. The corresponding percentages for colored farmers are 95.8 and 4.2. Indians constitute 88.8 per cent of the colored farmers.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

The value of the farm property of colored farmers is $1,050,505. Of this amount $132,458 represents the farm property of negroes, and $918,047 that of Indian farmers.

Farms conducted by owners have the smallest average area, 111.8 acres, and those of managers, the largest, 238.2 acres. Some of the latter are adjuncts of public institutions, while others are conducted for

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	169,795	117.0	19,862,727	100.0	$811,712,319	100.0
White farmers	169,275	117.0	19,805,094	99.7	810,661,814	99.9
Negro farmers	58	94.7	5,495	(1)	132,458	(1)
Indian farmers	462	112.9	52,138	0.3	918,047	0.1
Owners	136,820	111.8	15,301,493	77.0	591,219,656	72.8
Part owners	7,733	154.5	1,194,945	6.0	50,343,665	6.2
Owners and tenants	855	137.7	117,743	0.6	5,208,098	0.7
Managers	1,391	238.2	331,343	1.7	16,302,762	2.0
Cash tenants	10,249	113.5	1,163,217	5.9	67,154,404	8.3
Share tenants	12,747	137.6	1,753,986	8.8	81,483,734	10.0

1 Less than one-tenth of 1 per cent.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$3,125	$917	$172	$567	$682	14.3
White farmers	3,130	919	172	568	684	14.3
Negro farmers	1,557	334	77	316	352	15.4
Indian farmers	1,515	214	81	177	114	5.7
Owners	2,750	874	165	532	631	14.6
Part owners	4,473	1,110	222	705	913	14.0
Owners and tenants	3,858	1,274	204	765	938	15.4
Managers	7,956	2,275	341	1,148	1,177	10.0
Cash tenants	4,644	1,032	188	688	846	12.9
Share tenants	4,526	988	187	691	886	13.9

wealthy individuals in connection with their summer homes. These farms, as a rule, are favorably located and highly improved, and the average values of the various forms of farm property, shown in Table 7, are much larger for this class than for any other class of farms grouped by tenure. The ratio which the gross income of these farms bears to the total value of farm property, however, is smaller than for the other groups. This is due to the high average valuation of the land and buildings, and to the fact that many of these farms are not cultivated primarily for profit.

The high percentage of gross income shown for negro farmers is due to the small size and consequent intensive cultivation of their farms, and to the low average value of farm property or capital invested.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	169,795	117.0	19,862,727	100.0	$811,712,319	100.0
Under 3 acres	948	1.7	1,605	(1)	1,538,576	0.2
3 to 9 acres	4,264	6.1	25,966	0.1	7,470,136	0.9
10 to 19 acres	4,316	13.2	57,182	0.3	9,611,571	1.2
20 to 49 acres	25,479	37.2	947,329	4.8	54,552,181	6.7
50 to 99 acres	52,590	76.8	4,037,908	20.3	191,346,991	23.6
100 to 174 acres	54,232	134.3	7,284,121	36.7	294,757,934	36.3
175 to 259 acres	18,171	209.4	3,805,408	19.2	141,651,755	17.5
260 to 499 acres	8,659	327.4	2,835,210	14.3	91,598,629	11.3
500 to 999 acres	991	608.7	603,181	3.0	15,668,591	1.9
1,000 acres and over	145	826.3	264,817	1.3	3,515,955	0.4

1 Less than one-tenth of 1 per cent.

The group of medium-sized farms, containing from 100 to 174 acres each, comprises a larger percentage of the total acreage than any other group. For farms containing over 3 acres, the average values of farm property and products rise in unbroken series, with the single exception of the average value of buildings. For the group of farms containing less than 3 acres each, the average values are relatively high. This is explained by the fact that this group includes many florists' establishments and a large number of city dairies. The average gross incomes per acre for the various groups are as follows: Farms under 3 acres, $171.45; 3 to 9 acres, $37.26; 10 to 19 acres, $19.91; 20 to 49 acres, $8.05; 50 to 99 acres, $6.69; 100 to 174 acres, $5.86; 175 to 259 acres, $5.38; 260 to 499 acres, $4.63; 500 to 999 acres, $3.56; and 1,000 acres and over, $1.43.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$3,125	$917	$172	$567	$682	14.3
Under 3 acres	696	786	47	94	290	17.9
3 to 9 acres	915	675	46	116	227	12.9
10 to 19 acres	1,290	717	61	159	264	11.8
20 to 49 acres	1,295	525	86	235	299	14.0
50 to 99 acres	2,312	754	152	420	614	14.1
100 to 174 acres	3,573	1,022	194	646	788	14.5
175 to 259 acres	5,297	1,274	257	967	1,126	14.4
260 to 499 acres	7,188	1,682	331	1,377	1,516	14.3
500 to 999 acres	10,926	2,350	446	2,089	2,169	13.7
1,000 acres and over	18,577	2,764	556	2,351	2,615	10.8

In considering the high gross income per acre for farms of less than 3 acres, it should be borne in mind that the incomes of the florists' establishments, nurseries, and city dairies, of which this group is largely composed, are determined not so much by the acreage of land used as by the amount of capital invested in buildings, implements, and live stock, and the amounts expended for labor and fertilizers.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40 per cent of the products not fed to live stock, it is a "vegetable" farm. The farms of other groups are classified in accordance with the same general principle.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	169,795	117.0	19,862,727	100.0	$811,712,319	100.0
Hay and grain	33,437	122.5	4,099,218	20.6	166,566,221	20.5
Vegetables	6,351	89.3	566,934	2.9	21,345,590	2.6
Fruits	654	88.5	57,848	0.3	2,604,323	0.3
Live stock	59,182	133.9	7,926,842	39.9	319,448,898	39.4
Dairy produce	25,246	104.5	2,637,299	13.3	138,155,713	17.0
Tobacco	3,181	79.9	254,306	1.3	16,478,435	2.1
Sugar	14	112.0	1,568	(1)	54,876	(1)
Flowers and plants	128	6.2	796	(1)	880,835	0.1
Nursery products	30	117.4	3,523	(1)	241,870	(1)
Miscellaneous	41,572	103.8	4,314,393	21.7	145,935,558	18.0

1 Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$3,125	$917	$172	$567	$682	14.3
Hay and grain	3,473	887	174	447	634	12.7
Vegetables	2,255	709	131	266	530	15.8
Fruits	2,632	1,032	114	204	850	21.3
Live stock	3,450	1,010	184	754	810	15.0
Dairy produce	3,531	1,077	193	671	709	12.9
Tobacco	3,429	1,119	152	480	1,001	19.3
Sugar	2,432	861	281	346	978	24.9
Flowers and plants	3,828	2,763	224	67	2,159	31.4
Nursery products	5,845	1,760	280	177	2,560	31.8
Miscellaneous	2,248	717	149	396	515	14.7

"Miscellaneous" farms are those whose operators do not derive 40 per cent of their income from any class of farm products. Farms for which no income was reported in 1899 are classified according to the agricultural operations upon other farms in the same locality.

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms whose operators derive their principal income from flowers and plants, $347.17; nursery products, $21.80; tobacco, $12.52; fruits, $9.61; sugar, $8.73; dairy produce, $6.78; live stock, $6.05; vegetables, $5.93; hay and grain, $5.17; and miscellaneous, $4.96. In computing these averages, the total area of the farms of each group is used, and not the acreage devoted to the crop from which the principal income is derived.

The wide variations shown in the averages and percentages of gross income are largely due to the fact that in computing gross income no deductions are made for expenditures. For florists' establishments and nurseries, the average expenditure for such items as labor and fertilizers represents a far greater percentage of the gross income than in the case of "live stock" or "miscellaneous" farms. Were it possible to present the average net incomes, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	169,795	117.0	19,862,727	100.0	$811,712,319	100.0
$0	666	84.5	56,268	0.3	827,500	0.1
$1 to $49	2,633	59.3	156,236	0.8	2,908,860	0.3
$50 to $99	6,133	53.8	330,259	1.7	7,124,050	0.9
$100 to $249	27,264	64.6	1,760,314	8.8	46,762,919	5.8
$250 to $499	44,209	90.6	4,004,805	20.2	125,552,800	15.5
$500 to $999	53,429	119.6	6,388,797	32.2	267,332,690	32.9
$1,000 to $2,499	32,397	192.2	6,227,301	31.3	302,220,740	37.2
$2,500 and over	3,064	306.4	938.747	4.7	58,982,760	7.3

The absence of income in the first group is due, in part, to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The persons in charge of such farms on June 1, 1900, could not always give definite information concerning the products of the preceding year. The same statement is true, also, of some of the farms with reported incomes of less than $100. To

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$3,125	$917	$172	$567	$682	14.3
$0	882	224	28	108	....	....
$1 to $49	712	278	28	87	32	2.9
$50 to $99	721	297	34	110	69	6.0
$100 to $249	1,049	397	66	203	172	10.0
$250 to $499	1,758	601	127	354	365	12.8
$500 to $999	3,238	985	185	596	708	14.2
$1,000 to $2,499	6,276	1,656	308	1,089	1,422	15.3
$2,500 and over	13,388	3,018	550	2,294	3,463	18.0

this extent the reports fall short of giving a complete exhibit of farm income in 1899. Other farms with small reported incomes are doubtless the country homes of city merchants and professional men who derive their principal incomes from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES, ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS. Number.	Value.	Average value.	NOT ON FARMS. Number.
Calves	Under 1	623,343	$4,107,904	$6.59	5,211
Steers	1 and under 2	205,798	3,228,364	15.69	1,087
	2 and under 3	73,319	1,917,616	26.15	804
	3 and over	10,773	412,672	38.30	335
Bulls	1 and over	48,062	1,283,081	26.70	193
Heifers	1 and under 2	285,319	4,526,586	15.87	1,970
Cows kept for milk	2 and over	998,397	29,642,522	29.69	34,414
Cows and heifers not kept for milk.	2 and over	69,094	1,730,773	25.05	157
Colts	Under 1	33,889	788,154	23.26	883
Horses	1 and under 2	41,983	1,871,157	44.57	908
	2 and over	479,884	31,657,164	65.97	83,946
Mule colts	Under 1	543	19,625	36.14	9
Mules	1 and under 2	414	19,867	47.99	11
	2 and over	3,533	204,001	57.74	437

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES, ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS—Continued.

LIVE STOCK.	Age in years.	ON FARMS. Number.	Value.	Average value.	NOT ON FARMS. Number.
Asses and burros	All ages	428	$8,505	19.87	101
Lambs	Under 1	689,241	1,176,969	1.71	1,208
Sheep:					
Ewes	1 and over	918,638	3,048,269	3.32	2,201
Rams and wethers.	1 and over	67,574	285,118	4.22	386
Swine	All ages	2,014,631	7,580,423	3.76	27,463
Goats	All ages	3,882	12,760	3.29	1,522
Fowls:[1]					
Chickens[2]	....	8,097,399	2,410,714	....	....
Turkeys	....	155,121			
Geese	....	102,224			
Ducks	....	92,800			
Bees (swarms of)	....	106,090	377,105	3.55	....
Unclassified	....	....	18,400	....	....
Value of all live stock.	....	....	96,327,649	....	....

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The value of all live stock on farms, June 1, 1900, was $96,327,649. Of this amount, 35.6 per cent represents the value of horses; 30.8 per cent, that of dairy cows; 17.8 per cent, that of other neat cattle; 7.9 per cent, that of swine; 4.7 per cent, that of sheep; 2.5 per cent, that of poultry; and 0.7 per cent, that of all other live stock.

The $18,400 given as the value of unclassified live stock represents the value of 74 buffaloes reported from Buffalo county.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of all live stock not on farms, exclusive of poultry and bees, is $6,893,640, and the total value of live stock in the state is, approximately, $103,221,289.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the numbers of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	998,397	1,315,708	555,756	4,918	986,212	2,014,631
1890	792,620	855,327	460,740	5,752	984,972	1,347,750
1880	478,374	650,767	352,428	7,136	1,336,807	1,128,825
1870	308,377	384,917	252,019	4,195	1,069,282	512,778
1860	203,001	318,859	116,180	1,030	332,954	334,055
1850	64,339	119,094	30,179	156	124,896	159,276

[1] Lambs not included.

Every class of live stock shows a very great increase in number in the half century since 1850. For dairy cows, other neat cattle, horses, and swine, this progress has been uninterrupted, but the greatest numbers of mules and sheep are shown for 1880. The number of mules has decreased steadily since, the rate being 14.5 per cent for the last decade. The number of sheep decreased 26.3 per cent from 1880 to 1890, but increased 0.1 per cent between 1890 and 1900. The following increases in number are shown for the decade 1890 to 1900: Dairy cows, 26.0 per cent; other neat cattle, 53.8 per cent; horses, 20.6 per cent; swine, 49.5 per cent.

The enumerators in 1900 were instructed to report no fowls under 3 months old, which limitation was not made in previous census reports. This fact accounts for the small increases in numbers of chickens and ducks and the decreases in numbers of turkeys and geese. Compared with the census of 1890 the present census shows increases of 43.4 per cent and 1.7 per cent in the numbers of chickens and ducks, respectively, and decreases of 24.8 per cent and 21.4 per cent in the numbers of turkeys and geese.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the animal products of 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS, IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	7,224,733	$1,461,279
Mohair and goat hair	Pounds	514	145
Milk	Gallons	[1]472,274,264	[2]26,779,721
Butter	Pounds	44,739,147	
Cheese	Pounds	1,635,618	
Eggs	Dozens	46,249,580	4,854,020
Poultry			3,398,427
Honey	Pounds	2,677,100	270,742
Wax	Pounds	44,670	
Animals sold			27,131,916
Animals slaughtered			5,407,114
Total value			69,303,364

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of all milk sold or consumed, and of butter and cheese made.

The value of animal products for 1899 was $69,303,364, nearly three-fourths as great as the value of all live stock on farms, June 1, 1900. Of this amount, 47.0 per cent represents the value of animals sold and animals slaughtered on farms; 38.6 per cent, that of dairy products; 11.9 per cent, that of poultry and eggs; 2.1 per cent, that of wool; and 0.4 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms in 1899 is $32,539,030, or 20.7 per cent of all farm products, and 28.1 per cent of the gross farm income. Of all farmers in the state reporting live stock, 134,530, or 82.0 per cent, report animals slaughtered on farms, the average value per farm being $40.19. Sales of live animals were reported by 123,092 farmers, or 75.0 per cent of all those reporting live stock in the state, the average receipts per farm being $220.42. Grant county is first in amount of sales, reporting an average of $559.31 from each of 3,627 farms.

In obtaining these reports the enumerators were instructed to secure from each farm operator a statement of the amount received from sales in 1899, less the amount paid for animals purchased during the same year.

DAIRY PRODUCE.

Dairying is an important branch of agriculture in Wisconsin. The $26,779,721 given in Table 16 as the value of dairy produce is 17.0 per cent of the value of all farm products and 23.1 per cent of the gross farm income. Of this amount, 78.6 per cent represents the value of dairy produce sold, and 21.4 per cent, that consumed on the farms of the producers. Of the former amount, $15,717,043 was received from the sale of 252,450,051 gallons of milk; $4,508,775, from 26,931,757 pounds of butter; $686,629, from 1,638,601 gallons of cream; and $135,938, from 1,558,575 pounds of cheese. The leading dairy counties are in the southeastern part of the state, and, ranking in the order named, are as follows: Dane, Dodge, Jefferson, Walworth, Sheboygan, and Fond du Lac. There was an increase of 168,573,130 gallons, or 55.5 per cent, in the production of milk in the decade preceding 1900. The amount of butter produced on farms decreased 3.4 per cent, and that of cheese made on farms increased 80.5 per cent in the same time.

POULTRY AND EGGS.

Of the $8,252,447 which is the total value of poultry and eggs produced in 1899, 58.8 per cent represents the value of eggs and 41.2 per cent that of poultry raised. An increase in production of eggs of 16,858,796 dozens, or 57.4 per cent, is shown by the report of 1899 over that of 1889.

WOOL.

The production of wool for 1899 was greater than that for any previous census year. The year 1889 showed a considerable decrease compared with 1879, but the present census shows an increase of 2.9 per cent in the production of wool since 1879, and 45.0 per cent since 1889. A part of this increase is more apparent than real, owing to the fact that in 1890 the fleeces from at least 223,197 sheep were omitted from the tables but included in a general estimate of wool shorn after the census enumeration. With the exception of Pierce, all the leading wool-producing counties are in the southern and southeastern parts of the state. Ranking in the order named, they are as follows: Fond du Lac, Columbia, Richland, Waukesha, Vernon, Dane, Pierce, and Grant.

HONEY AND WAX.

Compared with the census of 1890, the present census shows a decrease of 23.9 per cent in the production of honey, and 3.0 per cent in the amount of wax. The counties reporting more than 100,000 pounds of honey as the production of 1899 were Vernon, Richland, Washington, Juneau, Dodge, and Outagamie.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	154,769	555,756	3.6	156,136	998,397	6.4
White farmers	154,341	554,608	3.6	155,927	997,918	6.4
Colored farmers	428	1,148	2.7	209	479	2.3
Owners[1]	132,759	463,965	3.5	134,557	823,705	6.1
Managers	1,227	8,389	6.8	1,214	11,052	9.1
Cash tenants	9,314	36,619	3.9	9,112	71,159	7.8
Share tenants	11,469	46,783	4.1	11,253	92,481	8.2
Under 20 acres	6,119	9,467	1.5	6,667	13,141	2.0
20 to 99 acres	69,070	180,366	2.6	70,643	310,898	4.4
100 to 174 acres	52,361	202,102	3.9	52,053	380,419	7.3
175 to 259 acres	17,633	93,799	5.3	17,300	173,811	10.0
260 acres and over	9,586	70,022	7.3	9,473	120,128	12.7
Hay and grain	29,201	101,810	3.5	27,936	143,376	5.1
Vegetable	5,476	14,836	2.7	3,601	13,660	3.8
Fruit	509	1,136	2.2	410	1,032	2.5
Live stock	53,739	229,506	4.3	57,816	404,792	7.0
Dairy	24,803	85,965	3.5	25,246	241,548	9.6
Tobacco	2,752	10,274	3.7	2,658	15,342	5.8
Flower and plant	58	95	1.6	21	41	2.0
Miscellaneous[2]	38,231	112,145	2.9	38,448	178,606	4.6

[1] Including "part owners" and "owners and tenants."
[2] Including sugar farms and nurseries.

CROPS.

The following table gives the statistics of the principal crops grown in 1899.

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	1,497,474	Bushels	63,309,810	$16,905,822
Wheat	556,614	Bushels	9,005,170	5,116,346
Oats	2,365,115	Bushels	84,040,800	17,931,685
Barley	555,747	Bushels	18,699,690	6,916,935
Rye	362,193	Bushels	5,142,606	2,443,946
Buckwheat	39,713	Bushels	489,896	288,481
Broom corn	64	Pounds	38,850	2,510
Kafir corn	88	Bushels	1,877	613
Flaxseed	11,263	Bushels	140,765	143,239
Clover seed		Bushels	91,189	392,177
Grass seed		Bushels	60,577	54,553
Hay and forage	2,397,982	Tons	3,667,212	19,267,709
Tobacco	33,830	Pounds	45,500,480	2,898,091
Hops	342	Pounds	165,346	18,020
Dry beans	12,989	Bushels	143,182	206,216
Dry pease	68,819	Bushels	1,098,819	824,603
Potatoes	256,931	Bushels	24,641,498	5,826,552
Sweet potatoes	4	Bushels	86	$99
Onions	1,230	Bushels	331,662	154,310
Chicory	11	Pounds	84,000	289
Miscellaneous vegetables	38,348			2,066,324
Maple sugar		Pounds	4,180	400
Maple sirup		Gallons	6,625	6,478
Sorghum cane	2,399	Tons	[1]952	2,716
Sorghum sirup		Gallons	160,414	61,728
Sugar beets	34	Tons	233	937
Small fruits	12,389			835,119
Grapes	[2]341	Centals	5,715	[3]15,173
Orchard fruits	[2]55,009			[4]267,391
Nuts				1,460
Forest products				6,109,033
Flowers and plants	194			270,872
Seeds	67			15,336
Nursery products	736			85,087
Willows	([5])			100
Miscellaneous	201			13,099
Total	8,270,127			88,142,349

[1] Sold as cane.
[2] Estimated from number of vines or trees.
[3] Including value of raisins, wine, etc.
[4] Including value of cider, vinegar, etc.
[5] Less than 1 acre.

Of the total value of crops, cereals contributed 55.1 per cent; hay and forage, 21.9 per cent; vegetables, including potatoes, sweet potatoes, and onions, 9.1 per cent; forest products, 6.9 per cent; tobacco, 3.3 per cent; fruits and nuts, 1.3 per cent; dry beans and pease, 1.2 per cent; and all other products, 1.2 per cent.

The average values per acre of the principal crops are as follows: Flowers and plants, $1,396; onions, $125; nursery products, $116; tobacco, $86; small fruits, $67; miscellaneous vegetables, $54; hops, $53; broom corn, $39; sweet potatoes, $25; potatoes, $23; dry beans, $16; flaxseed, $13; dry pease, $12; cereals, $9; hay and forage, $8; and orchard fruits, $5. The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production required a relatively great amount of labor, and large expenditures for fertilizers.

CEREALS.

The following table is a statement of the changes in cereal production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

Year.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	555,747	39,713	1,497,474	2,365,116	362,193	556,614
1889	474,914	77,458	1,120,341	1,627,151	275,058	744,080
1879	204,335	34,117	1,015,393	955,597	169,692	1,948,160

PART 2.—BUSHELS PRODUCED.

Year.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	18,699,690	489,895	53,309,810	84,040,800	5,142,606	9,005,170
1889	15,225,872	1,064,178	34,024,216	60,739,052	4,250,582	11,698,922
1879	5,043,118	299,107	34,230,579	32,905,320	2,298,513	24,884,689
1869	1,645,019	408,897	15,033,998	20,180,016	1,325,294	25,606,344
1859	707,307	38,987	7,517,300	11,059,260	888,544	15,657,458
1849	209,692	79,878	1,988,979	3,414,672	81,253	4,286,131

[1] No statistics of acreage were secured prior to 1879.

The total number of acres in cereals was 4,319,002 in 1889, and 5,376,856 in 1899, an increase of 24.5 per cent. The rates of increase in acreage for the last decade were: Oats, 45.4 per cent; corn, 33.7 per cent; rye, 31.7 per cent; and barley, 17.0 per cent. The area devoted to wheat decreased 25.2 per cent, and the acreage in buckwheat, 48.7 per cent.

Of the total acreage in 1899, oats occupied 44.0 per cent; corn, 27.0 per cent; wheat, 10.4 per cent; barley, 10.3 per cent; rye, 6.7 per cent; and buckwheat, 0.7 per cent. Oats were grown in 1899 by 138,706 farmers, or 81.7 per cent of the total number in the state; corn, by 127,900, or 75.3 per cent; and wheat, by 79,695, or 47.0 per cent.

The southern counties of Dane, Grant, Lafayette, Green, Dodge, and Iowa produced over one-third of the corn and more than one-fifth of the oats grown in the state. St. Croix, Buffalo, Pierce, Trempealeau, Polk, and Jackson counties, in the western part, reported over one-fifth of the wheat crop; and Dodge, Fond du Lac, Washington, Sheboygan, and Calumet counties, in the eastern part, produced over one-half of the total barley crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table.

TABLE **20**.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	2,557,265	1,383,070	303,373	1,591,747
Apricots	978	758	57	38
Cherries	273,740	75,670	31,067	22,712
Peaches	6,967	387	209	12
Pears	26,766	5,977	1,540	4,071
Plums and prunes	94,338	18,451	12,166	3,223

In the last ten years, the total number of trees increased from 1,484,313 to 2,960,054, or a gain of 99.4 per cent. The number of peach trees reported in 1900 was over 18 times as great as that reported in 1890. The rates of increase for other fruits are: Plum and prune trees, 411.3 per cent; cherry trees, 261.8 per cent; pear trees, 347.8 per cent; apple trees, 84.9 per cent; and apricot trees, 29.0 per cent.

Of the total number of trees reported in 1900, 86.1 per cent were apple trees; 9.2 per cent, cherry trees; 4.7 per cent, apricot, peach, pear, plum and prune, and unclassified fruit trees. The latter class, which is not included in the table, numbered 10,074 and yielded 188 bushels of fruit. The counties in the central and southern parts of the state report by far the largest numbers of fruit trees.

The value of orchard fruits given in Table 18 includes the value of 604 barrels of cider, 321 barrels of vinegar, and 2,670 pounds of dried and evaporated fruits.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 12,389 acres, distributed among 26,237 farms. Of this total, 5,821 acres, or 47.0 per cent, was devoted to cranberries, yielding 111,098 bushels, an average of 19.1 bushels per acre. Their production was entirely confined to nine counties, most of which are situated in the south central portion of the state. Wood and Waushara counties report 64.3 per cent of the total cranberry production, from 61.5 per cent of the total acreage.

To strawberries 14,246 farmers devoted 3,508 acres, yielding 7,343,740 quarts. The acreages and productions of the other berries were as follows: Raspberries and Logan berries, 1,616 acres and 2,314,920 quarts; currants, 667 acres and 1,153,190 quarts; blackberries and dewberries, 411 acres and 644,880 quarts; gooseberries, 177 acres and 255,590 quarts; and other small fruits, 189 acres and 191,570 quarts.

VEGETABLES.

The total area used in the cultivation of vegetables, including potatoes, sweet potatoes, and onions, in 1899, was 296,513 acres. Of this amount, 86.7 per cent was devoted to potatoes and sweet potatoes; 0.4 per cent, to onions; and 12.9 per cent, to miscellaneous vegetables. Potatoes were raised throughout the state, but the southern counties of Portage, Waushara, Waupaca, Adams, Milwaukee, and Columbia reported 32.3 per cent of the total acreage. Of the 169,795 farms in the state, 145,463, or 85.7 per cent, reported that they cultivated 256,931 acres, yielding 24,641,498 bushels.

Of the 38,348 acres devoted to miscellaneous vegetables no detailed reports were received for the products grown on 23,087 acres. Of the 15,261 acres concerning which detailed reports were received, 4,400 were devoted to cabbages; 3,257, to sweet corn; 2,214, to pease; 1,266, to tomatoes; 999, to cucumbers; 600, to watermelons; 573, to turnips; 539, to beets; 457, to muskmelons; 265, to carrots; 238, to celery; and 453, to other vegetables.

TOBACCO.

Tobacco was grown in 1899 by 6,919 farmers, on 38,830 acres, an average of 4.9 acres for each farm reporting. On this area they produced 45,500,480 pounds, a gain in ten years of 96.2 per cent in acreage, and of 134.7 per cent in production. The crop has increased rapidly in every decade since 1849, when a production of 1,268 pounds was reported. In 1859 the production was 87,340 pounds; in 1869, 960,813 pounds; in 1879, 10,608,423 pounds; and in 1889, 19,389,166 pounds.

The average yield per acre in 1889 was 1,124.6 pounds, while in 1899 it was 1,345.0 pounds. The total value of the crop in the latter year was $2,898,091, an average of $418.86 for each farm reporting, and of $85.67 per acre. The average value per pound was 6.4 cents.

The crop was grown in 46 counties of the state, Rock county leading, with 9,988 acres, Vernon and Columbia counties being next in rank. These three counties together reported 47.0 per cent of the entire acreage, and 45.6 per cent of the total production.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was grown by 4,889 farmers on 2,399 acres, an average of 0.49 acres for each farm reporting. From this area they sold 952 tons of cane for $2,716, and from the remaining product manufactured 160,414 gallons of sirup, valued at $61,728. This was a decrease in acreage from 1889 of 30.5 per cent. The total value of sorghum-cane products was $64,444, an average of $13.18 for each farm reportiug and of $26.86 per acre.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 194 acres, and the value of the products sold therefrom was $270,872. These flowers and plants were grown by 193 farmers and florists. Of this number, 128 made commercial floriculture their principal business. They had invested in the aggregate $880,835, of which $490,000 represents the value of the land and the improvements other than buildings; $353,615, that of buildings; $28,670, that of implements and machinery; and $8,550, that of live stock. Their sales of flowers and plants amounted to $257,238, and of other products to $19,110. The expenditure for labor was $49,187, and for fertilizers $2,850. The average income for each farm reporting, including products fed to live stock, was $2,175.

In addition to the 128 principal florists' establishments, 491 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 519,053 square feet, making, with the 711,427 belonging to the florists' establishments, a total of 1,230,480 square feet.

NURSERIES.

The total value of nursery stock sold in 1899 was $85,087, reported by the operators of 117 farms and nurseries. Of this number, 30 derived their principal income from the nursery business. They had 3,523 acres of land, valued at $175,350; buildings worth $52,800; implements and machinery worth $8,405; and live stock worth $5,315. The value of their products not fed to live stock in 1899 was $76,797, of which $66,737 represents the value of nursery stock, and $10,060, that of other products. They expended $17,180 for labor, and $405 for fertilizers. The average income for each farm reporting, including products fed to live stock, was $2,671.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $10,468,610, an average of $62 per farm. The average was highest on the most intensively cultivated farms, being $573 for nurseries, $384 for florists' establishments, $212 for fruit farms, $84 for tobacco farms, $79 for sugar farms, $72 for dairy and live-stock farms, $60 for vegetable farms, and $58 for hay and grain farms. "Managers" expended on an average $350; "cash tenants," $83; "share tenants," $83; and "owners," $54. White farmers expended $62 per farm, and colored farmers, $7.

Fertilizers purchased in 1899 cost $294,320, an average of only $2 per farm, but an increase since 1890 of 179.8 per cent. The average expenditure was $22 for florists' establishments, $14 for nurseries, $5 for vegetable farms, $3 for fruit and tobacco farms, $2 for live-stock and for hay and grain farms, and $1 for dairy farms.

INDIAN RESERVATIONS.

The Indian reservations in Wisconsin on which agriculture was carried on in 1899, are La Pointe, Menominee, Oneida, and Stockbridge. The Stockbridge are self-supporting, but take little interest in agriculture; a few, however, have good farms. The Menominee and Chippewa, on the Menominee and La Pointe reservations, respectively, derive most of their support from the sale of their timber, although a few of them carry on agriculture on a small scale. The Menominee are dependent upon Government rations for 20.0 per cent of their subsistence.

LA POINTE RESERVATION.

La Pointe, or Bad River, reservation is situated in the extreme northern part of Wisconsin, in Ashland county, and comprises an area of 194 square miles. The land is well adapted to agriculture and produces abundantly when properly cultivated. There is also considerable timber on the reserve.

The Indians at Bad River are a portion of the Lake Superior band of Chippewa (Algonquian) with a population of 627. These Indians do not take much interest in agriculture, and it is extremely difficult to induce them to build permanent homes and to work. Here and there some have cleared small patches on their allotments and have planted gardens. They have a splendid opportunity to till the soil, but as long as they can derive an income from selling their pine timber they will do little farming.

The four Indian farmers at Bad River reserve raised a crop of hay, consisting of clover and other tame grasses; one also had 4 acres in oats, another a small patch of corn. All raised vegetables of some kind, and three had several acres of potatoes. The largest area under cultivation was 40 acres, the smallest 10 acres.

Their live stock consisted principally of farm horses. One Indian had 21 horses valued at $2,000, 62 swine, and 40 chickens, and reported sales of live stock and animal products to the amount of $420. The three remaining farmers owned no swine or chickens, but one possessed a dairy cow and reported a good production of milk and butter.

MENOMINEE AND STOCKBRIDGE RESERVATIONS.

Menominee and Stockbridge reservations, embracing areas of 362 and 18¼ square miles, respectively, are located in the northeastern part of Wisconsin, the former in Shawano and Oconto counties, the latter in Shawano county, adjoining the Menominee reserve on the southwest. Menominee is largely timbered with hemlock, pine, elm, maple, and other valuable wood, yet the arable land is fertile and yields large returns when properly cultivated. Stockbridge also contains much farming land in addition to timber.

The Menominee (Algonquian) are an aboriginal Wisconsin tribe and have a present population of 1,487. Their principal occupations are lumbering and farming.

The Stockbridge and Munsee tribes, of Algonquian stock, inhabit the reserve of the first named. These tribes originally lived in New England; later they moved to western New York and thence to Wisconsin; they are nonconsolidated, and number 376. Those among them who cultivate the soil have excellent crops to show for their labor, but most of them have not made an effort in this direction.

The principal crops raised on these two reserves are oats and corn; a few acres are also sown to wheat, rye, and buckwheat. The hay crop consists of clover and other tame grasses. All of the 37 Indian farmers raised patches of potatoes, while some also had other garden vegetables. The majority cultivated from 10 to 50 acres, while two had 110 and 130 acres, respectively, under cultivation.

Most farms are well supplied with work horses; many own dairy cows, and a few also have beef cattle. Chickens and swine are raised quite generally among these farmers.

ONEIDA RESERVATION.

Oneida reservation, now existing as such only in name, is situated in the extreme east-central part of Wisconsin, in Brown and Outagamie counties. The entire area, 102 square miles, has been allotted, with the exception of a small tract for school purposes. The land is generally adapted to agriculture, though there are a few swamps on the reserve.

The Oneida (Iroquoian) were formerly a portion of the Six Nations of New York, where they resided before being sent to Wisconsin. Their present population is 1,704. They have long been a self-supporting, agricultural people, and all are engaged in farming. Their farms are well cultivated, and are supplied with good buildings, plenty of implements, and stock.

Their principal crops are oats, wheat, and corn in the order named, while small quantities of rye, buckwheat, and barley are also raised. Nearly all of the 309 Indian farmers planted patches of potatoes, but other garden vegetables were not reported. A few have small orchards of apple, plum, and cherry trees. The majority of Oneida farmers cultivated from 5 to 60 acres. Their proximity to several large cities gives them an excellent market for all farm produce.

The live stock of the Oneidas consists principally of farm horses of a good American grade and dairy cows, the latter being quite common among them. Chickens and swine are also found on most farms.

O

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 219. WASHINGTON, D. C. July 1, 1902.

AGRICULTURE.

OHIO.

Hon. William R. Merriam,
Director of the Census.

Sir: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Ohio, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

> The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Ohio, June 1, 1900, numbered 276,719 and were valued at $1,036,615,180. Of this amount, $219,451,470, or 21.2 per cent, represents the value of buildings, and $817,163,710, or 78.8 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $36,354,150, and of live stock, $125,954,616. These values, added to that of the farms, give $1,198,923,946, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $257,065,826, of which amount $100,213,468, or 39.0 per cent, represents the value of animal products, and $156,852,358, or 61.0 per cent, the value of crops, including forest products. The "total value of farm products" for 1899 exceeds that for 1889 by $123,833,328, or 92.9 per cent, but a part of this gain is doubtless due to a more complete enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $56,245,050, leaving $200,820,776 as the gross farm income for that year. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Ohio in 1899 it was 16.8 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Ohio.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN OHIO.

GENERAL STATISTICS.

Ohio has a total land surface of 40,760 square miles, or 26,086,400 acres, of which 24,501,985 acres, or 93.9 per cent, are included in farms.

The surface of the state is a rolling plain, with a gradual slope toward the southwest. A high ridge extending across the northern part forms a watershed, dividing the drainage basins of Lake Erie on the north and the Ohio River on the south. In the border counties adjacent to the Ohio River, the surface is broken by hills.

The soil is generally adapted to agriculture and to the cultivation of all products permitted by the latitude. In the southeast it is formed directly from the underlying and outcropping rocks, while elsewhere it is composed of drift material, including the limestone soil in the west, the clay formation of the uplands, and the northwestern swamp lands. The vast body of water in Lake Erie modifies the climate and renders the northern belt especially adapted to the culture of orchards and vineyards. The large cities furnish good markets, and the excellent railway and water transportation facilities have been important factors in the agricultural development of the state.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the percentage of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	276,719	24,501,985	19,244,472	5,257,513	88.5	78.5
1890	251,430	23,352,408	18,338,824	5,013,584	92.9	78.5
1880	247,189	24,529,226	18,081,091	6,448,135	99.2	73.7
1870	195,953	21,712,420	14,469,133	7,243,287	110.8	66.6
1860	179,889	20,472,141	12,625,394	7,846,747	113.8	61.7
1850	143,807	17,997,493	9,851,493	8,146,000	125.2	54.7

The number of farms nearly doubled in the half century, and increased 10.1 per cent in the last decade. The total farm area also increased steadily, except during the decade ending in 1890, while the improved area more than doubled. The percentage of farm land improved shows a rapid increase for every decade except the last, when there was neither gain nor loss. The average area of farms has decreased steadily throughout the fifty years.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$1,198,923,946	$1,036,615,180	$36,354,150	$125,954,616	$257,065,826
1890	1,195,688,864	1,050,031,828	29,475,346	116,181,690	133,232,498
1880	1,261,726,263	1,127,497,353	30,521,180	103,707,730	156,777,152
1870[2]	1,200,458,541	1,054,465,226	25,692,787	120,300,528	[3]198,256,907
1860	776,056,642	678,132,991	17,538,832	80,384,819	....
1850	415,630,929	358,758,603	12,750,585	44,121,741	....

[1] For year preceding that designated.

[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.

[3] Includes betterments and additions to live stock.

Though the total value of farm property in 1900 was nearly three times as great as in 1850, an increase of only 0.3 per cent is shown for the last decade. This low rate is due to a decrease of $13,416,648, or 1.3 per cent, in the value of farms. A gain of $6,878,804, or 23.3 per cent, is shown for the value of implements and machinery, and of $9,772,926, or 8.4 per cent, for the value of live stock. The apparent gain of $123,833,328, or 92.9 per cent, in the value of farm products, and the gain shown for implements and machinery, are due in part to a more complete enumeration in 1900 than in previous census years.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	276,719	268,404	24,501,985	19,244,472	$817,163,710	$219,451,470	$36,354,150	$126,954,616	$200,820,776	$14,502,600	$2,696,470
Adams	3,533	3,454	325,125	212,928	4,009,020	1,323,710	263,270	1,054,169	1,606,741	69,490	46,240
Allen	2,858	2,795	245,283	196,465	9,415,270	2,451,660	416,820	1,469,218	2,215,685	154,390	8,400
Ashland	2,631	2,585	254,689	202,677	7,733,720	2,503,140	413,070	1,363,933	2,140,010	131,790	36,330
Ashtabula	5,038	4,939	416,963	244,013	9,131,730	4,127,170	595,660	1,898,780	2,427,804	186,040	76,500
Athens	3,004	2,861	297,166	229,399	6,832,510	1,500,660	258,300	1,167,917	1,381,435	70,220	27,050
Auglaize	2,810	2,713	240,607	187,924	8,849,140	2,079,860	405,000	1,256,092	2,217,715	111,340	4,020
Belmont	3,839	3,731	327,460	267,625	8,654,890	2,456,180	363,810	1,589,308	2,207,419	131,090	27,240
Brown	3,963	3,771	309,036	265,741	7,229,090	2,117,980	349,080	1,372,780	2,435,739	113,770	29,420
Butler	2,724	2,690	280,331	226,347	11,249,330	2,698,760	396,570	1,264,902	2,826,237	302,670	13,850
Carroll	2,301	2,244	243,060	199,557	5,527,290	1,560,310	300,230	1,227,601	1,417,229	72,270	21,860
Champaign	2,540	2,456	269,021	218,543	10,045,330	2,207,470	375,210	1,544,148	2,624,330	218,140	32,580
Clark	2,330	2,283	240,903	198,857	12,105,310	2,900,000	410,670	1,514,474	2,903,793	323,100	21,720
Clermont	4,113	4,013	274,880	233,432	6,955,640	2,284,700	336,770	1,108,019	1,985,642	97,610	25,440
Clinton	2,531	2,457	257,164	225,676	10,000,980	2,020,300	312,880	1,610,758	2,523,445	182,840	24,560
Columbiana	3,763	3,666	315,943	244,869	9,348,800	3,659,320	528,330	1,715,503	2,324,296	158,430	48,470
Coshocton	3,364	3,241	347,240	279,856	8,300,500	2,139,270	342,330	1,640,822	2,036,203	117,350	26,220
Crawford	2,640	2,568	248,831	202,540	10,201,910	2,654,300	493,410	1,582,371	2,440,345	167,480	18,270
Cuyahoga	4,571	4,473	237,507	154,080	23,596,300	4,982,740	554,220	1,294,671	3,336,921	407,810	81,700
Darke	5,365	6,248	370,382	311,867	16,202,920	3,911,070	857,020	2,036,420	4,598,684	187,730	26,920
Defiance	2,760	2,673	244,798	176,546	8,025,050	2,229,460	441,190	1,226,720	2,066,135	117,680	8,450
Delaware	3,133	3,011	282,396	234,482	9,148,000	2,166,560	345,780	1,716,274	2,403,421	139,960	23,440
Erie	1,970	1,885	148,416	123,140	7,222,170	2,321,550	273,690	730,686	1,433,050	180,500	19,350
Fairfield	3,425	3,348	308,629	266,174	11,586,210	2,647,480	482,020	1,835,177	2,758,174	185,110	61,120
Fayette	1,955	1,906	248,198	225,576	11,622,110	1,954,120	322,440	1,555,540	2,699,034	252,550	32,810
Franklin	3,686	3,588	310,053	274,495	21,958,620	3,462,750	557,280	1,921,779	3,506,206	364,290	21,580
Fulton	3,273	3,213	247,129	195,741	9,551,240	2,767,160	458,950	1,539,706	2,260,203	96,320	12,940
Gallia	3,361	3,287	279,420	226,422	3,958,080	1,279,680	318,540	925,620	1,296,800	64,050	32,240
Geauga	2,520	2,457	246,801	136,704	6,373,590	2,148,380	377,470	1,280,126	1,655,640	135,130	42,500
Greene	2,637	2,577	256,172	214,388	10,929,480	2,763,040	395,310	1,627,546	2,894,185	219,720	15,130
Guernsey	3,228	3,060	323,993	265,374	6,175,060	1,605,350	411,340	1,471,284	1,366,423	59,600	30,250
Hamilton	4,111	4,049	203,938	169,773	13,714,030	4,783,350	700,820	1,360,191	3,939,686	565,750	44,450
Hancock	3,263	3,193	322,267	268,375	13,122,410	2,960,250	526,250	1,829,994	2,955,410	194,120	8,890
Hardin	3,251	3,081	290,992	233,864	10,496,610	2,120,820	435,740	1,660,048	2,976,551	236,810	6,890
Harrison	2,390	2,324	247,933	208,073	6,177,440	1,766,680	260,410	1,397,261	1,364,495	64,730	14,210
Henry	3,387	3,233	253,549	204,054	11,317,590	2,420,400	510,840	1,446,794	2,411,784	129,800	1,700
Highland	3,539	3,428	363,892	306,669	8,518,110	2,073,740	370,170	1,789,347	2,426,659	155,850	60,960
Hocking	2,255	2,189	244,206	179,609	3,123,720	642,390	254,620	762,476	1,039,225	48,760	26,270
Holmes	2,632	2,678	253,357	196,201	7,896,410	2,176,810	391,720	1,490,961	1,902,848	122,490	28,950
Huron	3,097	3,021	300,163	237,093	10,048,390	2,890,240	455,140	1,637,715	2,347,864	184,830	54,820
Jackson	2,078	2,010	234,173	184,057	2,794,460	844,430	147,670	710,536	778,651	43,290	30,000
Jefferson	2,011	1,969	246,989	173,347	6,034,470	1,942,440	283,420	1,222,152	1,456,691	103,030	20,910
Knox	3,425	3,249	326,049	267,660	9,245,540	2,171,450	368,660	1,750,432	2,305,094	145,160	34,610
Lake	1,902	1,830	132,214	94,812	6,904,160	2,676,210	270,130	643,630	1,309,861	127,910	26,140
Lawrence	2,945	2,864	209,915	142,835	3,069,330	1,009,000	171,050	663,257	1,050,387	69,540	9,350
Licking	4,458	4,229	417,030	353,412	12,519,460	3,124,010	533,500	2,296,639	2,960,421	199,370	46,950
Logan	3,172	2,993	289,777	226,657	8,809,190	2,022,260	384,870	1,678,205	2,628,449	169,370	17,160
Lorain	3,660	3,564	296,128	222,680	11,436,270	3,891,950	533,090	1,677,205	2,550,371	250,950	50,880
Lucas	2,807	2,700	167,133	131,098	10,965,260	2,575,410	441,380	991,712	1,986,050	292,350	10,780
Madison	1,928	1,835	294,353	256,006	12,806,960	1,764,270	330,280	1,794,049	2,826,168	292,860	8,760
Mahoning	3,034	2,982	247,976	175,213	7,918,500	2,977,590	401,200	1,428,848	2,058,599	160,050	55,280
Marion	2,227	2,178	241,191	206,505	9,248,090	1,869,210	279,850	1,541,349	2,364,489	160,200	11,990
Medina	2,978	2,939	255,708	192,662	8,054,480	3,109,660	472,240	1,474,145	2,134,062	204,370	68,010
Meigs	3,231	3,006	261,153	204,486	4,152,650	1,156,040	224,070	904,623	1,309,582	66,270	39,960
Mercer	3,288	3,152	274,909	217,017	9,174,370	2,481,710	503,420	1,465,689	2,607,617	117,230	4,180
Miami	2,989	2,927	249,411	219,112	11,565,540	2,977,950	540,600	1,204,517	3,038,989	185,910	29,880
Monroe	3,485	3,407	281,464	214,561	5,550,610	1,727,220	297,160	1,084,647	1,682,090	61,870	31,310
Montgomery	4,462	4,388	280,938	234,828	16,019,940	4,872,730	765,800	1,653,719	4,465,022	335,340	67,890
Morgan	2,741	2,685	260,760	212,822	4,938,910	1,528,140	268,370	1,204,791	1,474,005	72,220	32,290
Morrow	2,728	2,683	248,403	194,642	7,269,400	2,108,610	324,720	1,546,776	2,024,987	110,410	33,600
Muskingum	3,974	3,869	405,481	333,866	8,114,160	2,376,030	427,970	1,748,390	2,276,232	137,980	46,150
Noble	2,826	2,747	248,495	214,315	5,305,510	1,400,170	259,030	1,219,180	1,442,401	76,800	20,580
Ottawa	2,367	2,295	158,472	121,318	8,844,480	2,518,240	408,120	816,656	1,438,536	153,310	1,110
Paulding	3,783	3,509	248,303	189,068	7,743,670	1,765,460	344,800	1,251,993	2,192,093	95,590	1,960
Perry	2,356	2,277	227,242	182,188	4,694,000	1,387,610	283,600	1,049,027	1,261,417	70,620	43,380
Pickaway	2,429	2,325	309,642	257,140	14,374,900	2,398,380	379,160	1,969,272	3,030,735	332,510	40,550
Pike	2,385	2,313	243,016	144,498	2,900,460	641,990	163,740	586,333	990,732	71,900	32,870
Portage	3,657	3,471	304,162	209,145	9,316,710	3,731,100	510,670	1,543,428	2,245,994	195,780	61,200
Preble	3,085	2,978	264,537	215,457	10,219,230	2,598,170	493,550	1,449,545	3,206,582	159,380	68,570
Putnam	3,598	3,431	290,563	234,066	11,986,090	2,600,900	543,370	1,621,507	2,783,229	155,470	3,020
Richland	3,419	3,359	304,243	239,361	9,475,670	2,649,690	472,770	1,663,419	2,619,937	171,960	38,300
Ross	3,301	3,169	405,198	307,181	11,541,300	1,925,010	379,620	1,678,754	2,677,657	272,740	46,160
Sandusky	2,842	2,803	247,243	198,982	13,296,920	3,926,760	656,140	1,470,783	2,485,665	221,930	12,140
Scioto	2,635	2,593	283,950	184,795	3,796,840	935,680	230,120	656,916	1,181,165	18,350	44,450
Seneca	3,353	3,266	327,485	254,634	13,902,250	4,062,320	676,160	2,014,260	3,213,585	196,480	42,110
Shelby	2,856	2,786	251,793	202,356	8,181,670	1,963,110	324,870	1,128,993	2,198,933	97,080	20,190

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Stark	4,495	4,412	342,290	281,064	$14,619,270	$5,323,100	$659,310	$1,905,043	$3,169,742	$285,820	$53,450
Summit	2,871	2,788	238,816	162,020	10,361,140	3,364,820	403,200	1,402,483	2,307,603	234,580	43,100
Trumbull	4,345	4,290	377,552	240,147	9,865,700	4,064,820	525,470	2,067,342	2,454,621	184,580	52,760
Tuscarawas	3,581	3,439	339,786	275,206	9,358,350	2,954,500	428,260	1,583,309	2,085,637	147,400	27,720
Union	2,937	2,839	275,958	227,534	9,518,240	1,947,250	357,860	1,738,692	2,368,775	138,760	11,460
Van Wert	3,367	3,225	256,014	211,556	9,831,640	2,194,540	499,240	1,467,591	2,487,288	96,820	1,980
Vinton	2,089	1,990	226,474	145,569	2,323,650	566,220	230,010	624,248	669,858	32,120	22,810
Warren	2,514	2,408	250,003	210,557	9,002,870	2,681,570	287,810	1,337,997	2,588,069	213,040	17,510
Washington	4,478	4,349	374,694	280,691	7,637,600	2,271,580	463,370	1,444,574	2,116,307	112,860	65,400
Wayne	3,943	3,871	338,149	272,280	13,526,030	4,775,510	754,300	2,020,606	3,204,507	280,370	86,500
Williams	2,833	2,794	253,228	195,074	8,408,650	2,427,550	430,180	1,426,218	2,056,964	99,520	6,170
Wood	4,781	4,599	367,527	296,928	18,970,210	4,389,810	724,230	2,123,450	3,631,133	271,520	8,570
Wyandot	2,389	2,330	248,222	208,246	9,318,210	2,040,480	334,590	1,410,956	2,283,329	139,120	13,640

In nearly all counties the number of farms increased in the last decade, the six northern counties of Ashland, Holmes, Medina, Morrow, Sandusky, and Williams alone showing decreases in the total farm acreage. The smaller area of improved land reported in many of the counties is due to the use of a more strict construction of the term "improved land" by the Twelfth than by any preceding census. The average size of farms for the state is 88.5 acres, and varies from less than 60 to more than 120 acres.

A little less than one-half of the counties in the state report increases in the total value of farms, the increases being generally in the western and northeastern counties. In the value of implements and machinery the majority of counties show an increase, slight decreases being reported by only eight counties. The value of live stock has decreased in one-fourth of the counties.

FARM TENURE.

Table 4 gives a comparative statement of farm tenure for 1880, 1890, and 1900. The farms operated by tenants are divided into two groups, designated as farms operated by "cash tenants," who pay a rental in cash or a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, the farms operated by owners being subdivided into four groups, designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other, or others, owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	276,719	200,788	24,051	51,880	72.5	8.7	18.8
1890	251,430	193,895	18,947	38,588	77.1	7.5	15.4
1880	247,189	199,562	14,834	32,793	80.7	6.0	13.3

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	276,719	169,370	23,730	4,261	3,427	24,051	51,880
White	274,750	168,369	23,509	4,244	3,399	23,839	51,390
Colored[1]	1,969	1,001	221	17	28	212	490

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	61.2	8.6	1.5	1.2	8.7	18.8
White	100.0	61.3	8.6	1.5	1.2	8.7	18.7
Colored[1]	100.0	60.8	11.2	0.9	1.4	10.8	24.9

[1] Comprising 1 Chinese, 2 Indians, and 1,966 negroes.

There was a slight decrease in the number of farms operated by owners in the decade from 1880 to 1890, but an increase of 3.6 per cent is shown for the last decade. The relative number of owners has, however, decreased each decade. Gains are shown for both tenant groups, the rates for the twenty years being 62.1

per cent for cash tenants and 58.2 per cent for share tenants.

Of the farms of the state, 99.3 per cent are operated by white farmers and 0.7 per cent by colored. The percentages of tenure for white and colored farmers do not differ greatly, a somewhat larger portion of the negroes being tenants.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number of farms conducted by the last-named group is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	276,719	88.5	24,501,985	100.0	$1,198,923,946	100.0
White	274,750	88.8	24,396,326	99.6	1,194,618,103	99.6
Colored[1]	1,969	53.7	105,659	0.4	4,306,843	0.4
Owners	169,370	83.1	14,070,387	67.4	670,537,844	56.9
Part owners	23,730	98.1	2,326,729	9.5	119,421,064	9.9
Owners and tenants	4,261	118.2	503,596	2.1	22,509,403	1.9
Managers	3,427	164.8	564,863	2.3	31,953,870	2.7
Cash tenants	24,051	82.0	1,971,501	8.0	107,567,883	9.0
Share tenants	51,880	97.6	5,064,910	20.7	246,933,882	20.6

[1] Including 2 Indians and 1 Chinese.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900.				AVERAGE VALUES PER FARM OF—	Per cent of gross income on total investment in farm property.
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	
The State	$2,953	$793	$132	$455	$726	16.8
White	2,963	796	132	467	729	16.7
Colored[1]	1,601	291	61	234	402	18.4
Owners	2,601	796	126	437	670	16.9
Part owners	3,509	829	150	544	888	17.6
Owners and tenants	3,555	962	169	607	889	16.8
Managers	6,750	1,639	186	749	1,092	11.7
Cash tenants	3,206	691	127	448	740	16.6
Share tenants	3,430	748	136	446	789	16.6

[1] Including 2 Indians and 1 Chinese.

The average area, value of property, and value of products are very much lower for colored than for white farmers. The higher per cent of gross income for colored farmers does not indicate superior farm management, but is due to the smaller average area, more intensive cultivation, and to the low value of farm property of the colored farmers.

The farms of managers, though fewest in number, have the largest average area and the highest average values, but as the values are high, the per cent of gross income is lowest for this group. The averages are lowest for owners and cash tenants.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	276,719	88.5	24,501,985	100.0	$1,198,923,946	100.0
Under 3 acres	2,531	1.7	4,319	([1])	3,034,248	0.3
3 to 9 acres	14,816	5.9	87,753	0.4	18,458,860	1.6
10 to 19 acres	18,115	13.7	248,359	1.0	27,962,749	2.3
20 to 49 acres	57,566	34.3	1,972,566	8.0	120,224,919	10.0
60 to 99 acres	89,774	73.9	6,636,508	27.1	329,132,854	27.5
100 to 174 acres	67,258	128.8	8,663,663	35.4	402,364,342	33.6
175 to 259 acres	18,361	201.5	3,699,942	15.1	166,973,652	13.9
260 to 499 acres	7,218	325.6	2,350,226	9.6	100,066,949	8.4
500 to 999 acres	916	627.0	574,368	2.3	23,174,633	1.9
1,000 acres and over	164	1,611.5	264,281	1.1	7,530,740	0.6

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900.				AVERAGE VALUES PER FARM OF—	Per cent of gross income on total investment in farm property.
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	
The State	$2,963	$793	$132	$455	$726	16.8
Under 3 acres	495	676	46	83	332	27.7
3 to 9 acres	624	471	49	102	224	18.0
10 to 19 acres	879	473	55	137	266	17.2
20 to 49 acres	1,294	496	78	221	387	18.5
50 to 99 acres	2,425	721	128	392	650	17.7
100 to 174 acres	4,146	1,028	178	630	989	16.5
175 to 259 acres	6,606	1,308	224	956	1,412	15.5
260 to 499 acres	10,320	1,802	278	1,464	2,001	14.4
500 to 999 acres	19,508	2,603	372	2,817	3,483	13.8
1,000 acres and over	36,890	3,817	543	4,669	6,479	14.1

The group of farms containing from 50 to 99 acres contains the largest number of farms, but the next largest group constitutes a larger percentage of the total acreage and value.

For the two groups containing less than 10 acres per farm, the average values given in Table 9 are relatively high, as these groups include most of the florists' establishments and a number of city dairies. It should be borne in mind that the income from these industries is determined, not so much by the acreage of land used, as by the amount of capital invested in buildings and implements and the amounts expended for labor and fertilizers.

The average gross incomes for the various groups classified by area are as follows: Farms under 3 acres, \$194.48; 3 to 9 acres, \$37.85; 10 to 19 acres, \$19.40; 20 to 49 acres, \$11.30; 50 to 99 acres, \$8.80; 100 to 174 acres, \$7.68; 175 to 259 acres, \$7.01; 260 to 499 acres, \$6.15; 500 to 999 acres, \$5.55; 1,000 acres and over, \$4.02.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40 per cent of the value of such products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40 percent of their income from any one class of products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	276,719	88.5	24,501,985	100.0	\$1,198,923,946	100.0
Hay and grain	80,809	100.6	8,131,676	33.2	423,134,731	35.3
Vegetables	7,171	32.5	233,339	1.0	25,418,977	2.1
Fruits	5,074	40.3	204,387	0.8	19,933,852	1.7
Live stock	113,520	96.2	10,926,072	44.6	481,319,434	40.1
Dairy produce	12,768	88.4	1,128,380	4.6	65,735,524	5.5
Tobacco	6,199	52.7	326,400	1.3	18,360,076	1.5
Sugar	60	64.5	3,871	(1)	215,184	(1)
Flowers and plants	505	5.6	2,832	(1)	2,970,336	0.3
Nursery products	147	73.6	10,818	0.1	1,063,545	0.1
Miscellaneous	50,466	70.0	3,534,210	14.4	160,772,287	13.4

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	\$2,953	\$793	\$132	\$455	\$726	16.8
Hay and grain	3,843	821	142	430	806	15.4
Vegetables	2,481	768	113	183	634	17.9
Fruits	2,726	912	99	192	624	15.9
Live stock	2,778	772	135	555	730	17.2
Dairy produce	3,354	1,042	148	604	909	17.7
Tobacco	1,861	722	114	265	794	26.8
Sugar	2,616	503	139	328	464	12.9
Flowers and plants	3,106	2,592	134	50	2,765	47.0
Nursery products	5,179	1,682	164	210	3,557	49.2
Miscellaneous	2,038	712	110	326	527	16.5

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, \$493.12; nursery products, \$48.34; vegetables, \$19.49; fruits, \$15.50; tobacco, \$15.09; dairy produce, \$10.29; hay and grain, \$8.01; live stock, \$7.58; miscellaneous, \$7.53; and sugar, \$7.19.

The wide variations shown in the averages and in the percentages of gross income are largely due to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens, the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than for "hay and grain," "live stock," or "miscellaneous" farms. Were it possible to present the average net incomes the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	276,719	88.5	24,501,985	100.0	\$1,198,923,946	100.0
\$0	686	47.0	32,275	0.1	1,498,590	0.1
\$1 to \$49	3,184	23.2	73,862	0.3	3,127,510	0.3
\$50 to \$99	8,909	23.4	208,423	0.8	9,593,320	0.8
\$100 to \$249	43,366	34.8	1,507,965	6.2	62,616,076	5.2
\$250 to \$499	68,328	60.7	4,147,086	16.9	170,925,390	14.3
\$500 to \$999	89,437	94.4	8,447,082	34.5	394,371,730	32.9
\$1,000 to \$2,499	56,979	147.5	8,402,808	34.3	453,449,210	37.8
\$2,500 and over	5,830	288.6	1,682,484	6.9	103,342,120	8.6

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,953	$793	$132	$455	$726	16.8
$0	1,530	395	24	236	....	....
$1 to $49	621	264	23	74	34	3.4
$50 to $99	655	303	29	90	74	6.9
$100 to $249	875	367	48	154	175	12.2
$250 to $499	1,610	530	86	276	370	14.8
$500 to $999	2,958	833	145	473	720	16.3
$1,000 to $2,499	5,612	1,311	225	810	1,415	17.8
$2,500 and over	13,048	2,452	385	1,841	3,814	21.5

The absence of income in the first group is due in part to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The persons in charge of such farms on June 1, 1900, frequently could not give definite information concerning the products of the preceding year. The same statement is true also of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete exhibit of farm income in 1899. Other farms with little or no reported incomes are doubtless the suburban or summer homes of city merchants and professional men, who derive their principal incomes from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in previous census reports.

The total value of live stock on farms, June 1, 1900, was $125,954,616, of which 39.8 per cent represents the value of horses; 19.6 per cent, that of dairy cows; 17.3 per cent, that of other neat cattle; 9.4 per cent, that of swine; 8.7 per cent, that of sheep; 4.1 per cent, that of poultry; 0.8 per cent, that of mules and asses; and 0.3 per cent, that of all other live stock.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	494,584	$4,186,575	$8.46	6,167
Steers	1 and under 2	223,946	4,300,265	19.20	1,336
Steers	2 and under 3	144,725	4,571,321	31.59	1,334
Steers	3 and over	27,932	1,243,524	44.52	829
Bulls	1 and over	39,276	1,226,696	31.23	346
Heifers	1 and under 2	217,571	3,959,411	18.20	2,607
Cows kept for milk	2 and over	818,239	24,725,382	30.22	50,593
Cows and heifers not kept for milk.	2 and over	87,040	2,347,072	26.97	1,400
Colts	Under 1	55,324	1,395,896	25.23	1,837
Horses	1 and under 2	67,332	3,037,402	45.11	1,567
Horses	2 and over	755,549	45,725,947	60.52	186,561
Mule colts	Under 1	1,464	46,525	31.78	20
Mules	1 and under 2	1,321	60,244	45.60	101
Mules	2 and over	13,986	834,442	59.66	4,651
Asses and burros	All ages	250	18,981	75.92	212
Lambs	Under 1	1,372,378	2,370,851	1.73	2,252
Sheep (ewes)	1 and over	2,090,093	6,790,239	3.25	4,327
Sheep (rams and wethers).	1 and over	558,157	1,795,218	3.22	2,814
Swine	All ages	3,188,563	11,813,168	3.70	97,226
Goats	All ages	5,432	16,975	3.13	1,149
Fowls:[1]					
Chickens[2]	....	14,269,525	5,085,921	....	....
Turkeys	....	362,924			
Geese	....	179,665			
Ducks	....	206,238			
Bees (swarms of)	....	151,391	402,561	2.66	....
Value of all live stock.	....	....	125,954,616	....	....

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of domestic animals not on farms is $13,878,677. Exclusive of poultry and bees not on farms the value of all live stock in the state is, approximately, $139,833,293.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the numbers of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	818,239	1,235,074	878,205	17,021	2,648,250	3,188,563
1890	794,833	968,554	880,677	18,858	4,060,729	3,275,922
1880	767,043	1,093,143	736,478	19,481	4,902,486	3,141,333
1870	654,390	781,827	609,722	16,065	4,928,635	1,728,968
1860	676,585	958,155	625,346	7,194	3,546,767	2,251,653
1850	544,499	814,448	463,397	3,423	3,942,929	1,964,770

[1] Lambs not included.

For the last half century all classes of live stock show fluctuations in numbers from decade to decade. Larger numbers of every class except sheep are shown for 1900 than for 1850, but for the last decade, only neat cattle show an increase. The decreases since 1890 were general throughout the state, and were due in part to the high prices prevailing just before the enumeration, which led many farmers to reduce their flocks and herds to an unusual extent.

The increase in number of dairy cows has been constant since 1870, that year's report showing the effects of the Civil War. The number reported in 1900 is 50.3 per cent greater than in 1850, and 2.9 per cent greater than in 1890. The number of other neat cattle has increased 51.6 per cent since 1850, and 27.5 per cent since 1890. There were 89.5 per cent more horses reported in 1900 than in 1850, but 0.3 per cent fewer than in 1890. Nearly five times as many mules and asses were reported in 1900 as in 1850, but the last decade shows a decrease of 9.7 per cent. The years 1870 and 1880 show the largest numbers of sheep, the decrease in the last decade being 34.8 per cent. In 1900 there were 62.3 per cent more swine than in 1850, but 2.7 per cent less than in 1890.

In 1900 the enumerators were instructed to report no fowls under 3 months old, but in 1890 no such limitation was made. This accounts for the small increase in the number of chickens and the apparent decreases in the numbers of other classes of poultry. Compared with the census of 1890, the report of 1900 shows an increase of 4.5 per cent in the number of chickens, and a decrease of 38.0 per cent in the number of other classes of poultry. The increase in the number of eggs produced indicates conclusively that the apparent decreases in the numbers of fowls are due to a difference in the methods of enumeration in 1890 and 1900.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the animal products of 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	20,350,721	$4,299,025
Mohair and goat hair	Pounds	469	112
Milk	Gallons	[1] 425,870,394	} [2] 25,383,627
Butter	Pounds	79,551,299	
Cheese	Pounds	1,167,001	
Eggs	Dozens	91,766,630	10,280,769
Poultry			8,847,009
Honey	Pounds	1,980,530	} 252,321
Wax	Pounds	34,620	
Animals sold			40,873,674
Animals slaughtered			10,276,931
Total value			100,213,468

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of milk sold or consumed, and of butter and cheese made.

The value of the animal products of the state for 1899 was $100,213,468. Of this value 51.0 per cent represents the value of animals sold and animals slaughtered on farms; 25.3 per cent, that of dairy produce; 19.1 per cent, that of poultry and eggs; 4.3 per cent, that of wool, mohair, and goat hair; and 0.3 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms in 1899 was $51,150,605, or 25.5 per cent of the gross farm income. Of all farmers reporting live stock, 222,155, or 83.3 per cent, reported animals slaughtered on farms, and 193,642, or 72.6 per cent, reported sales of live animals, the average receipts per farm being $46.26 and $211.08, respectively.

DAIRY PRODUCE.

In 1899 the proprietors of 12,768 farms, or 4.6 per cent of the total number in the state, derived their principal income from the sale of dairy produce. The production of milk in 1899 was 98,944,998 gallons greater than in 1889, a gain of 30.3 per cent. The quantity of butter produced on farms increased 6.1 per cent, and the quantity of cheese made on farms, 9.3 per cent, the development of creameries and the increased consumption of milk and cream in cities accounting for the smallness of the increases.

Of the $25,383,627 given in Table 16 as the value of dairy produce, $15,484,849, or 61.0 per cent, represents the value of such produce sold, and $9,898,778, or 39.0 per cent, the value of that consumed on farms. Of the former amount, $8,303,626 was derived from the sale of 84,543,703 gallons of milk; $6,896,334 from 47,118,140 pounds of butter; $213,716 from 429,143 gallons of cream; and $71,173 from 1,047,202 pounds of cheese.

POULTRY AND EGGS.

Of the $19,127,778 given as the value of poultry products, 53.7 per cent represents the value of eggs produced, and 46.3 per cent the value of poultry raised. The 91,766,630 dozens of eggs reported in 1900 are 21,604,390 dozens, or 30.8 per cent, more than were reported in 1890.

WOOL.

The production of wool was greatest in 1880. There was a decrease for the last decade of 3.0 per cent. That this decrease was not so great as that shown in the number of sheep in Table 15 is due to the facts that the average weight of fleeces has increased, and that in 1890 the fleeces of at least 376,906 sheep were not included in the tables, but were given in a general estimate of wool shorn after the census enumeration.

The average weight of fleeces increased from 5.7 pounds in 1889 to 7.0 pounds in 1899, indicating improvement in the grade of sheep kept. Harrison county led in the production of wool, reporting 1,017,810 pounds for 1899, with an average weight of 8.5 pounds per fleece.

HONEY AND WAX.

The production of honey for 1899 was 1,980,530 pounds, and of wax, 34,620 pounds, a decrease in the last decade of 31.6 per cent in quantity of honey, and an increase of 3.3 per cent in quantity of wax.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

Table 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	261,788	878,205	3.5	244,405	818,239	3.3
White farmers	250,211	873,385	3.5	243,135	816,875	3.4
Colored farmers	1,577	4,820	3.1	1,270	2,364	1.9
Owners[1]	178,017	610,193	3.4	176,450	582,100	3.3
Managers	2,879	13,927	4.8	2,734	16,857	5.8
Cash tenants	21,836	77,033	3.5	20,254	78,101	3.9
Share tenants	49,056	177,062	3.6	44,967	142,181	3.2
Under 20 acres	25,662	41,671	1.6	22,187	33,503	1.5
20 to 99 acres	134,997	386,711	2.9	131,784	360,386	2.7
100 to 174 acres	65,078	282,177	4.3	64,776	277,379	4.3
175 to 259 acres	17,935	102,124	5.7	17,740	95,581	5.4
260 acres and over	8,116	65,522	8.1	7,918	51,390	6.5
Hay and grain	71,067	270,612	3.8	66,682	197,182	3.0
Vegetable	6,067	14,056	2.3	4,307	8,265	1.9
Fruit	4,166	9,367	2.2	3,375	7,126	2.1
Live stock	107,834	397,140	3.7	107,074	341,838	3.2
Dairy	11,949	41,369	3.5	12,768	121,323	9.6
Tobacco	5,530	15,310	2.8	4,758	10,915	2.3
Flower and plant	182	364	2.0	89	153	1.7
Nursery	65	276	4.2	64	147	2.3
Miscellaneous[2]	44,928	129,711	2.9	45,388	131,290	2.9

[1] Including "part owners" and "owners and tenants."
[2] Including sugar farms.

CROPS.

The following table gives the statistics of the principal crops of 1899.

Table 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	3,826,013	Bushels	162,055,390	$48,037,895
Wheat	3,209,074	Bushels	50,376,800	32,855,834
Oats	1,115,149	Bushels	42,050,910	10,236,251
Barley	34,058	Bushels	1,053,240	402,977
Rye	17,583	Bushels	257,120	128,072
Buckwheat	13,071	Bushels	164,305	87,242
Broom corn	802	Pounds	537,160	26,317
Kafir corn	12	Bushels	90	49
Flaxseed	3,092	Bushels	29,821	28,935
Clover seed		Bushels	336,318	1,358,494
Grass seed		Bushels	52,403	60,195
Hay and forage	3,015,261	Tons	4,192,871	29,047,532
Tobacco	71,422	Pounds	65,957,100	4,864,191
Hops	3	Pounds	2,910	279
Peanuts	1	Bushels	20	20
Dry beans	1,828	Bushels	19,042	33,307
Dry pease	506	Bushels	7,521	7,410
Potatoes	167,690	Bushels	13,709,238	5,750,058
Sweet potatoes	3,796	Bushels	249,767	158,103
Onions	6,067	Bushels	1,671,442	826,212
Miscellaneous vegetables.	98,279			5,620,024
Maple sugar		Pounds	613,990	48,736
Maple sirup		Gallons	923,519	616,490
Sorghum cane	6,037	Tons	[1]1,855	5,651
Sorghum sirup		Gallons	341,623	121,130
Small fruits	21,121			1,767,357
Grapes	[2]22,955	Centals	791,739	[3]992,746
Orchard fruits	[2]370,769			[4]6,141,118
Nuts				4,871
Forest products				5,625,897
Flowers and plants	685			1,399,957
Seeds	206			33,989
Nursery products	4,699			538,012
Willows	14			1,144
Miscellaneous	2			26,854
Total	12,008,095			156,852,358

[1] Sold as cane.
[2] Estimated from number of vines or trees.
[3] Including value of raisins, wine, etc.
[4] Including value of cider, vinegar, etc.

Of the total value of crops in 1899, corn contributed 30.6 per cent; other cereals, 27.9 per cent; hay and forage, 18.5 per cent; vegetables, including potatoes, sweet potatoes, and onions, 7.9 per cent; fruits and nuts, 5.7 per cent; forest products, 3.6 per cent; tobacco, 3.1 per cent; and all other products, 2.7 per cent.

The average values per acre of crops were as follows: Flowers and plants, $2,043.73; onions, $163.06; nursery products, $114.49; tobacco, $68.10; sweet potatoes, $41.65; potatoes, $34.31; dry pease and beans, $17.45; orchard fruits, $16.56; and cereals, $11.17.

CEREALS.

The following table is an exhibit of the changes in cereal production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

Year.[1]	Barley.	Buck-wheat.	Corn.	Oats.	Rye.	Wheat.
1899	34,058	13,071	3,826,013	1,115,149	17,583	3,209,074
1889	37,092	14,052	3,189,553	1,215,355	59,643	2,269,585
1879	57,482	22,130	3,281,923	910,388	29,499	2,556,134

PART 2.—BUSHELS PRODUCED.

Year.	Barley.	Buck-wheat.	Corn.	Oats.	Rye.	Wheat.
1899	1,053,240	164,305	152,055,390	42,050,910	257,120	50,376,800
1889	1,059,915	162,833	113,892,318	40,136,732	1,007,156	35,559,208
1879	1,707,129	280,229	111,877,124	28,664,505	389,221	46,014,869
1869	1,715,221	180,341	67,501,144	25,347,549	846,890	27,882,159
1859	1,663,868	2,370,650	73,543,190	15,409,234	683,686	15,119,047
1849	354,358	638,060	59,078,695	13,472,742	425,918	14,487,351

[1] No statistics of acreage were secured prior to 1879.

The total area devoted to cereals in 1879 was 6,857,556 acres; in 1889, 6,785,280 acres; and in 1899, 8,214,948 acres. The total number of bushels produced in 1849 was 88,457,124, and in 1899, 245,957,765, showing an increase in fifty years of 157,400,641 bushels, or almost twice the quantity produced in 1849. The increases in acreage under cereals in the decade from 1889 to 1899, were: Wheat, 41.4 per cent, and corn, 20.0 per cent. The decreases were: Oats and barley, each 8.2 per cent; rye, 70.5 per cent; and buckwheat, 7.0 per cent.

Of the total area under cereals in 1899, 46.6 per cent was devoted to corn; 39.0 per cent to wheat; 13.6 per cent to oats; 0.4 per cent to barley; and 0.4 per cent to rye and buckwheat.

Corn, oats, and wheat were raised extensively throughout the state. Henry and Hamilton counties, in the western part, reported 13.5 per cent of the total area under rye, and Henry and Paulding counties 28.5 per cent of the total acreage devoted to barley. The largest acreages in buckwheat were in the northern section, Lucas and Ashtabula counties reporting 36.2 per cent of the total area devoted to this grain.

HAY AND FORAGE.

In 1900, 220,089 farmers, or 79.5 per cent of the total number, reported hay and forage crops. Exclusive of cornstalks, they obtained an average yield of 1.2 tons per acre. The acreage in hay and forage in 1899 was 3,015,261, or 0.8 per cent greater than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 3,548 acres and 3,563 tons; millet and Hungarian grasses, 13,048 acres and 19,552 tons; alfalfa or lucern, 2,799 acres and 3,944 tons; clover, 617,516 acres and 773,857 tons; other tame and cultivated grasses, 2,276,898 acres and 2,627,989 tons; grains cut green for hay, 60,813 acres and 77,749 tons; crops grown for forage, 40,639 acres and 123,068 tons; cornstalks, 446,079 acres and 563,149 tons.

In Table 18 the production of cornstalks is included under "hay and forage," but the acreage is included under "corn," as the forage secured was only an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 may be seen in the following table.

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	12,952,625	10,860,613	20,617,480	13,789,278
Apricots	5,348	6,077	449	434
Cherries	697,270	368,311	192,954	117,330
Peaches	6,363,127	1,882,191	240,686	687,112
Pears	921,412	353,232	244,565	279,831
Plums and prunes	892,441	145,832	81,485	17,921

The total number of trees in the state in 1890 was 13,616,256, and in 1900, 21,832,223, an increase of 8,215,967, or 60.3 per cent, in the decade. The number of apple trees increased 19.3 per cent, and of cherry trees, 89.3 per cent, while the number of peach and pear trees in 1900 was, approximately, three times, and of plum and prune trees six times, as great as in 1890. The number of apricot trees decreased 12.0 per cent.

Of all trees reported in 1900, 59.1 per cent were apple trees; 29.1 per cent, peach trees; 4.2 per cent, pear trees; 4.1 per cent, plum and prune trees; 3.2 per cent, cherry trees; 0.3 per cent, apricot and unclassified trees. The latter class, which is not included in the table, numbered 61,579 and yielded 21,704 bushels of fruit.

The value of orchard products given in Table 18 includes the value of 400,578 barrels of cider, 71,909 barrels of vinegar, and 1,191,170 pounds of dried and evaporated fruits. Comparisons of the yield of orchard fruits, when made by decades only, are of little importance, as the crop is subject to great seasonal variations.

SMALL FRUITS.

The total area devoted to small fruits in 1899 was 21,121 acres, distributed among 49,113 farms, an average of 0.4 acre per farm. Of the total acreage, 9,373 acres, or 44.4 per cent of the total, were devoted to strawberries, yielding 17,916,080 quarts. The acreages and productions of the other berries were as follows: Raspberries and Logan berries, 6,795 acres and 8,745,950 quarts; blackberries and dewberries, 3,397 acres and 4,905,430 quarts; currants, 765 acres and 1,153,920 quarts; gooseberries, 539 acres and 767,760 quarts; and other small fruits, 252 acres and 246,890 quarts.

FLAX.

Flax was grown in 1899 by 413 farmers. The area devoted to the crop was 3,092 acres, and the yield was 29,821 bushels of seed. Large decreases are shown for the last decade, the acreage in 1899 being but one-seventh, and the production but one-fifth of that reported in 1889. The average yield per acre was 7.1 bushels of seed in 1889, and 9.6 in 1899. The average area per farm in 1899 was 7.5 acres, and the value of the crop per acre, $9.36.

The seven northern counties of Ashland, Medina, Huron, Richland, Lorain, Wayne, and Summit, ranking in the order named, reported 90.1 per cent of the total acreage. Ashland county alone reported four times the acreage of any other county, or 52.5 per cent of the total.

VEGETABLES.

The total area used in the cultivation of vegetables, including potatoes, sweet potatoes, and onions, in 1899, was 274,732 acres. Of this amount 61.0 per cent was devoted to potatoes, 35.8 per cent to miscellaneous vegetables, 1.8 per cent to onions, and 1.4 per cent to sweet potatoes.

Potatoes were reported by 190,745 farmers, or 68.9 per cent of the total number in the state. The average area per farm devoted to potatoes by the farmers reporting them was 0.9 acre, and the average yield was 81.8 bushels per acre. Potatoes were grown throughout the state generally, but the northeastern counties of Cuyahoga, Portage, Ashtabula, Stark, and Trumbull reported 20.7 per cent of the product from 18.9 per cent of the acreage.

Of the 98,279 acres used in the cultivation of other vegetables no detailed reports were received for 55,034 acres, or 56.0 per cent of the total. Of the 43,245 acres whose products were reported in detail, 16,659 were devoted to sweet corn; 10,800, to tomatoes; 6,970, to cabbages; 2,256, to muskmelons; 1,959, to watermelons; 1,432, to cucumbers; 954, to celery; 748, to pease; 306, to beans, and 1,161, to other vegetables.

TOBACCO.

The tobacco crop in Ohio, as in other states, has been subject to many fluctuations during the last fifty years. According to the census of 1850 the state produced 10,454,449 pounds in 1849. That of 1860 showed a gain over this amount of 14,638,132 pounds, or 140.0 per cent, while that of 1870 showed a falling off of 6,350,608 pounds, or 25.3 per cent. Between 1870 and 1880 there was a gain of 15,993,262 pounds, or 85.3 per cent, and between 1880 and 1890 a gain of 3,118,328 pounds, or 9.0 per cent.

In 1899 tobacco was grown in Ohio by 16,666 farmers, who obtained from 71,422 acres a yield of 65,957,100 pounds. This was an increase in area in the last decade of 27,119 acres, or 61.2 per cent, and in production of 28.103,537 pounds, or 74.2 per cent. The total value of the crop was $4,864,191, an average, for each farm reporting, of $291.86. The average yield per acre in 1899 was 923 pounds, as against 854 pounds in 1889, and 1,001 pounds in 1879. The average value in 1899 was 7.4 cents per pound.

Tobacco was grown in 1899 in 71 counties of the state. The leading county was Montgomery, with 18,883 acres, and the second in rank was Darke county, with 11,995 acres. These two counties together contributed 43.2 per cent of the acreage and 43.5 per cent of the production of the state, and with Preble, Warren, Miami, and Brown, furnished 77.6 per cent of the entire area, and 78.7 per cent of the entire production of the state.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was raised by 12,418 farmers, on 5,037 acres, an average of 0.4 acre for each farm reporting. From this area were sold 1,855 tons of cane for $5,651, and from the remaining product manufactured 341,523 gallons of sirup, valued at $121,130. This was a decrease in acreage from 1889 of 32.9 per cent, and in production of 37.6 per cent. The total value of all sorghum products was $126,781, an average of $10.21 for each farm reporting. The crop was distributed over 88 counties of the state, Lawrence county leading with 756 acres.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 685 acres, and the value of the products sold therefrom was $1,399,957. These flowers and plants were grown by 662 farmers and florists, and of this number, 505 made commercial floriculture their principal business. They had invested in the aggregate $2,970,336, of which $1,568,354 represents the value of land and improvements other than buildings; $1,308,956 the value of buildings; $67,850 that of implements and machinery; and $25,176 that of live stock. Their sales of flowers and plants amounted to $1,342,470, and of other products, to $54,060. They expended for labor $273,233, and for fertilizers $11,824.

In addition to the 505 principal florists' establishments, 2,233 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 4,059,484 square feet, making, with the 3,910,706 belonging to the florists' establishments, a total of 7,970,190 square feet.

NURSERIES.

The total value of nursery products sold in 1899 was $538,012, reported by the operators of 317 farms and nurseries. Of this number, 147 derived their principal income from the nursery business. They had 10,818 acres of land, valued at $761,375; buildings worth $247,259; implements and machinery worth $24,040; and live stock worth $30,880. Their total income, exclusive of products fed to live stock, was $522,905, of which $484,539 represents the value of nursery stock, and $38,366 that of other products.

The expenditure for labor was $127,390, and for fertilizers, $4,732.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including tne value of board furnished, was $14,502,600, an average of $52 per farm. The average was highest on the most intensively cultivated farms, being $867 for nurseries, $541 for florists' establishments, $96 for dairy farms, $92 for vegetable farms, $75 for fruit farms, $60 for hay and grain farms, $44 for live-stock farms, $35 for tobacco farms, and $28 for sugar farms. "Managers" expended on an average $219; "cash tenants," $53; "share tenants," $49; and "owners," $47. White farmers expended $53 per farm, and colored farmers, $23.

Fertilizers purchased in 1899 cost $2,695,470, an average of $10 per farm and an increase since 1889 of 68.2 per cent. The average expenditure was $32 for nurseries, $23 for florists' establishments, $15 for vegetable farms, $12 for dairy farms, $10 for live-stock farms, $9 for hay and grain farms, $8 for tobacco farms, $7 for fruit farms, and $5 for sugar farms.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 220. WASHINGTON, D. C. JULY 1, 1902.

AGRICULTURE.

KENTUCKY.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Kentucky, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Kentucky, June 1, 1900, numbered 234,667, and were valued at $382,004,890. Of this amount, $90,887,460, or 23.8 per cent, represents the value of buildings, and $291,117,430, or 76.2 per cent, the value of land and improvements other than buildings. On the same date the value of farm implements and machinery was $15,301,860, and of live stock, $73,739,106. These values, added to that of farms, give $471,045,856, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $123,266,785, of which amount $44,303,940, or 35.9 per cent, represents the value of animal products, and $78,962,845, or 64.1 per cent, the value of crops, including forest products cut or produced on farms. The total value of farm products for 1899 exceeds that for 1889 by $57,318,300, or 86.9 per cent, but a part of this increase is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $21,128,530, leaving $102,138,255 as the gross farm income. The ratio which the latter amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Kentucky in 1899 it was 21.7 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Kentucky.

Very respectfully,

L. G. Powers.
Chief Statistician for Agriculture.

KENTUCKY.

GENERAL STATISTICS.

Kentucky has a total land surface of 40,000 square miles, or 25,600,000 acres, of which 21,979,422 acres, or 85.9 per cent, are included in farms.

The surface is an elevated plateau sloping from the Appalachian Mountains in the southeast to the Ohio and Mississippi rivers on the north and west. In the western part the surface is generally level, and low in altitude, while some of the mountains in the east attain a height of 2,500 feet above sea level. The Tennessee, Cumberland, Green, Kentucky, and Licking rivers flow into the Ohio and form a succession of river valleys across the State.

The soil is generally favorable for cultivation. In the north central part is situated the blue grass region, renowned for its fertile lands, rich pastures, and superior grades of horses and cattle. Here the soil is enriched by disintegrating limestone of such great depth as to insure almost perpetual fertility. The productive alluvial soil of the river valleys is fertilized by frequent inundations. Corn, tobacco, wheat, and hay are the leading products. Nearly all the hemp produced in the United States is grown in Kentucky. Vegetables and orchard fruits are grown in large quantities in the region along the Ohio River between the cities of Louisville and Cincinnati, which furnish good markets for the products of the state.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the per cent of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	234,667	21,979,422	13,741,968	8,237,454	93.7	62.5
1890	179,264	21,412,229	11,818,882	9,593,347	119.4	55.2
1880	166,453	21,495,240	10,731,683	10,763,557	129.1	49.9
1870	118,422	18,660,106	8,103,850	10,556,256	157.6	43.4
1860	90,814	19,163,261	7,644,208	11,519,053	211.0	39.9
1850	74,777	16,949,748	5,968,270	10,981,478	226.7	35.2

The number of farms reported June 1, 1900, was more than three times the number reported in 1850, and 30.9 per cent greater than in 1890. The total acreage of farm land shows alternating increases and decreases through the five decades. For the last decade, a gain of 2.6 per cent is shown. The fact that the number of farms has increased more rapidly than the total acreage indicates a progressive division of farm holdings, and a decrease in the average size of farms. The steady increase in the acreage and per cent of improved farm land is in keeping with this movement.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$471,045,856	$382,004,890	$15,301,860	$73,739,106	$123,266,785
1890	428,170,266	346,339,360	10,906,506	70,924,400	65,948,485
1880	358,703,832	299,298,631	9,734,634	49,670,567	63,850,155
1870[2]	386,099,155	311,238,916	8,572,896	66,287,343	[3]87,477,374
1860	360,839,765	291,496,955	7,474,573	61,868,237	....
1850	189,851,735	155,021,262	5,169,037	29,661,436	....

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

The gain in the last decade in the total value of farm property was $42,875,590, or 10.0 per cent. The increase in the value of land, improvements, and buildings was $35,665,530, or 10.3 per cent; in that of implements and machinery, $4,395,354, or 40.3 per cent; and in that of live stock, $2,814,706, or 4.0 per cent. The value of the farm products of 1899 was 86.9 per cent greater than that reported for 1889. A portion of this increase, and of that shown for implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous census years.

COUNTY STATISTICS.

Table 3 gives a statement of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	234,667	226,408	21,979,422	13,741,968	$291,117,430	$90,887,460	$15,301,860	$73,739,106	$102,138,255	$6,613,330	$908,250
Adair	2,422	2,349	225,257	124,365	1,214,900	454,950	93,540	496,380	498,088	19,190	10,580
Allen	2,345	2,265	199,540	120,341	1,062,970	396,630	104,710	551,600	713,637	29,130	10,050
Anderson	1,255	1,224	116,658	97,378	1,443,120	658,440	101,730	461,380	528,023	29,480	390
Ballard	1,440	1,391	130,497	84,401	1,636,070	476,880	142,160	509,854	728,825	50,620	1,480
Barren	3,321	3,231	285,706	214,010	2,490,340	1,072,080	185,720	888,139	1,302,458	48,330	12,190
Bath	2,027	1,917	151,266	124,200	3,224,790	794,560	104,670	741,418	996,300	53,760	1,610
Bell	1,420	1,351	143,288	41,074	706,970	234,160	26,340	243,613	325,770	9,640	430
Boone	1,698	1,540	149,191	137,304	4,416,450	1,673,210	187,620	838,759	1,110,368	77,910	9,260
Bourbon	1,348	1,274	174,383	155,849	10,481,060	2,154,820	233,740	1,824,275	1,947,600	242,530	900
Boyd	708	637	65,111	44,741	627,260	222,460	43,830	231,741	261,999	13,400	1,130
Boyle	875	851	108,831	80,138	3,661,240	1,039,650	130,120	713,727	708,916	65,320	1,630
Bracken	1,711	1,661	126,953	112,255	2,902,320	1,042,090	139,560	471,936	1,033,680	34,600	2,860
Breathitt	2,048	1,986	261,547	59,914	805,100	200,670	31,410	348,964	478,507	22,620	1,480
Breckinridge	2,815	2,689	357,903	231,596	1,973,760	858,770	184,190	850,609	1,107,037	60,800	35,270
Bullitt	1,173	1,165	167,809	95,111	1,647,930	640,600	136,450	493,741	601,986	48,700	10,510
Butler	2,223	2,187	231,107	121,962	962,380	342,340	86,100	549,439	723,134	21,640	3,220
Caldwell	1,760	1,736	195,666	140,299	1,681,130	631,050	134,310	629,124	752,813	51,480	10,560
Calloway	2,798	2,780	232,935	137,196	1,557,480	612,740	157,700	654,818	1,010,796	35,880	4,190
Campbell	1,622	1,595	85,037	73,994	2,914,990	1,283,860	229,120	439,451	1,013,224	62,750	2,810
Carlisle	1,441	1,404	114,108	78,349	1,692,820	475,810	161,580	474,050	702,607	28,960	990
Carroll	1,254	1,182	92,890	78,658	1,943,470	723,870	103,640	384,105	672,172	36,860	2,480
Carter	2,738	2,668	211,927	113,327	1,070,990	458,680	71,470	505,178	650,163	26,040	690
Casey	2,435	2,373	237,612	93,306	1,165,670	404,710	89,910	477,997	543,994	21,410	3,170
Christian	4,162	4,036	416,347	300,408	5,871,240	1,922,170	465,070	1,310,126	2,601,693	306,160	43,590
Clark	1,373	1,296	146,997	124,451	6,199,960	1,273,030	150,690	1,170,465	1,261,054	93,720	1,790
Clay	2,477	2,353	244,735	90,838	1,015,140	240,360	38,020	448,212	563,227	17,800	50
Clinton	1,269	1,252	114,076	69,190	524,050	190,940	38,780	226,307	297,014	14,960	3,920
Crittenden	2,209	2,142	220,309	151,717	1,847,630	653,560	151,860	668,716	788,025	41,990	10,050
Cumberland	1,526	1,383	167,216	67,217	659,190	288,410	46,930	297,789	417,710	16,860	700
Daviess	3,616	3,464	282,184	236,221	6,764,450	1,931,170	382,360	1,163,700	2,212,317	159,140	24,230
Edmonson	1,631	1,303	149,227	78,268	582,860	227,430	50,800	310,641	403,204	9,190	6,760
Elliott	1,697	1,636	150,619	75,565	554,820	208,930	29,820	308,962	348,831	8,410	920
Estill	1,665	1,626	138,189	63,334	751,050	231,670	43,200	336,846	411,187	14,760	1,190
Fayette	1,246	1,210	178,894	139,919	12,032,270	3,163,170	341,990	3,463,010	2,626,023	374,300	7,870
Fleming	2,627	2,410	204,617	162,634	3,834,840	1,233,360	178,680	967,394	1,338,149	71,780	4,420
Floyd	2,490	2,345	244,725	76,815	993,360	266,530	39,260	441,810	606,705	18,290	340
Franklin	1,668	1,619	129,042	110,876	2,802,160	993,600	141,130	662,227	800,864	66,150	1,760
Fulton	1,001	925	87,086	69,091	2,164,590	461,010	115,270	393,901	698,996	57,730	500
Gallatin	797	731	63,062	57,264	1,274,900	423,320	57,270	265,169	444,642	15,820	340
Garrard	1,306	1,278	129,460	113,554	2,836,950	826,880	115,830	754,699	900,769	49,060	1,280
Grant	2,056	1,972	154,892	139,986	2,924,920	1,121,940	140,680	660,366	1,061,985	66,670	13,450
Graves	4,526	4,431	328,564	241,066	3,536,000	1,265,320	313,570	1,137,068	1,949,072	70,870	3,580
Grayson	3,125	3,036	291,623	175,702	1,356,830	547,320	134,920	717,620	818,881	26,080	33,300
Green	2,172	2,078	145,957	124,142	1,049,660	433,140	90,110	471,962	523,922	17,170	10,480
Greenup	1,897	1,867	162,747	76,412	1,158,190	357,060	74,230	389,116	543,989	21,950	2,510
Hancock	1,332	1,292	107,081	76,284	921,850	360,230	74,670	333,503	471,670	20,810	5,790
Hardin	3,155	3,071	362,814	255,252	3,769,690	1,314,500	286,760	1,156,840	1,447,279	94,020	60,020
Harlan	1,674	1,608	179,486	46,975	835,000	180,590	34,400	288,967	333,999	7,510	150
Harrison	2,456	2,365	194,480	170,330	4,591,660	1,441,650	193,910	1,020,905	1,472,477	83,020	2,540
Hart	2,861	2,783	240,523	167,729	2,183,810	803,660	136,190	713,511	947,794	46,030	14,930
Henderson	2,832	2,684	267,717	216,725	6,555,860	1,416,690	285,540	1,005,835	2,035,966	220,280	10,300
Henry	2,127	2,069	175,727	154,934	3,922,970	1,339,680	154,980	798,996	1,340,339	54,400	2,560
Hickman	1,432	1,376	117,634	89,277	2,399,260	682,780	166,940	541,046	901,478	68,240	410
Hopkins	2,954	2,723	278,453	179,098	2,811,820	903,040	197,050	724,460	1,206,462	43,500	12,760
Jackson	1,799	1,766	156,422	65,224	611,230	174,330	29,190	318,621	428,418	9,350	140
Jefferson	2,827	2,774	208,733	167,246	13,988,910	4,048,340	568,220	1,232,891	2,649,122	393,790	90,390
Jessamine	983	964	98,698	88,152	3,908,080	1,146,950	144,630	591,531	989,118	103,550	2,890
Johnson	2,262	2,147	166,727	85,441	879,430	281,870	31,690	370,328	470,649	10,360	720
Kenton	1,392	1,364	95,248	86,867	3,296,050	1,257,660	194,530	521,291	974,343	71,450	3,230
Knott	1,392	1,354	184,687	39,007	536,440	101,860	19,480	218,891	282,477	4,260	250
Knox	2,318	2,248	199,218	96,026	1,032,720	301,370	50,460	439,249	561,912	23,220	1,420
Larue	1,631	1,481	156,641	108,307	1,367,320	481,500	121,320	463,367	653,320	31,850	33,610
Laurel	2,330	2,283	204,876	92,779	923,330	398,880	70,020	437,106	582,569	16,690	5,190
Lawrence	2,959	2,857	247,661	131,013	1,197,510	469,710	73,900	692,187	783,290	29,680	320
Lee	1,022	1,001	87,834	30,736	395,970	106,630	19,520	174,867	271,776	5,750	130
Leslie	982	969	173,079	50,858	433,160	99,290	21,390	203,613	262,633	4,340	70
Letcher	1,487	1,437	162,881	49,876	583,070	159,250	23,580	257,241	327,406	8,590	310
Lewis	2,476	2,398	219,161	101,670	1,446,660	589,990	108,680	489,826	758,278	18,580	6,690
Lincoln	1,945	1,907	183,723	128,019	3,401,060	1,080,060	167,020	911,610	873,782	63,170	5,290
Livingston	1,556	1,517	183,118	113,281	1,362,960	421,250	112,550	544,960	627,229	36,410	3,120
Logan	3,779	3,619	316,552	221,350	4,284,170	1,376,790	292,260	1,003,197	1,888,294	122,120	48,510
Lyon	1,260	1,196	108,408	64,331	657,070	283,660	63,340	299,449	404,342	21,090	1,490
McCracken	1,559	1,508	133,579	84,704	1,638,060	530,360	162,720	465,689	739,439	27,360	1,660
McLean	1,570	1,501	141,731	98,976	1,725,910	607,240	136,030	476,651	771,048	35,960	5,430
Madison	2,741	2,677	267,159	229,185	6,197,870	1,662,450	168,240	1,719,462	1,498,909	87,390	3,080
Magoffin	1,865	1,796	163,885	67,879	767,010	183,460	27,430	367,942	375,245	11,480	1,470
Marion	1,590	1,553	238,609	140,635	2,679,380	924,250	165,060	797,819	813,117	56,760	7,970
Marshall	2,281	2,218	197,187	121,137	1,333,410	493,850	136,980	505,029	715,914	19,420	3,270
Martin	942	928	94,071	23,859	387,980	109,790	8,280	134,794	173,087	11,050	560
Mason	1,572	1,546	142,690	134,612	6,267,280	1,797,380	206,250	932,472	1,532,838	136,060	3,380

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Meade	1,465	1,411	178,458	115,208	$1,642,770	$580,590	$130,850	$460,007	$544,353	$36,870	$14,360
Menifee	979	959	102,541	32,497	475,290	129,800	24,850	179,275	239,155	8,110	130
Mercer	1,590	1,559	150,780	133,966	3,534,320	1,361,220	196,790	924,864	995,242	78,920	310
Metcalfe	1,864	1,826	166,935	91,992	897,750	366,310	76,200	376,938	482,197	17,350	8,000
Monroe	2,236	2,123	191,291	93,262	874,390	331,770	78,620	431,513	675,975	12,530	3,600
Montgomery	1,222	1,187	131,606	102,724	4,511,550	1,060,060	125,710	906,987	1,116,749	75,830	2,690
Morgan	2,278	2,162	206,918	96,347	941,730	328,190	57,190	469,952	542,084	19,040	620
Muhlenberg	2,701	2,593	249,938	139,501	1,683,270	559,460	138,630	593,292	915,825	26,220	10,630
Nelson	1,716	1,683	224,607	153,862	3,028,690	1,159,750	177,930	869,180	890,548	80,850	12,880
Nicholas	1,634	1,587	119,277	106,611	3,220,540	980,550	126,770	693,209	919,324	36,450	330
Ohio	3,914	3,844	342,349	219,334	2,073,330	941,080	201,920	975,450	1,314,715	46,870	26,050
Oldham	811	790	111,604	88,633	2,304,160	741,430	119,780	489,305	646,907	67,210	21,870
Owen	2,764	2,689	206,042	183,292	4,427,330	1,285,290	168,640	777,817	1,264,831	65,140	920
Owsley	1,223	1,171	110,086	46,721	481,790	169,350	23,980	227,043	249,379	7,930	230
Pendleton	2,483	2,367	158,662	151,818	2,645,300	1,094,760	147,400	672,038	1,031,210	44,100	3,020
Perry	1,347	1,305	171,791	36,435	489,830	134,350	20,020	239,005	271,808	10,580	350
Pike	3,684	3,600	506,010	100,914	1,633,620	446,140	67,760	596,531	871,413	22,120	290
Powell	895	872	107,089	36,662	554,810	147,420	22,560	191,632	262,215	4,740	240
Pulaski	4,506	4,388	367,586	186,989	2,123,630	663,390	135,220	796,585	921,653	24,450	11,380
Robertson	979	887	59,360	54,386	938,480	360,070	51,980	265,683	397,573	6,040	....
Rockcastle	1,747	1,723	164,117	74,611	909,440	320,100	53,340	318,887	390,942	6,870	2,730
Rowan	1,112	1,074	111,335	57,188	361,110	144,630	27,360	190,118	227,329	8,220	70
Russell	1,719	1,656	147,395	65,026	600,640	229,420	50,080	292,327	382,996	8,540	6,840
Scott	1,921	1,845	186,173	170,071	6,677,000	1,813,730	194,200	1,009,026	1,622,923	162,500	3,090
Shelby	1,997	1,972	234,135	205,940	7,151,170	2,236,040	266,720	1,287,102	1,996,915	168,750	15,510
Simpson	1,608	1,656	115,580	87,626	1,933,610	700,590	144,340	467,227	771,884	33,460	20,960
Spencer	1,084	1,009	117,087	93,739	1,672,180	636,260	105,090	639,683	693,307	61,410	2,110
Taylor	1,565	1,548	139,879	93,326	845,470	377,270	86,810	319,448	309,380	19,980	15,300
Todd	2,088	1,965	217,897	156,313	2,585,660	923,580	166,750	581,655	1,056,515	132,180	23,430
Trigg	1,834	1,797	229,492	137,679	1,624,610	558,600	124,330	539,692	854,428	52,620	6,840
Trimble	1,317	1,286	81,764	62,585	1,643,040	532,250	81,970	351,584	563,677	18,770	11,890
Union	2,279	2,195	198,638	175,697	6,424,160	1,181,720	284,730	983,860	1,655,268	153,960	3,380
Warren	3,145	3,020	310,169	223,919	4,438,580	1,496,080	242,610	1,003,761	1,543,059	110,670	17,310
Washington	2,052	1,996	187,731	156,121	2,702,220	1,087,510	170,320	863,651	1,017,484	65,990	1,980
Wayne	2,304	2,193	286,314	121,483	1,055,880	361,740	60,320	613,729	566,435	22,380	4,830
Webster	2,715	2,567	196,358	144,647	3,288,890	833,960	191,820	679,107	1,189,371	62,190	13,380
Whitley	3,111	3,024	276,736	116,503	1,398,100	386,260	76,560	561,940	723,381	18,020	1,360
Wolfe	1,390	1,342	146,880	65,498	712,800	225,490	31,430	287,102	341,803	15,760	310
Woodford	1,053	1,000	118,690	101,653	5,429,170	1,584,210	197,120	632,462	1,333,649	183,290	280

The number of farms increased in nearly all counties in the last decade, Bracken and Kenton alone reporting decreases. Nearly three-fourths of the counties report an increase in the total area of farm land since 1890. The decreases are mainly in the eastern half of the state. The smaller area of improved land reported in several of the counties is due to a more intensive cultivation of the soil, and to the use of a more strict construction of the term "improved" by the Twelfth than by any preceding census. The average size of farms is smallest in the northeastern counties, where tobacco and corn occupy a large area, and largest in the counties raising live stock. The average size for the state is 93.7 acres, and in the majority of counties the farms do not vary greatly from this average.

In a number of instances the counties whose farm areas decreased also report a decrease in the value of farms. The average value for the state is $1,627.86. Four counties, Campbell, Morgan, Owsley, and Todd, report a decrease in the value of implements and machinery, the majority of the others showing extensive increases. The value of live stock increased in more than two-thirds of the counties.

The expenditure for labor in 1899 averaged $28.18 per farm, and varied greatly in the different counties. For fertilizers, the total expenditure was nearly three times as great in 1899 as in 1889. The average per farm in 1899 was $3.87. Decreases are reported by two counties only, Bullitt and Robertson.

FARM TENURE.

Table 4 gives a comparative statement of farm tenure in 1880, 1890, and 1900. Tenants are divided into two groups: "Cash tenants," who pay a rental in cash or in a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, and "farms operated by owners" are subdivided into groups, designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive a fixed salary from the owners for their supervision ana other services.

Table 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	234,667	157,602	16,776	60,289	67.2	7.1	25.7
1890	179,264	134,529	14,524	30,211	75.1	8.1	16.8
1880	166,453	122,426	16,824	27,203	73.6	10.1	16.3

[1] Including "part owners," "owners and tenants," and "managers."

Table 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

Part 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	234,667	137,557	14,659	3,780	1,606	16,776	60,289
White	223,429	133,317	13,679	3,698	1,543	15,987	55,305
Colored[1]	11,238	4,240	1,080	82	63	789	4,984

Part 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

The State	100.0	68.6	6.2	1.6	0.7	7.2	25.7
White	100.0	59.7	6.1	1.6	0.7	7.2	24.7
Colored[1]	100.0	37.7	9.6	0.7	0.6	7.0	44.4

[1] Comprising 11 Indians and 11,227 negroes.

Since 1880 the total number of farms has increased 68,214; the number operated by owners, 35,176; and by tenants, 33,038. From 1890 to 1900 the total number of farms increased 55,403, or 30.9 per cent; that of owners 23,073, or 17.2 per cent; and that of tenants 32,330, or 72.3 per cent. The number of share tenants in 1900 is approximately twice that reported for 1890, but the number of cash tenants shows but a slight increase in the last decade, and is less for 1900 than for 1880.

Of the total number of farms in the state in 1900, 25.7 per cent were operated by share tenants. This percentage is an increase of 8.9 since 1890, while the percentages for owners and cash tenants show corresponding decreases.

Of the farms in Kentucky, 95.2 per cent are operated by white farmers and 4.8 per cent by colored farmers. Of the white farmers, 67.4 per cent own all or part of the farms they operate and 32.6 per cent operate farms owned by others. For colored farmers, the corresponding percentages are 48.1 and 51.9.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

Table 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	234,667	93.7	21,979,422	100.0	$471,045,856	100.0
White farmers	223,429	96.4	21,531,566	98.0	460,091,384	97.7
Colored farmers[1]	11,238	39.9	447,856	2.0	10,954,472	2.3
Owners	137,557	112.1	15,421,128	70.2	300,445,967	63.8
Part owners	14,659	96.5	1,414,173	6.4	37,858,886	8.0
Owners and tenants	3,780	132.0	499,023	2.3	10,510,999	2.2
Managers	1,606	225.5	362,219	1.6	12,453,771	2.7
Cash tenants	16,776	79.3	1,329,615	6.1	42,842,071	9.1
Share tenants	60,289	49.0	2,953,264	13.4	66,934,162	14.2

[1] Comprising 11 Indians and 11,227 negroes.

Table 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,241	$387	$65	$314	$435	21.7
White farmers	1,270	399	67	323	444	21.5
Colored farmers[1]	644	153	32	146	270	27.7
Owners	1,301	451	74	358	458	21.0
Part owners	1,650	462	87	384	555	21.5
Owners and tenants	1,649	575	103	454	608	21.9
Managers	4,797	1,325	174	1,459	1,048	13.5
Cash tenants	1,750	411	71	322	492	19.3
Share tenants	741	180	32	157	310	28.0

[1] Comprising 11 Indians and 11,227 negroes.

White farmers cultivate 98.0 per cent of the farm area and their property represents 97.7 per cent of the total value. For colored farmers the corresponding percentages are 2.0 and 2.3, respectively.

As shown in Table 6, the average number of acres per farm is largest for the farms of "managers." The average value per acre, and the average value per farm under Table 7, are highest for the same group. The lowest average values per farm are shown for tenant-operated farms. The relatively high per cent of gross income shown for farms operated by share tenants and for those operated by negroes must not be construed as evidence of superior farm management. This condition is the result of a system of tenure whereby many estates formerly cultivated by hired labor are now divided into small tracts which are leased and reported as tenant farms. The tracts not so leased by the owners, including the main buildings but less productive land, constitute the farms as reported by such owners. The large per cent of gross income shown for colored farmers is due also to the smaller average size of their farms, and to the lower value of their farm property.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	234,667	93.7	21,979,422	100.0	$471,045,856	100.0
Under 3 acres	1,175	2.2	2,641	(1)	888,446	0.2
3 to 9 acres	14,960	6.3	94,460	0.4	6,482,363	1.4
10 to 19 acres	26,769	13.7	367,939	1.7	15,204,769	3.2
20 to 49 acres	51,850	32.0	1,658,283	7.6	52,191,359	11.1
60 to 99 acres	60,435	68.9	4,161,328	18.9	83,377,574	17.7
100 to 174 acres	48,564	125.8	6,107,837	27.8	114,537,839	24.3
175 to 259 acres	17,480	207.6	3,629,315	16.5	74,630,621	15.9
260 to 499 acres	10,406	332.3	3,458,131	15.7	76,803,655	16.3
500 to 999 acres	2,470	612.9	1,513,808	6.9	33,602,346	7.1
1,000 acres and over	558	1,766.5	985,680	4.5	13,326,884	2.8

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,241	$387	$65	$314	$435	21.7
Under 3 acres	305	337	25	89	266	35.2
3 to 9 acres	201	148	16	68	127	29.3
10 to 19 acres	309	139	20	100	185	32.6
20 to 49 acres	623	194	35	155	269	26.8
50 to 99 acres	811	280	55	234	356	25.8
100 to 174 acres	1,405	489	86	378	525	22.3
175 to 259 acres	2,700	798	132	639	815	19.1
260 to 499 acres	4,829	1,276	194	1,082	1,238	16.8
500 to 999 acres	9,233	2,031	279	2,061	2,082	15.3
1,000 acres and over	17,308	2,857	325	3,393	3,027	12.7

Of the total number of farms, the group containing farms of 50 to 99 acres each comprises 25.8 per cent. The sixth group, or that of medium-sized farms, containing from 100 to 174 acres each, represents approximately one-fourth of both the total farm acreage and the total value of farm property.

For the two groups of farms containing less than 10 acres each, the average values given in table 9 are relatively high, as these groups contain most of the florists' establishments and a number of city dairies. The income from these industries is determined not so much by the acreage of land used as by the amount of capital invested in buildings and implements, and by the amounts expended for labor and fertilizers.

The average gross incomes per acre for the various groups classified by area are as follows: Farms under 3 acres, $118.46; 3 to 9 acres, $20.09; 10 to 19 acres, $13.45; 20 to 49 acres, $8.42; 50 to 99 acres, $5.17; 100 to 174 acres, $4.18; 175 to 259 acres, $3.93; 260 to 499 acres, $3.71; 500 to 999 acres, $3.40; 1,000 acres and over, $1.71.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40 per cent of the value of such products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40 per cent of their income from any one class of products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	234,667	93.7	21,979,422	100.0	$471,045,856	100.0
Hay and grain	53,397	94.7	5,056,310	23.0	115,255,486	24.5
Vegetables	4,319	39.9	172,186	0.8	10,497,678	2.2
Fruits	1,918	84.7	162,534	0.7	3,630,907	0.8
Live stock	78,547	108.0	8,481,529	38.6	174,147,432	37.0
Dairy produce	2,443	87.4	213,402	1.0	10,726,118	2.3
Tobacco	35,406	72.9	2,581,938	11.7	78,911,706	16.7
Cotton	162	107.8	17,465	0.1	469,726	0.1
Sugar	72	65.0	4,679	(1)	100,626	(1)
Flowers and plants	77	4.8	366	(1)	537,731	0.1
Nursery products	26	120.3	3,128	(1)	207,427	(1)
Miscellaneous	58,300	90.7	5,285,885	24.1	76,561,019	16.3

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,241	$387	$65	$314	$435	21.7
Hay and grain	1,442	385	69	262	415	19.2
Vegetables	1,686	613	77	155	384	15.8
Fruits	1,141	461	82	209	480	25.3
Live stock	1,277	430	70	440	442	20.0
Dairy produce	2,760	953	129	549	829	18.9
Tobacco	1,446	430	70	283	594	26.7
Cotton	1,961	487	105	347	784	27.0
Sugar	908	275	56	159	268	19.2
Flowers and plants	3,410	3,314	214	46	2,825	40.5
Nursery products	5,810	1,759	270	139	4,288	53.8
Miscellaneous	782	266	48	217	327	24.9

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $594.37; nursery products, $35.65; vegetables, $9.63; dairy produce, $9.49; tobacco, $8.15; cotton, $7.27; fruits, $5.66; hay and grain, $4.38; sugar, $4.12; live stock, $4.10; and miscellaneous products, $3.61.

The wide variations shown in the averages and in the percentages of gross income are largely due to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than in the case of "hay and grain," "live-stock," or "miscellaneous" farms. Were it possible to present the average net income, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	234,667	93.7	21,979,422	100.0	$471,045,856	100.0
$0	1,788	40.2	71,886	0.3	1,481,710	0.3
$1 to $49	9,909	28.3	280,861	1.3	3,401,340	0.7
$50 to $99	22,003	38.6	849,009	3.9	9,668,410	2.1
$100 to $249	76,471	61.5	4,699,249	21.4	54,885,090	11.6
$250 to $499	66,561	92.8	6,174,858	28.1	93,377,326	19.8
$500 to $999	37,980	132.9	5,046,857	22.9	112,446,720	23.9
$1,000 to $2,499	16,545	209.4	3,464,374	15.8	120,623,610	25.6
$2,500 and over	3,410	408.3	1,392,328	6.3	75,161,650	16.0

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,241	$387	$65	$314	$435	21.7
$0	624	102	18	85	....	....
$1 to $49	210	70	10	53	28	8.2
$50 to $99	251	92	13	83	70	16.1
$100 to $249	400	147	25	146	166	23.2
$250 to $499	793	286	54	270	348	24.8
$500 to $999	1,802	604	109	446	680	22.1
$1,000 to $2,499	4,791	1,368	218	914	1,444	19.8
$2,500 and over	15,052	3,543	491	2,966	4,305	19.5

The absence of income in the first group is due in part to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. Frequently the persons in charge of such farms on June 1, 1900, could not give definite information concerning the products of the preceding year. The same statement is true, also, of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete exhibit of farm income in 1899. Other farms with small reported incomes are doubtless the suburban or summer homes of city merchants and professional men, who derive their principal incomes from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	250,502	$2,480,227	$9.90	6,497
Steers	1 and under 2	141,943	2,851,193	20.09	945
Steers	2 and under 3	107,655	3,326,702	30.90	2,599
Steers	3 and over	49,580	2,140,220	43.17	1,378
Bulls	1 and over	12,937	431,512	33.35	130
Heifers	1 and under 2	104,861	1,880,432	17.93	1,045
Cows kept for milk	2 and over	364,025	10,518,031	28.89	23,583
Cows and heifers not kept for milk.	2 and over	51,745	1,359,424	26.27	314
Colts	Under 1	26,487	1,062,057	40.10	576
Horses	1 and under 2	24,927	1,428,700	57.32	611
Horses	2 and over	400,283	22,057,785	55.11	44,361
Mule colts	Under 1	20,710	600,746	29.01	191
Mules	1 and under 2	20,945	933,563	44.57	207
Mules	2 and over	149,010	9,571,244	64.23	7,047
Asses and burros	All ages	5,259	459,210	87.32	379
Lambs	Under 1	581,185	1,779,651	3.06	993
Sheep (ewes)	1 and over	647,838	2,172,170	3.35	2,018
Sheep (rams and wethers).	1 and over	68,320	239,384	3.50	478
Swine	All ages	1,954,537	5,176,183	2.65	54,452
Goats	All ages	11,967	19,753	1.65	636
Fowls:[1]					
Chickens[2]		6,849,079	2,723,221		
Turkeys		279,749			
Geese		541,576			
Ducks		185,064			
Bees (swarms of)		203,820	527,098	2.59	
Unclassified			600		
Value of all live stock.			73,739,106		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including guinea fowls.

The value of live stock on farms, June 1, 1900, was $73,739,106. Of this amount 33.3 per cent represents the value of horses; 19.6 per cent, that of neat cattle other than dairy cows; 15.0 per cent, that of mules; 14.3 per cent, that of dairy cows; 7.0 per cent, that of swine; 5.7 per cent, that of sheep; 3.7 per cent, that of poultry; and 1.4 per cent, that of all other live stock.

The average prices of all young horses are high, and prices of horses 1 and under 2 years old are higher than of horses over 2 years old. This is due to the fact that Kentucky contains many extensive stock farms devoted exclusively to the breeding and training of fine horses.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, the value of live stock not on farms, exclusive of poultry and bees, June 1, 1900, was $4,095,901, and the total value of live stock in the state was approximately $77,835,007.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the number of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	364,025	719,223	451,697	195,924	716,158	1,954,537
1890	364,516	701,575	401,356	151,649	937,124	2,036,746
1880	301,882	541,912	372,648	116,153	1,000,269	2,225,225
1870	247,615	452,712	317,034	99,230	936,765	1,838,227
1860	269,215	566,844	355,704	117,634	938,990	2,330,595
1850	247,475	505,037	315,682	65,609	1,102,091	2,891,163

[1] Lambs not included.

Many fluctuations in the numbers of the different classes of live stock are shown, but, with the exception of the decade including the Civil War period, the numbers of all neat cattle, horses, and mules show quite regular increases throughout the half century. Since 1880 the numbers of sheep and swine have decreased.

For the decade following 1890 the number of dairy cows shows a decrease of 0.1 per cent, probably due to the close restriction of the term "dairy cows" by the census of 1900 to "cows kept for milk" exclusively, while many cows which were milked at some time in the year, but were dry at the time of enumeration, were classed with "cows and heifers not kept for milk," and consequently with "other neat cattle." The numbers of sheep and swine show decreases in the last decade of

23.6 per cent and 4.0 per cent, respectively. The following increases in numbers were shown for the same period: Mules and asses, 29.2 per cent; horses, 12.5 per cent; and neat cattle other than dairy cows, 2.5 per cent.

In 1900 the enumerators were instructed to report no fowls under three months old, which limitation was not made in previous census reports. This fact partially accounts for the decrease in numbers of all classes of domestic fowls in the decade 1890 to 1900. The decreases in numbers of fowls for that period are as follows: Turkeys, 58.4 per cent; ducks, 50.0 per cent; chickens, 46.2 per cent; and geese, 44.0 per cent.

ANIMAL PRODUCTS.

Table 16 is a summarized exhibit of the animal products of 1899.

Table 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS, IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	3,617,497	$737,632
Mohair and goat hair	Pounds	524	163
Milk	Gallons	[1] 159,311,527	[2] 9,985,540
Butter	Pounds	30,446,381	
Cheese	Pounds	45,759	
Eggs	Dozens	35,337,340	3,460,607
Poultry			4,970,063
Honey	Pounds	2,681,720	291,179
Wax	Pounds	53,120	
Animals sold			16,660,676
Animals slaughtered			8,198,080
Total			44,303,940

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of milk sold or consumed, and of butter and cheese made.

The value of the animal products of the state for 1899 was $44,303,940, or about 60 per cent as great as the value of all live stock on farms, June 1, 1900. Of this amount, 56.1 per cent represents the value of animals sold and animals slaughtered; 22.5 per cent, that of dairy products; 19.0 per cent, that of poultry and eggs; 1.7 per cent, that of wool; and 0.7 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms in 1899 was $24,858,756, or 20.2 per cent of the total value of farm products. Of all farmers in the state reporting live stock, 183,341, or 81.9 per cent, report animals slaughtered, the average value per farm being $44.71. Sales were reported by 122,784 farmers, or 54.9 per cent of all reporting live stock. The average receipts per farm were $135.69. Fayette, Bourbon, and Shelby counties each reported more than $500,000 received from the sale of live animals, the average receipts per farm for Fayette county being $1,169.11. In obtaining these reports the enumerators were instructed to secure from each farm operator a statement of the amount received from sales in 1899, less the amount paid for animals purchased during the same year.

DAIRY PRODUCE.

In 1899, 2,443 farms, or 1.0 per cent of all in the state, received their principal income from the sale of dairy produce. There was an increase of 40,814,238 gallons, or 34.4 per cent, in the production of milk, an increase of 4.8 per cent in amount of butter made on farms, and a decrease of 29.4 per cent in amount of cheese made on farms in the decade 1890 to 1900.

Of the $9,985,540 given in Table 16 as the value of dairy products, $7,691,040, or 77.0 per cent, represents the value of dairy products consumed on farms, and $2,294,500, or 23.0 per cent, the receipts from sales. Of the latter amount, $1,291,641 was received from the sale of 8,923,259 gallons of milk; $953,370, from 5,873,883 pounds of butter; $45,766, from 95,671 gallons of cream; and $3,723, from 37,245 pounds of cheese.

POULTRY, EGGS, WOOL, AND HONEY AND WAX.

Of the $8,430,670 given as the value of poultry and eggs, 59.0 per cent represents the value of poultry raised, and 41.0 per cent that of eggs produced. The production of eggs in 1899 was 10,645,903 dozens greater than in 1889, a gain of 43.1 per cent.

Compared with the production of wool for 1889, that of 1899 shows an increase of 839,964 pounds, or 30.2 per cent. This increase is more apparent than real, owing to the fact that the fleeces of at least 273,757 sheep were omitted from the tables in 1890, but included in a general estimate of wool shorn after the census enumeration. Bourbon, Boone, Clarke, Scott, Mercer, and Harrison counties lead in the production of wool, ranking in the order named and each reporting more than 100,000 pounds as the product of 1899.

The production of apiarian products in 1899 compared with that in 1889 shows an increase of 16.1 per cent in amount of honey, and 42.7 per cent in amount of wax. The counties leading were Pendleton, Pike, Pulaski, and Madison.

HORSES AND COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents for the leading groups of farms the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm
Total	181,179	451,697	2.5	189,905	364,025	1.9
White farmers	174,162	438,815	2.5	183,796	355,845	1.9
Colored farmers	7,017	12,882	1.8	6,109	8,180	1.3
Owners[1]	128,808	339,922	2.6	136,457	278,715	2.0
Managers	1,199	6,114	5.1	1,235	4,036	3.3
Cash tenants	12,617	31,351	2.5	12,546	25,917	2.1
Share tenants	38,555	74,310	1.9	39,667	55,357	1.4
Under 20 acres	23,037	34,380	1.5	24,307	30,722	1.3
20 to 99 acres	87,454	177,661	2.0	91,388	142,941	1.6
100 to 174 acres	42,652	119,097	2.8	44,871	95,903	2.1
175 to 259 acres	15,875	57,839	3.6	16,546	46,450	2.8
260 acres and over	12,161	62,720	5.2	12,793	48,009	3.7
Hay and grain	36,384	88,281	2.4	36,557	65,067	1.8
Vegetable	2,988	5,804	1.9	2,552	4,647	1.8
Fruit	1,533	3,200	2.1	1,412	2,733	1.9
Live stock	66,493	186,830	2.8	69,599	146,660	2.1
Dairy	2,066	6,268	3.0	2,443	18,513	7.6
Tobacco	28,326	73,667	2.6	27,290	44,937	1.6
Miscellaneous[2]	43,389	87,647	2.0	49,952	81,468	1.6

[1] Including "part owners" and "owners and tenants."
[2] Including florists' establishments and nurseries, and cotton and sugar farms.

CROPS.

The following table presents the statistics of the principal crops of 1899.

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	3,319,257	Bushels	73,974,220	$29,423,996
Wheat	1,431,027	Bushels	14,264,500	8,923,760
Oats	316,590	Bushels	4,009,830	1,247,928
Barley	953	Bushels	17,772	8,157
Rye	17,618	Bushels	155,365	88,315
Buckwheat	84	Bushels	879	615
Broom corn	839	Pounds	384,550	18,209
Flaxseed	3	Bushels	10	10
Clover seed		Bushels	7,707	30,933
Grass seed		Bushels	270,973	167,860
Hay and forage	683,139	Tons	776,534	6,100,647
Cotton seed		Tons	[1]660	5,940
Cotton	2,396	Bales	1,369	52,812
Tobacco	384,805	Pounds	314,288,050	18,541,982
Hemp	14,107	Pounds	10,303,560	468,464
Hops	4	Pounds	1,668	113
Peanuts	92	Bushels	1,405	1,353
Dry beans	5,633	Bushels	49,106	57,672
Dry pease	8,394	Bushels	83,089	90,739
Potatoes	37,160	Bushels	2,661,774	1,260,100
Sweet potatoes	14,178	Bushels	925,786	507,038
Onions	1,705	Bushels	305,113	237,694
Miscellaneous vegetables	81,929			4,181,122
Maple sugar		Pounds	2,340	291
Maple sirup		Gallons	2,367	2,450
Sorghum cane	21,982	Tons	[2]22,601	64,984
Sorghum sirup		Gallons	1,277,206	384,292
Small fruits	6,126			435,462
Grapes	[3]2,382	Centals	51,342	[4]112,350
Orchard fruits	[3]230,336			[5]1,943,645
Nuts				8,365
Forest products				4,180,085
Flowers and plants	132			262,288
Seeds	52			8,668
Nursery products	837			114,749
Willows	90			7,007
Miscellaneous	846			22,760
Total	6,582,696			78,962,845

[1] Exclusive of 13 tons, valued at $119, sold in seed cotton and included with the cotton.
[2] Sold as cane.
[3] Estimated from number of vines or trees.
[4] Including value of raisins, wine, etc.
[5] Including value of cider, vinegar, etc.

Of the total value of crops in 1899, cereals contributed 50.3 per cent; vegetables, including potatoes, sweet potatoes, and onions, 7.8 per cent; hay and forage, 7.7 per cent; forest products, 5.3 per cent; fruits, 3.2 per cent; flowers and plants, 0.3 per cent; and all other products, 25.4 per cent.

The average values per acre of crops were: Flowers and plants, $1,987.03; onions, $139.41; nursery products, $137.10; small fruits, $71.08; miscellaneous vegetables, $51.03; tobacco, $48.18; potatoes, $33.91; hay and forage, $8.93; orchard fruits, $8.44; and cereals, $7.81. The crops yielding the greatest returns were grown upon the most highly cultivated land, and required relatively large expenditures for labor and fertilizers.

CEREALS.

The following table is an exhibit of the cereal production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	953	84	3,319,257	316,590	17,618	1,431,027
1889	5,776	384	2,960,382	645,316	45,546	898,694
1879	20,089	1,024	3,021,176	403,416	89,417	1,160,108
PART 2.—BUSHELS PRODUCED.						
1899	17,772	879	73,974,220	4,009,830	155,365	14,264,500
1889	165,959	3,804	78,434,847	8,775,814	423,847	10,707,462
1879	486,326	9,942	72,852,263	4,580,738	668,050	11,356,113
1869	238,486	3,443	50,091,006	6,620,103	1,108,933	5,728,704
1859	270,685	18,928	64,043,633	4,617,029	1,055,260	7,394,809
1849	95,343	16,097	58,672,591	8,201,311	415,073	2,142,822

[1] No statistics of acreage were secured prior to 1879.

The total area devoted to cereals in 1879 was 4,695,230 acres; in 1889, 4,556,098 acres; and in 1899, 5,085,529 acres, an increase in twenty years of 8.3 per cent. The increases in area under cereals in the decade from 1889 to 1899 were: Wheat, 59.2 per cent, and corn, 12.1 per cent. The decreases were: Oats, 50.9 per cent; rye, 61.3 per cent; barley, 83.5 per cent; and buckwheat, 78.1 per cent. The total number of bushels produced in 1849 was 69,543,237, and in 1899, 92,422,566, showing an increase of 32.9 per cent in fifty years.

Of the total area devoted to cereals in 1899, 65.3 per cent was devoted to corn; 28.1 per cent to wheat; 6.2 per cent to oats; 0.4 per cent to rye, barley, and buckwheat.

Corn is raised in all parts of the state. The four counties of Christian, Union, Hardin, and Logan, in the Ohio and Cumberland river valleys, report 13.7 per cent of all the area under wheat, while the largest acreage in oats is reported from the central counties, Barren, Warren, Pulaski, and Grayson, furnish 17.0 per cent of the total area. Barley and buckwheat receive little attention.

HAY AND FORAGE.

In 1900, 86,575 farmers, or 36.9 per cent of the total number, reported hay and forage crops. Exclusive of cornstalks and corn strippings, they obtained an average yield of 0.96 ton per acre. The total area in hay and forage in 1899 was 683,139 acres, or 3.2 per cent greater than ten years before.

The acreages and yields of the various kinds of hay and forage in 1899 were as follows: Wild, salt, and prairie grasses, 6,375 acres and 5,550 tons; millet and Hungarian grasses, 37,653 acres and 37,139 tons; alfalfa, or lucern, 808 acres and 1,056 tons; clover, 158,110 acres and 159,747 tons; other tame and cultivated grasses, 403,211 acres and 370,461 tons; grains cut green for hay, 55,334 acres and 56,911 tons; crops grown for forage, 21,648 acres and 24,202 tons; and cornstalks and corn strippings, 172,809 acres and 121,468 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is included under "corn," as the forage secured was only an incidental product of the corn crop.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was grown by 33,692 farmers on 21,982 acres, an average of 0.65 acre for each farm reporting. From this area they sold 22,601 tons of cane for $64,984, and from the remaining product manufactured 1,277,206 gallons of sirup, valued at $384,292. There was a decrease in acreage from 1889 of 41.0 per cent. The total value of sorghum-cane products was $449,276, an average of $13.33 for each farm reporting, and of $20.44 per acre. The average yield of sirup per acre was 58.1 gallons, not including the product of the cane sold, compared with 56.3 gallons in 1889. The average value per gallon was 30.1 cents.

HEMP.

Hemp was grown in 1899 by 937 farmers on 14,107 acres, from which they produced 10,303,560 pounds, a decrease since 1889 of 39.9 per cent in acreage and of 52.3 per cent in production. The largest crop ever reported was in 1859, when there was a production of 78,818,000 pounds. Since that time there has been a great falling off in the crop.

The total value of the crop in 1899 was $468,454, an average of $499.95 for each farm reporting, and of $33.21 per acre. The average yield per acre was 730.4 pounds, compared with 919.9 pounds in 1889.

The crop is confined to 17 counties of the state, the 5 leading counties being Fayette, with 4,297 acres; Jessamine, with 2,117 acres; Woodford, with 2,065 acres; Garrard, with 1,412 acres; and Clark, with 1,130 acres. These 5 counties furnished 78.1 per cent of the acreage and 78.1 per cent of the entire production.

COTTON.

The following table is a statement of the changes in cotton production since 1879.

TABLE 20.—ACREAGE AND PRODUCTION OF COTTON: 1879 TO 1899.

YEAR.	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	2,396	[1]8.9	1,369	685,724	64.7
1889	2,629	[1]1.4	873	416,421	[1]32.8
1879	2,667	....	1,367	619,251	....

[1] Decrease.

The total area under cotton in Kentucky in 1879, was 2,667 acres, which was the largest area reported for this crop by any census. This land produced 619,251 pounds of cotton. The census of 1890 showed a decrease in the production of cotton of 202,830 pounds, or 32.8 per cent.

In 1899, 190 farmers seeded to cotton an area of 2,396 acres, an average of 12.6 acres per farm reporting. From this land was produced 685,724 pounds of cotton, an average of 3,609 pounds per farm and 286 pounds per acre. The total value of this product, including the value of both lint and seed, was $58,752, an average of $309.22 per farm and $24.52 per acre.

The limited area devoted to cotton in 1899 was divided among 25 counties, of which Fulton county, located in the extreme southwestern corner of the state, reported all but 72 acres, or 97.0 per cent of the total acreage.

TOBACCO.

The present census shows that in 1899 tobacco was grown by 86,534 farmers, who reported 384,805 acres, and a yield of 314,288,050 pounds. This shows a gain in ten years of 40.1 per cent in acreage and 41.6 per cent in production, and is the largest acreage and production ever reported. The next largest was in 1889, when 274,587 acres yielded 221,880,303 pounds.

The average yield per acre in 1889 was 808.1 pounds, while in 1899 it was 816.7 pounds. The total value of the crop in the latter year was $18,541,982, an average of $214.27 for each farm reporting, and of $48.19 per acre. The average value per pound was 5.9 cents.

The crop was grown in 119 counties, Christian county leading, with 23,402 acres; Daviess county was next in rank, with 21,376 acres.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 may be seen in the following table.

TABLE 21.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	8,757,238	5,730,144	6,053,717	10,679,389
Apricots	5,417	3,417	392	1,621
Cherries	237,612	131,089	34,258	43,393
Peaches	2,884,193	1,205,866	34,700	846,138
Pears	322,201	116,311	76,940	118,850
Plums and prunes	375,716	162,825	76,574	56,914

In 1890 the total number of fruit trees in the state was 7,349,652; in 1900 there were 12,617,897 trees, an increase of 5,268,245, or 71.7 per cent. The increases were as follows: Apple trees, 52.8 per cent; apricot trees, 58.5 per cent; cherry trees, 81.3 per cent; peach trees, 139.2 per cent; pear trees, 177.0 per cent; plum and prune trees, 130.7 per cent. The increases were general throughout the state.

Of all trees reported in 1900, 69.4 per cent were apple trees; 22.9 per cent, peach trees; 3.0 per cent, plum and prune trees; 2.5 per cent, pear trees; 2.2 per cent, cherry, apricot, and unclassified fruit trees. The latter class, which is not included in Table 20, numbered 35,520, and yielded 9,593 bushels of fruit.

The value of orchard fruits, given in Table 18, includes the value of 20,305 barrels of cider, 8,277 barrels of vinegar, and 1,581,430 pounds of dried and evaporated fruits. The quantity of fruit produced in any given year is largely determined by the nature of the season. Comparisons between the crop of 1889 and that of 1899 have little significance, because in the latter year there was an almost complete failure of peaches and apricots, and a very small yield of other fruits.

The counties bordering on the Ohio River, especially those in the western part of the state, rank highest in numbers and variety of fruit trees. Apples and peaches, however, are extensively cultivated throughout the state. The 5 counties of Meade, Breckinridge, Hardin, Jefferson, and Pulaski, ranking in the order named, reported the largest numbers of apple trees; and Trimble, Bullitt, Hardin, Jefferson, and Campbell counties, all bordering on the Ohio River, reported 37.0 per cent of the total number of peach trees.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 6,126 acres, distributed among 12,254 farms, an average of 0.5 acre per farm. Of the total area 4,128 acres were devoted to strawberries, yielding 6,767,300 quarts. Campbell and Jefferson counties reported 39.6 per cent of the acreage devoted to this crop. The acreages and productions of the other berries were as follows: Blackberries and dewberries, 1,024 acres and 1,068,340 quarts; raspberries and Logan berries, 755 acres and 787,820 quarts; gooseberries, 99 acres and 114,590 quarts; currants, 15 acres and 19,370 quarts; and other small fruits, 105 acres and 105,140 quarts.

VEGETABLES.

The total area used in the cultivation of vegetables, including potatoes, sweet potatoes, and onions, in 1899, was 134,972 acres. Of this amount 60.7 per cent was devoted to miscellaneous vegetables, 27.5 per cent to potatoes, 10.5 per cent to sweet potatoes, and 1.3 per cent to onions. Potatoes were raised throughout the state, and the 37,160 acres occupied by them yielded 2,661,774 bushels, an average of 71.6 bushels per acre.

The total area devoted to miscellaneous vegetables was 81,929 acres, of which the products of 64,289 acres were not reported in detail. Of the 17,640 acres concerning which detailed reports were received, 5,307 acres were devoted to watermelons; 3,914 to tomatoes; 3,732 to cabbages; 1,705 to sweet corn; 1,263 to muskmelons; 540 to cucumbers; 381 to beans; 364 to pease; and 434 to other vegetables.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 128 acres, and the value of the products sold therefrom was $262,288. These flowers and plants were grown by 137 farmers and florists. Of this number 77 made commercial floriculture their principal business. They had invested in the aggregate $537,731, of which $262,532 represents the value of land and improvements other than buildings; $255,155, that of buildings; $16,490, that of implements and machinery; and $3,554, that of live stock. The value of their products in 1899 was $217,914, of which $212,944 represents the value of flowers and plants, and $4,970 that of other products. The expenditure for labor was $44,927, and for fertilizers, $2,025. The average gross value of products per farm was $2,830.

In addition to the 77 principal florists' establishments, 616 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 714,748 square feet, making, with the 623,512 square feet belonging to the florists' establishments, a total of 1,338,260 square feet.

NURSERY PRODUCTS.

The total value of nursery products sold in 1899 was $114,749, reported by the operators of 65 farms and nurseries. Of this number, 26 derived their principal income from the nursery business. They had 3,128 acres of land, valued at $151,050; buildings, valued at $45,750; implements and machinery, valued at $7,012; and live stock, valued at $3,615. Their total gross income was $112,684, of which $105,449 was derived from the sale of trees, shrubs, and vines, and $7,235 from other products. The average gross income was $4,334 for each farm reporting.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $6,613,330, an average of $28 per farm. The average was highest on the most intensively cultivated farms, being $667 for nurseries, $584 for florists' establishments, $81 for dairy farms, $76 for cotton farms, $42 for vegetable farms, $37 for fruit farms, $37 for tobacco farms, $28 for live-stock farms, and $13 for sugar farms. "Managers" expended, an average of $171; "cash tenants," $38; "owners," $30; and "share tenants," $13. White farmers expended $29 per farm, and colored farmers, $10.

Fertilizers purchased in 1899 cost $908,250, which was nearly three times the amount expended in 1889, and an average of $4 per farm. The average was $26 for florists' establishments, $15 for vegetable farms, $12 for nurseries, $5 each for cotton, fruit, and hay and grain farms, $4 for tobacco farms, $4 for live-stock farms, $3 for dairy farms, and $1 for sugar farms.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 221. WASHINGTON, D. C. July 2, 1902.

MANUFACTURES.

BOOTS AND SHOES.

Hon. William R. Merriam,
Director of the Census.

Sir: I transmit herewith, for publication in bulletin form, the statistics of the manufacture of boots and shoes, prepared under my direction by Mr. George C. Houghton, of Boston, Mass., acting as an expert special agent of the division of manufactures, of the Census Office.

The statistics are shown in 10 tables. Table 1 is a comparative summary, 1880, 1890, and 1900, with per cent of increase for each decade; Table 2 shows the capital invested in machinery, tools, and implements, value of products, and average investment required for a product valued at $100, by states, 1890 and 1900, with per cent of increase; Table 3 gives the rank of states, geographically arranged, in capital, average number of wage-earners, total wages, and value of products, 1880, 1890, and 1900; Table 4 shows materials and products classified by number of establishments, 1900; Table 5 presents the cities and towns having products of over $1,000,000 in 1900, ranked by value of products, 1890 and 1900; Table 6 gives average number of wage-earners, men, women, and children, by states, 1890 and 1900, and per cent each class is of the total wage-earners; Table 7 is a comparative summary, kinds, quantity, and value of product, 1890 and 1900, with per cent of increase; Table 8 shows the average capital required for a product valued at $100, 1880, 1890, and 1890; Table 9 is a comparative summary, by states, 1890 and 1900; and Table 10 gives the detailed statistics of the manufacture, by states, 1900.

In drafting the schedules of inquiry for the census of 1900 care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the items of inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least numbers of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class, overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890.

In some instances, the number of proprietors and firm members shown in the accompanying tables falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations or cooperative establishments. The number of salaried officials, clerks, etc., is the greatest number reported employed at any one time during the year.

The reports show a capital of $101,795,233 invested in the manufacture of boots and shoes. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations of the state. The value of the products is returned at $261,028,580, to produce which involved an outlay of $7,757,749 for salaries of officials, clerks, etc.; $59,175,883 for wages; $10,766,402 for miscellaneous expenses, including rent, taxes, etc.; and $169,604,054 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products is in any sense indicative of the profits in the manufacture of the products during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the shop or factory. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistican for Manufactures.

BOOTS AND SHOES.

By George C. Houghton, Expert Special Agent.

Prior to the census of 1880 the factory manufacture of boots and shoes was included with that of boots and shoes, custom work and repairing, and comparative figures, therefore, are not available beyond that period. In presenting the statistics of the industry for the Twelfth Census it seems proper to state that the business for the year covered by this census is said by manufacturers to have been considerably below normal, due to a reaction following the exceptional demand of the previous year and the upward tendency of prices. Table 1 presents the leading statistics of the industry at the censuses of 1880, 1890, and 1900, with per cent of increase for each decade.

Table 1.—COMPARATIVE SUMMARY, 1880 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.			PER CENT OF INCREASE.	
	1900	1890	1880	1890 to 1900	1880 to 1890
Number of establishments	1,600	2,082	1,959	[1]23.2	6.3
Capital	$101,795,233	$95,282,311	$42,994,028	6.8	121.6
Salaried officials, clerks, etc., number	7,843	[2]5,643	(3)	39.0	......
Salaries	$7,757,749	[2]$5,707,931	(3)	35.9	......
Wage-earners, average number	142,922	133,690	111,152	6.9	20.3
Total wages	$59,175,883	$60,667,145	$43,001,438	[1]2.5	41.1
Men, 16 years and over	91,215	91,406	82,547	[1]0.2	10.7
Wages	$43,301,430	$46,905,974	(3)	[1]7.7	......
Women, 16 years and over	47,186	39,849	25,122	18.4	58.6
Wages	$15,068,726	$13,393,611	(3)	12.5	......
Children, under 16 years	4,521	2,435	3,483	85.7	[1]30.1
Wages	$805,727	$367,560	(3)	119.2	......
Miscellaneous expenses	$10,766,402	$9,217,519	(4)	16.8	......
Cost of materials used	$169,604,054	$118,785,831	$102,442,442	42.8	16.0
Value of products	$261,028,580	$220,649,358	$166,050,354	18.3	32.9

[1] Decrease.
[2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 11.)
[3] Not reported separately.
[4] Not reported.

Table 1 shows that from 1890 to 1900 there was a decrease in the number of establishments of 482, or 23.2 per cent. This is accounted for in a measure by the fact that there were included in the reports of the Eleventh Census, to what extent it is impracticable to ascertain, a large number of establishments doing contract work. This has been a peculiar feature of the shoe manufacturing business in certain sections of New England ever since the industry assumed the proportions of the factory system. Especially has this been the case in Haverhill and Lynn, Mass., though the returns of the Twelfth Census show that the number of such establishments is growing notably less.

The work of these contract shops consists largely in stitching or fitting, working the buttonholes, or heeling the shoes for manufacturers, who are thereby relieved of the expense of fitting up one or more departments; and in rush times these shops are also taken advantage of by those manufacturers who ordinarily do the work in their own establishments. In 1890 there were reported in the city of Haverhill, Mass., 74 shops doing contract work, against 49 in 1900; Lynn, Mass., had 64 in 1890, compared with 16 in 1900; and a similar ratio, it is reasonable to assume, followed in other places where such shops were located. At the Twelfth Census there was reported a total of only 78 contract shops—73 of them located in Massachusetts, 4 in New Hampshire, and 1 in New Jersey. These 78 establishments are included in the present total of 1,600 establishments; and after deducting the same from the 1,600, as shown in Table 1, there remains 1,522 legitimate shoe-manufacturing establishments in the year 1900. Undoubtedly there was a larger number of boot and shoe factories in 1890 than in 1900. Many of the smaller establishments which existed in 1890 have discontinued operations, the tendency being to consolidate the business into larger establishments.

The apparently abnormal increase of capital from 1880 to 1890 is due in part to the fact that a return of live capital was first called for at the census of 1890.

From 1890 to 1900 the average number of wage-earners increased from 133,690 to 142,922, a gain of 9,232, or 6.9 per cent; the total wages paid decreased from $60,667,145 to $59,175,883, a loss of $1,491,262, or 2.5 per cent; and the value of products increased from $220,649,358 to $261,028,580, a gain of $40,379,222, or 18.3 per cent. The improvements in machinery have so increased the capacity of shoe factories that fewer hands are necessary in turning out a given amount of work. To a considerable extent women have taken the place of men in operating the lighter machines, while children now perform work that women were doing heretofore. As a larger portion of the work is done by these cheaper classes of workers, a reduction in the total wages paid necessarily follows. The reduction of total wages is also due to the fact that many boot and shoe manufacturers have found it more advantageous to purchase from cut-stock dealers outer soles, inner soles, taps, heels, etc., already prepared, and where formerly a considerable number of wage-earners were employed in the sole-leather department of individual establishments, in many cases but a fraction of that number are now employed. These employees were not only lost entirely to the industry, but reduced the number in a class that received above the average wages.

Statistics relating to the cost of materials used and the value of the products make it evident, notwithstanding the increased use of machinery and improvement in methods, that it is costing more to manufacture shoes now than it did ten years ago. There was an increase of 42.8 per cent in the cost of materials during the decade, while the value of the finished product shows an increase of but 18.3 per cent.

Table 2 shows the capital invested in machinery, tools, and implements, the total value of products, the value of machinery, tools, and implements required for a product of $100, by states, 1890 and 1900, with the per cent of increase for the decade.

Since the invention of the rolling machine—the first practical mechanical substitute for hand labor—there has been constant progress in the perfection of shoe machinery. The shoe factory of to-day provides a perfect system of continuous manufacture, involving, in some instances, more than 100 operations. The continued improvement of the various machines, together with the keen competition in the business, has made necessary the adoption, as soon as perfected, of the latest devices. This will be seen in the increase for 1900, over the previous census year, in the value of machinery, tools, and implements required for a product valued at $100, as shown in Table 2. The total increase for this item is $3,083,941, or 22.2 per cent for the industry. In 1900 the average amount invested in machinery, tools, and implements for a product valued at $100 was $6.50, compared with $6.29 in 1890, an increase of 3.3 per cent. This item varies greatly in the several states, being reported as high as $18.57 in California, and as low as $2.57 in Rhode Island. Massachusetts shows the largest investment in machinery, $5,750,238. The increase was but $94,200, or 1.7 per cent, while the amount invested in machinery required for a product valued at $100 shows an increase of 1 per cent. The largest percentage increase in machinery during the decade is credited to Georgia. The amount of money involved, though but $23,400, indicates an increase of more than 500 per cent over 1890. The average amount of investment in machinery for a $100 product in Georgia was $6.76, or within 35 cents of the average for the United States. Indiana also shows a large increase in machinery, the percentage being 307.5. The other states having more than doubled the value of their machinery are Vermont, showing an increase of 156.9 per cent; Minnesota, 143.5 per cent; Missouri, 108.4 per cent; and Ohio, 113.9 per cent.

While the manufacture of boots and shoes in other sections of the United States has made marked progress, New England still maintains the lead in the industry, the output for that section in 1900 representing 59.5 per cent of the total for the United States. The output of the factories of Massachusetts for 1900 was $117,115,243, or 44.9 per cent of the total for the entire country, compared with 52.7 per cent in 1890, a decrease of 7.8 per cent, although showing a small increase over the value of the products of the state for the decade.

TABLE 2.—CAPITAL INVESTED IN MACHINERY, TOOLS, AND IMPLEMENTS, VALUE OF PRODUCTS, AND AVERAGE AMOUNT OF INVESTMENT REQUIRED FOR A PRODUCT VALUED AT $100: BY STATES, 1890 AND 1900, WITH PER CENT OF INCREASE.

STATES.	Year.	Machinery, tools, and implements.	Value of products.	Average amount of investment in machinery, tools, and implements required for a product valued at $100.	PER CENT OF INCREASE.		
					Machinery, tools, and implements.	Value of products.	Average amount of investment in machinery, tools, and implements required for a product valued at $100.
United States	1900	$16,957,305	$261,028,580	$6.50	22.2	18.3	3.3
	1890	13,873,364	220,649,358	6.29			
California	1900	343,633	1,850,511	18.57	6.0	[1]45.5	94.5
	1890	324,252	3,395,043	9.55			
Connecticut	1900	117,172	1,617,364	7.72	[1]21.4	[1]1.2	[1]20.4
	1890	148,981	1,535,125	9.70			
Georgia	1900	23,400	346,259	6.76	500.0	1,767.4	[1]67.9
	1890	3,900	18,542	21.03			
Illinois	1900	931,083	11,434,842	8.14	46.4	30.6	12.1
	1890	635,816	8,756,824	7.26			
Indiana	1900	97,157	864,090	11.24	307.5	380.2	[1]15.2
	1890	23,845	179,936	13.25			
Iowa	1900	86,471	786,141	11.00	21.8	36.9	[1]11.0
	1890	71,000	574,378	12.36			
Kentucky	1900	44,456	630,358	7.05	[1]36.5	19.8	[1]47.0
	1890	70,000	526,387	13.30			
Louisiana	1900	72,933	660,987	11.03	19.3	[1]31.7	74.8
	1890	61,125	968,017	6.31			
Maine	1900	663,326	12,295,847	5.39	12.2	19.0	[1]5.8
	1890	591,304	10,335,342	5.72			
Maryland	1900	167,326	1,129,153	14.82	[1]6.2	[1]26.4	27.4
	1890	178,433	1,533,761	11.63			
Massachusetts	1900	5,750,238	117,115,243	4.91	1.7	0.6	1.0
	1890	5,656,038	116,387,900	4.86			
Michigan	1900	150,800	1,915,179	7.87	2.6	[1]7.3	10.5
	1890	146,997	2,065,531	7.12			
Minnesota	1900	337,236	3,615,801	9.33	143.5	77.9	37.0
	1890	138,512	2,032,814	6.81			
Missouri	1900	804,568	11,253,202	7.15	108.4	132.5	[1]10.3
	1890	385,982	4,841,004	7.97			
Nebraska	1900	8,700	73,210	11.88	....	....	....
	[2]1890	....	....	....			
New Hampshire	1900	1,063,569	23,405,558	4.54	58.1	95.3	[1]19.1
	1890	672,537	11,986,003	5.61			
New Jersey	1900	736,375	6,978,043	10.55	38.2	[1]3.8	43.7
	1890	532,757	7,255,409	7.34			
New York	1900	2,362,396	25,585,631	9.23	16.6	8.1	7.7
	1890	2,026,690	23,661,204	8.57			
North Carolina	1900	7,450	73,493	10.14	[1]35.2	[1]52.9	37.4
	1890	11,500	155,900	7.38			
Ohio	1900	1,180,322	17,920,854	6.59	113.9	111.1	1.4
	1890	551,756	8,489,728	6.50			
Pennsylvania	1900	1,309,513	13,235,933	9.89	15.9	27.8	[1]9.3
	1890	1,129,464	10,354,850	10.91			
Rhode Island	1900	6,200	241,278	2.57	[1]7.5	51.9	[1]39.1
	1890	6,700	158,800	4.22			
Utah	1900	21,743	225,986	9.62	....	....	....
	[2]1890	....	....	....			
Vermont	1900	77,596	792,707	9.79	156.9	49.7	71.5
	1890	30,209	529,486	5.71			
Virginia	1900	47,034	1,452,480	3.24	[1]40.6	13.6	[1]47.7
	1890	79,238	1,279,069	6.19			
Washington	1900	14,715	166,423	8.84	....	....	....
	[2]1890	....	....	....			
Wisconsin	1900	462,255	4,791,684	9.65	48.6	61.2	[1]7.8
	1890	311,059	2,972,233	10.47			
All other states[4]	1900	69,638	670,323	10.39	34.3	22.7	9.4
	1890	85,269	656,072	13.00			

[1] Decrease.
[2] Included in "all other states."
[3] No establishments reported.
[4] Includes establishments distributed as follows: 1900—Alabama, 1; Colorado, 1; Delaware, 1; Kansas, 1; Oregon, 2; Tennessee, 2. 1890—Alabama, 1; Delaware, 1; Kansas, 2; Nebraska, 1; Oregon, 1; South Carolina, 2; Tennessee, 2; Texas, 3; Utah, 2; Washington, 1.

Table 3 shows the relative rank of the various states as regards capital, number of wage-earners, total wages, and value of products at the censuses of 1880, 1890, and 1900.

TABLE 3.—RANK BY CAPITAL, AVERAGE NUMBER OF WAGE-EARNERS, TOTAL WAGES, AND VALUE OF PRODUCTS, BY STATES ARRANGED GEOGRAPHICALLY: 1880, 1890, AND 1900.

STATES.	Year.	CAPITAL.		WAGE-EARNERS.				PRODUCTS.	
				Average number.		Total wages.			
		Rank.	Amount.	Rank.	Number.	Rank.	Amount.	Rank.	Value.
United States	1900	....	$101,795,233	....	142,922	....	$59,175,883	....	$261,028,580
	1890	....	95,282,311	....	133,690	....	60,667,145	....	220,645,958
	1880	....	42,994,028	....	111,152	....	43,001,438	....	166,050,354
New England states	1900	....	52,174,549	....	78,167	....	35,810,931	....	155,367,997
	1890	....	54,389,199	....	82,901	....	39,140,122	....	140,932,656
	1880	....	24,882,333	....	71,617	....	28,574,114	....	111,364,440
Maine	1900	7	6,148,278	6	6,432	7	2,664,672	6	12,295,847
	1890	4	4,804,946	5	6,382	5	2,868,500	5	10,335,342
	1880	6	1,369,000	6	3,919	5	1,335,168	5	5,823,541
New Hampshire	1900	3	8,123,481	4	12,007	3	4,971,954	3	23,405,558
	1890	5	3,956,774	3	7,912	3	3,337,167	3	11,986,003
	1880	6	1,696,200	4	4,434	4	1,792,832	4	7,230,804
Vermont	1900	19	478,184	20	355	20	128,771	18	792,707
	1890	18	348,827	20	227	20	94,766	19	529,486
	1880	18	88,000	23	101	20	41,950	19	198,200
Massachusetts	1900	1	37,577,630	1	58,645	1	27,745,820	1	117,115,243
	1890	1	44,567,702	1	67,374	1	32,379,899	1	116,387,900
	1880	1	21,098,133	1	61,651	1	24,875,106	1	95,900,510
Rhode Island	1900	25	57,358	27	9	27	1,888	23	241,278
	1890	23	27,850	24	11	24	4,084	22	158,800
	[1]1880	....	....	....	....	....	....	....	....
Connecticut	1900	14	789,618	16	719	14	297,826	14	1,517,364
	1890	15	683,100	16	995	15	455,706	14	1,535,125
	1880	11	631,000	11	1,412	11	529,058	11	2,211,385
Middle states	1900	....	22,496,583	....	30,257	....	11,262,119	....	46,928,760
	1890	....	21,020,753	....	29,321	....	12,390,279	....	42,805,224
	1880	....	11,410,222	....	26,373	....	9,596,980	....	35,471,510
New York	1900	2	11,983,239	2	15,796	2	6,138,653	2	25,585,631
	1890	2	11,950,891	2	15,361	2	6,629,641	2	23,661,204
	1880	2	6,227,537	2	13,414	2	4,902,132	2	18,979,259
New Jersey	1900	9	3,163,255	9	4,421	9	1,723,159	9	6,978,043
	1890	9	2,811,098	7	6,162	7	2,206,652	8	7,255,409
	1880	9	964,245	6	3,318	6	1,278,269	6	4,689,286
Pennsylvania	1900	5	6,860,480	5	9,144	5	3,111,113	5	13,235,933
	1890	3	5,394,799	4	7,616	4	3,094,582	4	10,354,850
	1880	3	3,627,840	3	7,845	3	2,820,976	3	9,590,002
Maryland	1900	18	499,609	15	896	15	289,194	16	1,129,153
	1890	14	863,965	13	1,182	14	459,404	15	1,533,761
	1880	12	590,600	10	1,796	10	595,603	10	2,212,963
Southern states	1900	....	1,313,293	....	2,047	....	482,049	....	3,163,577
	1890	....	1,209,532	....	1,451	....	587,433	....	2,947,916
	1880	....	356,700	....	980	....	288,836	....	1,163,493
Virginia	1900	15	641,166	12	1,153	16	206,119	15	1,462,480
	1890	16	501,661	19	252	17	115,414	16	1,279,069
	1880	20	60,800	18	221	22	30,381	21	187,520
North Carolina	1900	27	37,700	26	40	26	14,107	26	73,493
	1890	21	118,000	22	95	22	26,720	23	155,900
	1880	23	34,000	22	108	23	23,900	23	107,600
Georgia	1900	23	90,700	21	250	21	66,000	22	346,259
	1890	24	16,461	23	22	23	4,104	25	18,642
	1880	22	41,800	25	38	25	11,446	24	89,725
Kentucky	1900	21	254,382	22	207	23	60,819	21	630,358
	1890	20	280,166	17	296	18	112,295	20	526,387
	1880	17	197,100	16	472	16	159,587	16	578,732
Tennessee	[2]1900	....	....	....	....	....	....	....	....
	[2]1890	....	....	....	....	....	....	....	....
	1880	26	6,000	26	26	26	9,906	26	35,826
Louisiana	1900	20	289,345	19	397	19	145,004	20	660,987
	1890	19	293,244	16	786	16	328,900	17	968,017
	1880	24	17,000	21	115	19	53,618	22	164 090

[1] No establishments reported.

[2] Included in "all other states."

TABLE 3.—RANK BY CAPITAL, AVERAGE NUMBER OF WAGE-EARNERS, TOTAL WAGES, AND VALUE OF PRODUCTS, BY STATES ARRANGED GEOGRAPHICALLY: 1880, 1890, AND 1900—Continued.

STATES.	Year.	CAPITAL.		WAGE-EARNERS.				PRODUCTS.	
				Average number.		Total wages.			
		Rank.	Amount.	Rank.	Number.	Rank.	Amount.	Rank.	Value.
Central states	1900	....	$23,980,711	....	31,011	....	$11,006,763	....	$52,581,793
	1890	....	16,592,691	....	17,360	....	7,281,303	....	29,912,448
	1880	....	5,169,040	....	9,388	....	3,366,085	....	13,966,600
Ohio	1900	4	7,549,142	3	12,718	4	3,989,744	4	17,920,854
	1890	8	3,176,318	6	5,743	6	2,303,393	7	8,489,728
	1880	7	1,154,200	7	3,204	7	1,089,116	7	4,167,476
Michigan	1900	13	1,135,961	13	1,117	13	386,074	12	1,915,179
	1890	13	972,534	12	1,309	13	495,202	12	2,065,531
	1880	15	343,500	14	783	14	340,172	14	1,216,255
Indiana	1900	16	542,224	17	610	18	151,455	17	864,090
	1890	22	98,065	21	173	21	57,079	21	179,936
	1880	16	226,500	17	341	17	111,465	17	476,845
Illinois	1900	6	5,351,482	8	5,553	6	2,694,959	7	11,434,842
	1890	6	3,781,476	8	3,992	8	1,896,998	6	8,756,824
	1880	4	1,729,200	9	2,060	9	755,769	9	3,183,026
Wisconsin	1900	10	2,473,626	10	2,507	10	821,403	10	4,791,684
	1890	10	2,621,606	11	2,036	11	774,163	11	2,972,233
	1880	13	548,800	13	1,177	13	381,732	13	1,736,773
Minnesota	1900	11	2,237,540	11	2,025	11	719,231	11	3,615,801
	1890	11	1,794,711	14	1,099	12	524,978	13	2,032,814
	1880	14	463,000	16	402	15	207,218	15	930,192
Iowa	1900	17	506,757	18	566	17	191,783	19	786,141
	1890	17	435,066	18	292	19	110,100	18	574,378
	1880	19	61,040	20	139	21	32,950	18	243,040
Missouri	1900	8	4,183,979	7	5,915	8	2,052,114	8	11,253,202
	1890	7	3,712,915	9	2,716	9	1,119,390	9	4,841,004
	1880	10	642,800	12	1,282	12	447,663	12	1,982,993
Western states	1900	....	167,767	....	195	....	69,860	....	299,196
	[1]1890	....	....	....	....	....	....	....	....
	1880	....	76,050	....	253	....	69,020	....	245,483
Nebraska	1900	26	43,500	25	55	25	17,302	27	73,210
	[1]1890	....	....	....	....	....	....	....	....
	[2]1880	....	....	....	....	....	....	....	....
Utah	1900	22	124,267	23	140	22	52,558	24	225,986
	[1]1890	....	....	....	....	....	....	....	....
	1880	21	60,050	19	186	18	65,220	20	189,669
Kansas	[1]1900	....	....	....	....	....	....	....	....
	[1]1890	....	....	....	....	....	....	....	....
	1880	25	16,000	24	67	24	13,800	25	55,814
Pacific states	1900	....	1,328,817	....	1,069	....	488,388	....	2,016,934
	1890	....	1,740,175	....	2,280	....	1,109,419	....	3,395,043
	1880	....	1,001,183	....	2,499	....	1,064,938	....	3,649,551
Washington	1900	24	71,071	24	75	24	31,461	25	166,423
	[1]1890	....	....	....	....	....	....	....	....
	[2]1880	....	....	....	....	....	....	....	....
California	1900	12	1,257,746	14	994	12	456,927	13	1,850,511
	1890	12	1,740,175	10	2,280	10	1,109,419	10	3,395,043
	1880	8	1,001,183	8	2,499	8	1,064,938	8	3,649,551
All other states[3]	1900	....	333,513	....	176	....	55,773	....	670,323
	1890	....	329,961	....	377	....	158,589	....	656.072
	1880	....	98,500	....	142	....	41,465	....	219,277

[1] Included in "all other states."
[2] No establishments reported.
[3] Includes establishments distributed as follows: 1900—Alabama, 1; Colorado, 1; Delaware, 1; Kansas, 1; Oregon, 2; Tennessee, 2. 1890—Alabama, 1; Delaware, 1; Kansas, 2; Nebraska, 1; Oregon, 1; South Carolina, 2; Tennessee, 2; Texas, 3; Utah, 2; Washington, 1. 1880—Colorado, 1; Idaho, 1; Mississippi, 2; Oregon, 1; West Virginia, 1.

Although the total capital for the United States shows an increase of $6,512,922, there was a decrease shown in reports from 7 states, ranging from $6,990,072 in Massachusetts to $3,899 in Louisiana. Maryland shows a decline in capital of $364,536; Wisconsin, $147,980; California, $482,429; Kentucky, $25,784; and North Carolina, $80,300. Louisiana, Maryland, and North Carolina show a decrease in value of products from 1890 to 1900. There was also a decrease in the average number of wage-earners in these states, except Wisconsin, although the returns for the United States, as a whole, show an increase of 9,232. On the other hand, each of the states showing a falling off in capital, and decrease in the number of wage-earners, except

California, reports an increase in the value of products, amounting, in the case of Wisconsin, to $1,819,451, or 61.2 per cent of the total of $2,972,233 in 1890. Of the geographic divisions, New England, in 1900, employed by far the largest capital, $52,174,549, or $1,276,932 in excess of one-half of the total for the industry in the United States. The average number of wage-earners, men, women, and children, in New England shoe factories was 78,167, or 54.7 per cent of the total, while the value of products for that section was $155,367,997, or 59.5 per cent of the total for the United States.

Of the New England states, in 1900, Maine occupied the position, as regards capital, that was held by Missouri in 1890, that of seventh in rank; though in the matter of product, Maine was sixth in 1900, and Missouri was eighth. Maine shows a gain in capital of $343,332, or 7.1 per cent, and an increase in product of $1,960,505, or 19 per cent. Compared with 1880, the gain in capital was 276.1 per cent, and in product 111.1 per cent. From 1890 to 1900, New Hampshire's gain in capital was $4,166,707, or 105.3 per cent, and in product, $11,419,555, or 95.3 per cent. For the same decade, Connecticut reports an increase in capital of 15.6 per cent, but shows a slight falling off in product, amounting to 1.2 per cent. Vermont and Rhode Island both show gains in capital and product, the latter aggregating $345,699 for the two states. Massachusetts shows a decrease in capital of $6,990,072, or 15.7 per cent, while the value of the product increased $727,343. From 1880 to 1900 the increase was $21,214,733.

Massachusetts, while first in rank in every item relating to shoe manufacture, shows a loss in the number of wage-earners of 8,729, or 13.0 per cent, in a total of 58,645 for 1900. The wages show nearly the same decrease, or 14.3 per cent, indicating a slight falling off in this item.

New Hampshire, which ranks second in New England as regards capital, wages, and products, ranks fourth in the United States in the number of wage-earners. This state shows an output valued at $23,405,558, with 12,007 wage-earners, who received $4,971,954. In 1890 it required 7,912 workers to produce $11,986,003, while $7,230,804 was produced by 4,434 wage-earners in 1880, the state then ranking fourth in all items except that of capital.

In 1900, Ohio in the matter of capital occupied fourth place, which was held by Maine in 1890, and by Illinois in 1880, and had 12,718 wage-earners, who earned $3,989,744; the products were valued at $17,920,854.

Illinois shows a gain in capital, in the number of wage-earners, wages paid, and the value of products. In capital the state stands sixth, as it also does in the total wages paid; but it ranks eighth in the number of wage-earners, and seventh in the value of products. The gain by this state since the census of 1880 represents $3,622,282 in capital, 3,493 in the number of wage-earners, and $8,251,816 in value of products.

Compared with the capital invested each wage-earner in the United States represented $712 in 1900, being about the same as in 1890. The largest amount of capital per wage-earner, $1,265, is reported from California. Of the other states having $1,000,000 capital and upward, Illinois has $964 invested for each wage-earner: Maine, $800; Massachusetts, $641; Michigan, $1,017; Minnesota, $1,105; New Hampshire, $677; New Jersey, $713; New York, $759; Pennsylvania, $750; Ohio, $594, and Wisconsin, $987. The increase in the average number of wage-earners from 1880 to 1890 was 20.3 per cent, and but 6.9 per cent during the decade from 1890 to 1900.

The Middle states, comprising New York, New Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia, employed capital amounting to $22,496,583, or 22.1 per cent of the total. The average number of wage-earners represents 21.2 per cent of the whole, while the product aggregates $46,928,760, or 18 per cent of the total. Of these states, Pennsylvania made the largest gain in capital over 1890, $1,465,681 in a total of $6,860,480, or 27.2 per cent. From 1890 to 1900 the average number of wage-earners in Pennsylvania increased from 7,616 to 9,144, while the value of the products increased from $10,354,850 to $13,235,933, a gain of $2,881,083, or 27.8 per cent.

New York still ranks second in the amount of capital, average number of wage-earners, and value of products. From 1890 to 1900 the gain in capital was but $32,348 in a total of $11,983,239, while the output increased from $23,661,204 to $25,585,631.

New Jersey, though reporting an increase of $342,157 in capital, shows a falling off both in the average number of wage-earners and the value of products, the decrease for the latter item being $277,366.

With the exception of Virginia and Georgia, every Southern state engaged in the shoe-manufacturing industry shows a decline in the amount of capital, aggregating, for the entire section, $109,983, or 22.9 per cent.

In 1900 North Carolina had a capital of $37,700, or $80,300 less than at the census of 1890.

In 1900 Kentucky had a capital of $254,382, against $280,166 in 1890; while Louisiana has $289,345, compared with $293,244. This decrease, however, does not indicate in every case a falling off in the product. For instance, Kentucky, while showing a decline in capital of $25,784, had an increased output of $103,971 in a total of $630,358. Louisiana, on the other hand, with a capital only $3,899 less than in 1890, shows a decrease of $307,030 in the value of its products.

The increase in the product from 1890 to 1900 was 18.3 per cent, or about three times the percentage of increase in the number of wage-earners. This is accounted for by the greater efficiency of machinery and the perfection of the factory system, which allows the largest output at the minimum expenditure of labor. The manufacture of boots and shoes, particularly in the

Eastern states, is to-day carried on under as favorable conditions, as regards the economical use of labor, modern machinery, and general factory appliances, as any other line of manufacture. This accounts for the low average cost of factory-made boots and shoes, as shown by Table 10.

The Eastern states are producing more per wage-earner than is the case where shoe manufacture is a newer industry. For instance, in Massachusetts the average product per wage-earner was $1,997.02, while in Michigan it was $1,714.57. In Maine the average was $1,911.67; in Missouri, $1,902.49; and in Ohio, $1,409.09.

It will be seen by the foregoing that while New England is still far in the lead in the production of boots and shoes, employing more than half the total capital and manufacturing considerably more than half of the entire shoe output, the Western states have made large gains during the last decade, though not so large as was generally expected. For, marked as the gain in the West has been, amounting to more than 75 per cent, it is but little more than half the total increase for the United States.

That Massachusetts has not made a larger gain is compensated for in the increase in New Hampshire and Maine, both in the same section; the increase in the first-named state alone being equal to the entire production of either Illinois or Missouri.

The advance made by Ohio is notable, as in passing from the seventh rank to that of fourth, the state takes a position in advance of Pennsylvania, Maine, and Illinois.

Michigan, though losing 7.3 per cent, holds its relative position.

Table 4 shows for 1900 the quantity and cost of each kind of leather used in the manufacture of footwear during the census year; the cost of findings, linings, trimmings, and other sundries; the amounts paid for fuel, power, heat, mill supplies, and all other materials; and the kinds, quantity, and value of the products.

TABLE 4.—MATERIALS AND PRODUCTS: CLASSIFIED BY NUMBER OF ESTABLISHMENTS, 1900.

	Number of establishments.	Unit of measure.	Quantity.	Cost of materials used.
Materials: Total				$169,604,054
Sole leather	946	Pounds	178,504,837	39,192,300
Split leather	273	Pounds	15,817,460	3,109,729
Calf and kip skins	420	Pounds	10,569,581	7,069,408
Grain and other side leather	587	Square feet	131,542,365	15,950,818
Goatskins	1,019	Square feet	233,050,841	35,398,638
All other upper material	881	Square feet	98,866,823	15,578,659
Sheep and leather linings and trimmings.	1,322			7,429,156
Cut soles, taps, heels, etc., purchased.	986			17,248,898
Findings, purchased	1,553			12,902,750
Fuel, rent of power and heat, mill supplies, freight, and all other materials.				15,723,698

TABLE 4.—MATERIALS AND PRODUCTS: CLASSIFIED BY NUMBER OF ESTABLISHMENTS, 1900—Continued.

	Number of establishments.	Unit of measure.	Quantity.	Value of products.
Products: Total			219,235,419	$261,028,580
Men's boots and shoes	561	Pairs	68,042,839	108,705,938
Boys' and youths' boots and shoes.	389	Pairs	21,080,479	20,799,297
Women's boots and shoes	589	Pairs	65,372,653	82,504,303
Misses' and children's boots and shoes.	652	Pairs	42,043,202	30,319,611
Men's and boys' and youths' slippers.	136	Pairs	4,456,965	2,812,213
Women's, misses' and children's slippers.	279	Pairs	12,655,876	10,146,393
All other kinds	127	Pairs	5,583,405	2,491,511
All other products	161			2,175,738
Amount received for custom or contract work.	148			1,073,576

Table 4 shows that sole leather was the largest item of materials used, 178,504,837 pounds, costing $39,192,300, being required for the total products of 219,235,419 pairs of boots and shoes. Goatskins constituted the largest portion of upper leather, the quantity reported being 233,050,841 square feet, costing $35,398,638—almost equal to the total cost of all other upper leathers. Split leather was used to the amount of 15,817,460 pounds, costing $3,109,729; while there were 10,569,581 pounds of calf and kip skins, costing $7,069,408, and 131,542,365 pounds of grain and other side leather, costing $15,950,818. All other upper material amounted to $15,578,659. Sheep and leather linings and trimmings cost $7,429,156, while cut soles, taps, heels, etc., were purchased, costing $17,248,898. Findings, fuel, power and heat, mill supplies, freight, and all other materials, amounting to $28,626,448, brought the total cost of materials up to $169,604,054. Men's boots and shoes led in the quantity and value of the products, the returns for the census year showing an output of 68,042,839 pairs, valued at $108,705,938. Women's boots and shoes followed with 65,372,653 pairs, valued at $82,504,303, while 42,043,202 pairs of misses' and children's shoes were made, valued at $30,319,611. The average cost of each pair of footwear was $1.19, and, after deducting the 3,016,720 pairs exported, permits a per capita consumption in the United States of 2.8 pairs.

Table 5 shows cities and towns having products valued at $1,000,000 in 1900, ranked by value of products, 1890 and 1900.

TABLE 5.—CITIES AND TOWNS HAVING PRODUCTS OF OVER $1,000,000 IN 1900, RANKED BY VALUE OF PRODUCTS: 1890 AND 1900.

CITIES.	1900		1890	
	Rank.	Value of product.	Rank.	Value of product.
Brockton, Mass	1	$19,844,397	2	$16,171,624
Lynn, Mass	2	16,830,733	1	20,190,695
Haverhill, Mass	3	15,231,440	3	16,137,352
Cincinnati, Ohio	4	8,788,424	7	6,024,454
St. Louis, Mo	5	8,286,156	9	4,250,960
Rochester, N. Y	6	6,933,111	6	6,489,382
Philadelphia, Pa	7	5,931,045	5	6,851,834

TABLE 5.—CITIES AND TOWNS HAVING PRODUCTS OF OVER $1,000,000 IN 1900, RANKED BY VALUE OF PRODUCTS: 1890 AND 1900—Continued.

CITIES.	1900		1890	
	Rank.	Value of product.	Rank.	Value of product.
Brooklyn, N. Y	8	$5,733,432	12	$2,489,885
Chicago, Ill	9	5,723,126	4	7,257,034
Auburn, Me	10	4,176,826	....	(1)
Manchester, N. H	11	4,052,204	23	39,024
Boston, Mass	12	3,882,655	17	1,508,697
Marlboro, Mass	13	3,852,931	....	(1)
Whitman, Mass	14	3,609,009	....	(1)
Columbus, Ohio	15	3,505,126	20	359,000
Nashua, N. H	16	3,433,597	....	(1)
New York, N. Y	17	3,391,063	8	5,306,411
Portsmouth, Ohio	18	3,043,916	....	(1)
Salem, Mass	19	2,974,631	18	1,178,724
North Adams, Mass	20	2,881,474	....	(1)
North Brookfield, Mass	21	2,798,711	....	(1)
Newburyport, Mass	22	2,714,693	....	(1)
Beverly, Mass	23	2,627,587	....	(1)
Newark, N. J	24	2,530,048	13	2,266,789
Hudson, Mass	25	2,317,636	....	(1)
Jefferson City, Mo	26	2,236,278	....	(1)
Weymouth, Mass	27	2,235,253	....	(1)
Natick, Mass	28	2,228,791	....	(1)
Milwaukee, Wis	29	2,195,928	14	1,617,534
Abington, Mass	30	2,170,880	....	(1)
Rochester, N. H	31	2,143,833	....	(1)
Spencer, Mass	32	2,000,205	....	(1)
Stoneham, Mass	33	1,946,783	....	(1)
St. Paul, Minn	34	1,645,999	22	133,375
San Francisco, Cal	35	1,618,514	10	3,315,043
Worcester, Mass	36	1,610,605	11	2,923,545
Rockland, Mass	37	1,604,000	....	(1)
Derry, N. H	38	1,530,000	....	(1)
Portsmouth, N. H	39	1,509,050	....	(1)
Exeter, N. H	40	1,503,650	....	(1)
Milford, Mass	41	1,472,671	....	(1)
Bridgewater, Mass	42	1,230,589	....	(1)
Richmond, Va	43	1,224,689	19	1,071,680
Somersworth, N. H	44	1,215,426	....	(1)
Detroit, Mich	45	1,212,742	15	1,611,700
Randolph, Mass	46	1,190,949	....	(1)
Burlington, N. J	47	1,180,649	....	(1)
Webster, Mass	48	1,162,939	....	(1)
Claremont, N. H	49	1,126,234	....	(1)
Dover, N. H	50	1,113,266	....	(1)
Middleboro, Mass	51	1,066,568	....	(1)
Baltimore, Md	52	1,065,507	16	1,519,261
Minneapolis, Minn	53	1,008,007	21	211,684
New Bedford, Mass	54	1,006,881	....	(1)

[1] Not reported.

Until well along in the present century little attempt was made to establish the boot and shoe industry outside eastern Massachusetts. However, it was not to be expected that the other enterprising sections of the United States would always remain content to depend entirely on New England for so important an article of merchandise as shoes. In New York city and other cities of New York state, especially Rochester, the industry has attained large proportions and has reached a high state of perfection. In Newark, N. J., where the business was early established, are made many of the finest shoes for men; and in Philadelphia the shoe industry has become very prominent among the manufactures for which that city is celebrated. In Cincinnati and St. Louis shoes are produced in great quantities and of an excellent style and finish. Chicago has taken up the industry with an energy that has already placed her in a prominent position, and she has several factories which equal those of older shoe-manufacturing centers.

In fact, all through the West, including the Pacific coast, there are scores of thoroughly equipped and financially successful shoe factories. It will be noticed that some cities, well up in the scale in 1900, were not reported in 1890, thus precluding any comparison of them during the decade. It must not be inferred, however, that no shoes were manufactured in those places in 1890. At the Eleventh Census only 165 principal cities were reported by specified industries. Several cities and towns named in the table produced boots and shoes in considerable quantities in 1890, but, as their manufacturing statistics were not shown separately, no figures are available for purposes of comparison. They appear in Table 5 as not reporting for 1890, but are ranked according to the output for 1900.

Lynn, Mass., which has been foremost as a shoe center for one hundred and seventy-five years, changes places in the census of 1900 with Brockton, Mass., as the largest producer of boots and shoes, the latter city having an output of $19,844,397. This is $346,298 less than Lynn is reported to have produced in 1890, but $3,013,664 more than was turned out in 1900. Haverhill, Mass., which ranks third in 1900, held the same position in 1890, though her output shows a decrease of $905,912. The decrease in the output of Lynn and Haverhill, shown by the returns for 1900, is undoubtedly due in a measure to the fact that the business for the census year was below normal, and the decrease in the value of products of Lynn is still further explained by the fact that just previous to the present census year one of the largest shoe manufacturing establishments in the city removed its entire business to Boston.

In 1900 Cincinnati, Ohio, takes fourth place, which was occupied at the Eleventh Census by Chicago, the latter city having dropped 5 numbers in the meantime.

Philadelphia's standing changed from fifth to seventh place and had a reduced output.

Remarkable gains are shown by several cities, one of the most notable being Manchester, N. H. In 1890 this city ranked twenty-third, with an output of $39,024; in 1900 it ranked eleventh, the production having increased to $4,052,204.

St. Louis, Mo., has nearly doubled the value of its product, which, in 1900, amounted to $8,286,156, compared with $4,250,960 in 1890. Boston made $3,882,655 worth of boots and shoes in 1900, compared with $1,508,697 in 1890.

Auburn, Me., not reported among the 165 principal cities ten years ago, ranks tenth, with an output of $4,176,826 in 1900.

Marlboro, Mass., showing a product of $3,852,931 with the rank of 13 would, under normal local conditions, be entitled to a much higher place, but unfortunately labor difficulties during a portion of the Census year are said to have reduced the output of the factories located there nearly one-half.

Columbus, Ohio, which stood twentieth at the Eleventh Census, with an output valued at $359,000, in 1900 is fifteenth in rank, with products valued at $3,505,126.

New York city shows a falling off of $1,915,348, during the decade, its rank having been reduced from eighth to seventeenth.

Chicago shows a decrease of $1,533,908 in the value of products for 1900, and drops from fourth to ninth place. The total in 1890 was $7,257,034.

St. Paul, Minn., while ranking thirty-fourth instead of twenty-second as in 1890, shows an increase of $1,512,624 in value of its output, and Minneapolis, Minn., increased from $211,684 in 1890 to $1,008,007 in 1900, although changing its rank from twenty-first to fifty-third.

Worcester, Mass., which stood eleventh in 1890, ranks as thirty-sixth, with an output of $1,610,605 in 1900, as compared with $2,923,545 at the Eleventh Census.

San Francisco, Cal., which ranked tenth in 1890, with products valued at $3,315,043, drops to thirty-fifth in 1900, and the value of its output decreased to $1,618,514.

It will be seen that 3 Massachusetts cities, Brockton, Lynn, and Haverhill, produced 27.4 per cent of the total for the 54 principal cities, while all the Massachusetts cities and towns in the list turned out 53.0 per cent of the total for cities and towns, having a product exceeding $1,000,000 each.

Table 6 shows the average number of men, women, and children employed in the industry, and the changes that have taken place in the employment of these classes in the United States as a whole, and in the several states, since the taking of the Eleventh Census.

Table 6.—AVERAGE NUMBER OF WAGE-EARNERS AND PROPORTION OF MEN, WOMEN, AND CHILDREN, BY STATES: 1890 AND 1900.

STATES.	Year.	AVERAGE NUMBER OF WAGE-EARNERS.				PER CENT. OF TOTAL.		
		Total average number.	Men, 16 years and over.	Women, 16 years and over.	Children, under 16 years.	Men.	Women.	Children.
United States	1900	142,922	91,215	47,186	4,521	63.8	33.0	3.2
	1890	133,690	91,406	39,849	2,435	68.4	29.8	1.8
California	1900	994	720	241	33	72.4	24.3	3.3
	1890	2,280	1,843	389	48	80.8	17.1	2.1
Connecticut	1900	719	456	254	9	63.4	35.3	1.3
	1890	995	698	285	12	70.2	28.6	1.2
Georgia	1900	250	190	40	20	76.0	16.0	8.0
	1890	22	18	3	1	81.8	13.6	4.6
Illinois	1900	5,553	3,484	1,836	233	62.7	33.1	4.2
	1890	3,992	2,678	1,282	32	67.1	32.1	0.8
Indiana	1900	610	434	170	6	71.1	27.9	1.0
	1890	173	124	46	3	71.7	26.6	1.7
Iowa	1900	566	272	227	67	48.1	40.1	11.8
	1890	292	176	116	......	60.3	39.7	......
Kentucky	1900	207	94	69	44	45.4	33.3	21.3
	1890	296	178	108	10	60.1	36.5	3.4
Louisiana	1900	397	326	37	34	82.1	9.3	8.6
	1890	786	727	9	50	92.5	1.1	6.4
Maine	1900	6,432	4,346	2,064	22	67.6	32.1	0.3
	1890	6,382	4,047	2,301	34	63.4	36.1	0.5
Maryland	1900	896	597	285	14	66.6	31.8	1.6
	1890	1,182	792	380	10	67.0	32.2	0.8
Massachusetts	1900	58,645	39,022	18,636	987	66.5	31.8	1.7
	1890	67,374	47,817	18,577	980	71.0	27.6	1.4
Michigan	1900	1,117	691	417	9	61.9	37.3	0.8
	1890	1,309	847	454	8	64.7	34.7	0.6
Minnesota	1900	2,025	1,438	566	21	71.0	28.0	1.0
	1890	1,099	715	383	1	65.1	34.8	0.1
Missouri	1900	5,915	3,256	2,207	452	55.1	37.3	7.6
	1890	2,716	1,569	1,024	123	57.8	37.7	4.5
Nebraska	1900	55	18	37	......	32.7	67.3	......
	[1] 1890	......	......	......	......	......	......	......
New Hampshire	1900	12,007	7,755	3,866	386	64.6	32.2	3.2
	1890	7,912	5,418	2,370	124	68.5	29.9	1.6
New Jersey	1900	4,421	2,740	1,497	184	62.0	33.8	4.2
	1890	5,162	3,294	1,720	148	63.8	33.3	2.9
New York	1900	15,796	9,754	5,483	559	61.8	34.7	3.5
	1890	15,361	10,150	4,839	372	66.1	31.5	2.4
North Carolina	1900	40	40	......	......	100.0	......	......
	1890	95	79	8	8	83.2	8.4	8.4
Ohio	1900	12,718	7,289	4,781	648	57.3	37.6	5.1
	1890	5,743	3,523	2,149	71	61.4	37.4	1.2
Pennsylvania	1900	9,144	5,291	3,239	614	57.9	35.4	6.7
	1890	7,616	4,842	2,441	333	63.6	32.0	4.4
Rhode Island	1900	9	4	4	1	44.5	44.5	11.0
	1890	11	7	3	1	63.6	27.3	9.1
Utah	1900	140	98	40	2	70.0	28.6	1.4
	[1] 1890	......	......	......	......	......	......	......
Vermont	1900	355	199	155	1	56.0	43.7	0.3
	1890	227	141	76	10	62.1	33.5	4.4
Virginia	1900	1,153	1,021	127	5	88.6	11.0	0.4
	1890	252	168	77	7	66.7	30.5	2.8
Washington	1900	75	50	22	3	66.7	29.3	4.0
	[1] 1890	......	......	......	......	......	......	......
Wisconsin	1900	2,507	1,494	849	164	59.6	33.9	6.5
	1890	2,036	1,273	727	36	62.5	35.7	1.8
All other states [2]	1900	176	136	37	3	77.3	21.0	1.7
	1890	377	282	82	13	74.8	21.8	3.9

[1] Included in "all other states."

[2] Includes establishments distributed as follows: 1900—Alabama, 1; Colorado, 1; Delaware, 1; Kansas, 1; Oregon, 2; Tennessee, 2. 1890—Alabama, 1; Delaware, 1; Kansas, 2; Nebraska, 1; Oregon, 1; South Carolina, 2; Tennessee, 2; Texas 3; Utah, 2; Washington, 1.

It will be noted that there has been a marked gain in the number of women and children, and a decrease in the number and percentage of men employed. This is accounted for by the growing tendency to substitute women for men in many of the departments of shoe manufacture, and the turning over to children of the work heretofore done by women. As a consequence, the number of women and children employed furnished a larger ratio of the total than has formerly been the case. The total average number of wage-earners reported in 1900 was 142,922, and in 1890, 133,690, an increase of 9,232, or 6.9 per cent. Men of 16 years and over numbered 91,215 in 1900, against 91,406 in

1890, a decrease of 191, or two-tenths of 1 per cent. There were 47,186 women employed in 1900, and 39,849 in 1890, an increase of 7,337, or 18.4 per cent. Children under 16 years were employed to the number of 4,521 in 1900 and 2,435 in 1890, an increase of 2,086, or 85.7 per cent.

The percentage of men decreased from 68.4 per cent to 63.8 per cent, while the percentage of women increased from 29.8 per cent to 33 per cent, and that of children from 1.8 per cent to 3.2 per cent. The largest number employed at any one time, as shown in Table 10, printed elsewhere in this report, was 169,912, and the smallest number was 116,436. February and March show the greatest activity in shoe manufacture, the total number employed in the first month being 148,015, and in the latter 149,728, or 5,093 more in February and 6,806 more in March than the average for the year.

The only state employing men exclusively was North Carolina; while another Southern state, Kentucky, reports the smallest proportion of men, 45.4 per cent. Massachusetts shoe factories, which employ 58,645 workers, have 66.5 per cent men, 31.8 per cent women, and 1.7 per cent children. New York, which follows Massachusetts, employs 15,796 wage-earners—61.8 per cent men, 34.7 per cent women, and 3.5 per cent children.

Practically all the shoe manufacturing in Rhode Island during the census year was done by contract, and the number of wage-earners engaged in such work does not appear in the table, the average number employed, outside of those persons performing contract work, being 9—4 men, 4 women, and 1 child.

Vermont has the largest proportion of women employed, 43.7 per cent, but has the smallest percentage of child labor, 0.3 per cent. This is an increase since 1890 of 10.2 per cent for women, and a decrease of 4.1 per cent for children.

New Hampshire, with 12,007 wage-earners, has doubled the percentage of child labor and employs a smaller proportion of adults. In 1900 the percentage of men wage-earners in this state was 64.6 per cent compared with 68.5 per cent, in 1890; of women 32.2 per cent, against 29.9 per cent ten years ago; and of children 3.2 per cent, compared with 1.6 per cent at the Eleventh Census.

Of the increase of 1,561 wage-earners reported for the decade in Illinois, 755, or 48.4 per cent, were women and children. This increase brings the percentage of children from 0.8 per cent in 1890 to 4.2 per cent in 1900, and increases the ratio of women 1 per cent.

Of the other Middle and Western states, Indiana reports an increase in the total number of wage-earners of 437, which, though not changing more than 1 per cent the proportion of the 3 classes employed, shows 71.1 per cent of men, 27.9 per cent of women, and 1 per cent of children. Michigan shows a decreased percentage of men and an increased percentage of women and children for the decade. In Wisconsin child labor constitutes 6.5 per cent in this industry, compared with 1.8 per cent in 1890, and 33.9 per cent was represented by women against 35.7 per cent in 1890.

CONVICT LABOR.

No account of the manufacture of boots and shoes would be complete without reference to the employment of convict labor. The business offers many advantages to the authorities of prisons who are seeking remunerative work for the men and women in their charge. The great number of operations in producing a shoe makes it possible to use all classes of convicts, from the strong to the weak; and as far back as 1850, even before machinery was introduced, it was not an uncommon thing for houses of correction and prisons to produce footwear not only for their own convicts, but to be sold in the market. After the introduction of machinery, and during the demand for cheap shoes which followed the close of the Civil War, many of the states leased the labor of their convicts to shoe manufacturers. In the year 1870 there were employed in this industry in 26 different states 6,581 convicts, while there were only 129,989 employed in the industry in the same states outside the prisons. In the fiscal year 1886 there were made by 7,609 convicts, 6,634,960 pairs of shoes, valued at $10,990,173, and it is probable that the number employed and the annual production are steadily increasing. In states where the system was believed to have a harmful influence on the wages of the workman outside the prisons, the business has been conducted on the states' account, and in some instances, at least, the result has been disastrous. Attempts have been made, in the supposed interest of labor, to forbid prison authorities to use the convicts in any industry which would compete with outside labor. At the present time, in view of the fact that the boot and shoe factories of the United States can produce in nine months all of the shoes required for consumption in twelve months, and that convicts must be worked nearly every week day of the year, their employment at shoemaking must have more or less effect on the market.[1]

[1] One Hundred Years of American Commerce, published 1895. The Boot and Shoe Trade, William B. Rice, Vol. II, pages 566 to 574.

Table 7 shows the kinds, quantity, and value of the boots and shoes manufactured in 1890 and 1900.

TABLE 7.—COMPARATIVE SUMMARY, 1890 AND 1900, KINDS, QUANTITY, AND VALUE OF PRODUCTS, WITH PER CENT OF INCREASE.

	1900	1890	Per cent of increase.
Total number of pairs	219,235,419	173,862,940	26.1
Total value of products	$261,028,580	$220,649,358	18.3
Boots and shoes for men, youths, and boys—			
Number of pairs	89,123,318	67,740,489	31.6
Value	$129,505,235	$97,496,514	32.8
Boots and shoes for women, misses, and children—			
Number of pairs	107,415,855	106,122,451	1.2
Value	$112,823,914	$115,655,533	[1]2.4
Slippers for men, youths, and boys—			
Number of pairs	4,456,965	(2)	
Value	$2,812,213	(2)	
Slippers, oxfords, and low cuts for women, misses, and children—			
Number of pairs	12,655,876	(2)	
Value	$10,146,393	(2)	
All other kinds—			
Number of pairs	5,583,405	(2)	
Value	$2,491,511	(2)	
All other products	$3,249,314	$7,497,311	[1]56.7

[1] Decrease. [2] Not reported separately.

The total quantity of boots and shoes manufactured in 1900 was 219,235,419 pairs, an increase over 1890 of 45,372,479 pairs, or 20.6 per cent. This is about the same as the percentage of increase in population for the United States. In 1900, 89,123,318 pairs of men's, youths', and boys' boots and shoes were manufactured, valued at $129,505,235, compared with 67,740,489 pairs, valued at $97,496,514, in 1890. Women's, misses', and children's shoes were made to the number of 107,415,855 pairs, valued at $112,823,914, in 1900, and 106,122,451 pairs, valued at $115,655,533, in 1890. Slippers, which were reported separately for the first time at the Twelfth Census, were produced for men, youths, and boys to the number of 4,456,965 pairs, valued at $2,812,213. Another new item in 1900, "slippers, oxfords, and low cuts for women, misses, and children," is represented by 12,655,876 pairs, valued at $10,146,393. In the 1890 report slippers of all kinds, oxfords, and low cuts, were classified generally under the head of "boots and shoes," and no separate report was given. This new classification accounts for the apparently small increase in the number of women's, misses', and children's shoes, and the decrease of 2.4 per cent in value during the decade. The total product for 1900 was valued at $261,028,580, compared with $220,649,358 in 1890, an increase of $40,379,222, or 18.3 per cent.

The following tabular statement shows the value of the exports of leather boots and shoes from 1870 to 1901:[1]

YEARS.	Values.	YEARS.	Values.
1901	$5,526,290	1893	$590,754
1900	4,276,656	1892	914,974
1899	2,711,385	1891	651,343
1898	1,816,538	1890	662,974
1897	1,708,224	1885	598,151
1896	1,436,686	1880	441,069
1895	1,010,228	1875	429,363
1894	777,354	1870	419,612

[1] Statistical Abstract of the United States Treasury Department.

Early manufacturers shipped goods to the West Indies, more especially to Cuba, and up to the time of the Civil War the export business was prosecuted with considerable vigor and profit. In 1810, 10 per cent of all the boots and shoes sold in Boston were for export. In the year 1865 shoes to the value of more than $2,000,000 were exported. From that time the trade fell off sharply. This may be accounted for by the great advance in 1866, when values rose at least 50 per cent. Within the last few years interest has been renewed in the export trade. Manufacturers have become convinced that there is nothing in the conditions which will prevent competition with foreign countries. The raw materials are available, and, while many hides and skins are imported, the supply of the domestic product is constantly increasing and leather manufacturers have been able to produce materials for making boots and shoes as advantageously, both in regard to quality and price, as any other country. Styles have been adapted to the wants of such countries as import their footwear. Many of the leading manufacturers are alive to the situation and are endeavoring to secure a greater share of the world's trade.

The exports, with the exception of the year 1865, appear to have been unimportant until 1895, when the first decided gain was made, the exports for that year being valued at $1,010,228. Since that date there has been a steady increase until, in 1901, these exports amounted to $5,526,290. The maximum yearly capacity of the combined factories of the United States, on a basis of three hundred working days, is slightly under 400,000,000 pairs, showing that all the factories running at full capacity would require not exceeding seven months to produce all shoes consumed in the United States, and those exported for the year ending June 30, 1900.

Table 8 shows, by states, the average amount of capital required to produce $100 worth of boots and shoes at the Tenth, Eleventh, and Twelfth censuses.

TABLE 8.—AVERAGE AMOUNT OF CAPITAL REQUIRED FOR A PRODUCT VALUED AT $100: 1880, 1890, AND 1900.

STATES.	Year.	Capital.	Value of products.	For $100 of product.
United States	1900	$101,795,233	$261,028,580	$39.00
	1890	95,282,311	220,649,358	43.18
	1880	42,994,028	166,050,354	25.89
California	1900	1,257,746	1,850,511	67.97
	1890	1,740,175	3,395,043	51.26
	1880	1,001,183	3,649,551	27.43
Connecticut	1900	789,618	1,517,364	52.04
	1890	683,100	1,535,125	44.50
	1880	631,000	2,211,385	28.53
Georgia	1900	90,700	346,259	26.19
	1890	16,461	18,542	88.79
	1880	41,800	89,725	46.59
Illinois	1900	5,351,482	11,434,842	46.80
	1890	3,781,476	8,756,824	43.18
	1880	1,729,200	3,183,026	54.33
Indiana	1900	542,224	864,090	62.75
	1890	98,065	179,936	54.50
	1880	226,500	476,845	47.50
Iowa	1900	506,757	786,141	64.46
	1890	435,066	574,378	75.75
	1880	61,040	243,040	25.11
Kansas	[1] 1900	.....	.....	.....
	[1] 1890	.....	.....	.....
	1880	16,000	55,814	28.67
Kentucky	1900	254,382	630,358	40.36
	1890	280,166	526,387	53.22
	1880	197,100	578,732	34.06
Louisiana	1900	289,345	660,987	43.77
	1890	293,244	968,017	30.29
	1880	17,000	164,090	10.36
Maine	1900	5,148,278	12,295,847	41.87
	1890	4,804,946	10,335,342	46.49
	1880	1,369,000	5,823,541	23.51
Maryland	1900	499,609	1,129,153	44.25
	1890	863,965	1,533,761	56.33
	1880	590,600	2,212,963	26.69
Massachusetts	1900	37,577,630	117,115,243	32.09
	1890	44,567,702	116,387,900	38.29
	1880	21,098,133	95,900,510	22.00
Michigan	1900	1,135,961	1,915,179	59.32
	1890	972,534	2,065,531	47.08
	1880	343,500	1,216,255	28.24
Minnesota	1900	2,237,540	3,615,801	61.88
	1890	1,794,711	2,032,814	88.20
	1880	463,000	930,192	49.77
Missouri	1900	4,183,979	11,253,202	37.18
	1890	3,712,915	4,841,004	76.70
	1880	642,800	1,982,993	32.42
Nebraska	1900	43,500	73,210	59.42
	[1] 1890	.....	.....	.....
	[2] 1880	.....	.....	.....
New Hampshire	1900	8,123,481	23,405,558	34.71
	1890	3,956,774	11,986,003	33.01
	1880	1,696,200	7,230,804	23.46
New Jersey	1900	3,153,255	6,978,043	45.19
	1890	2,811,098	7,255,409	38.74
	1880	964,245	4,689,286	20.56
New York	1900	11,983,239	25,585,631	46.84
	1890	11,950,891	23,661,204	50.51
	1880	6,227,537	18,979,259	32.81
North Carolina	1900	37,700	73,493	51.30
	1890	118,000	155,900	75.69
	1880	34,000	107,600	31.60
Ohio	1900	7,549,142	17,920,854	42.12
	1890	3,176,318	8,489,728	37.41
	1880	1,154,200	4,167,476	27.69
Pennsylvania	1900	6,860,480	13,235,933	51.83
	1890	5,394,799	10,354,850	52.10
	1880	3,627,840	9,590,002	37.83

[1] Included in "all other states."
[2] No establishments reported.

TABLE 8.—AVERAGE AMOUNT OF CAPITAL REQUIRED FOR A PRODUCT VALUED AT $100: 1880, 1890, AND 1900—Continued.

STATES.	Year.	Capital.	Value of products.	For $100 of product.
Rhode Island	1900	$57,358	$241,278	$23.77
	1890	27,850	158,800	17.54
	[1] 1880	.....	.....	.....
Tennessee	[2] 1900	.....	.....	.....
	[2] 1890	.....	.....	.....
	1880	6,000	35,826	16.75
Utah	1900	124,267	225,986	54.99
	[2] 1890	.....	.....	.....
	1880	60,050	189,669	31.66
Vermont	1900	478,184	792,707	60.32
	1890	348,827	529,486	65.88
	1880	88,000	198,200	44.40
Virginia	1900	641,166	1,452,480	44.14
	1890	501,661	1,279,069	39.22
	1880	60,800	187,520	32.42
Washington	1900	71,071	166,423	42.71
	[1] 1890	.....	.....	.....
	[2] 1880	.....	.....	.....
Wisconsin	1900	2,473,626	4,791,684	51.62
	1890	2,621,606	2,972,233	88.20
	1880	548,800	1,736,773	31.60
All other states[3]	1900	333,513	670,323	49.75
	1890	329,961	656,072	50.29
	1880	98,500	219,277	44.92

[1] No establishments reported.
[2] Included in "all other states."
[3] Includes establishments distributed as follows: 1900—Alabama, 1; Colorado, 1; Delaware, 1; Kansas, 1; Oregon, 2; Tennessee, 2. 1890—Alabama, 1; Delaware, 1; Kansas, 2; Nebraska, 1; Oregon, 1; South Carolina, 2; Tennessee, 2; Texas, 3; Utah, 2; Washington, 1. 1880—Colorado, 1; Idaho, 1; Mississippi, 2; Oregon, 1; West Virginia, 1.

Capital in 1890 and 1900 included that invested in land, buildings, and machinery, tools, and implements, together with live capital either owned or borrowed. For the United States, in 1900, the average capital was $39 for every $100 of product against $43.18 in 1890 and $25.89 in 1880. Table 8 shows that there was a wide difference in the amounts required in different sections of the country to manufacture a product valued at $100. This is explained by the varying conditions under which the business was carried on. In 1900 the two extremes appeared to be Rhode Island, requiring $23.77, and California, $67.97. California's excessive average is due to the fact that the value of the products in the state decreased from $3,395,043 in 1890 to $1,850,511 in 1900, or 45.5 per cent, while the capital decreased in a lesser ratio, from $1,740,175 to $1,257,746, or 27.7 per cent. During the same period the number of establishments declined from 56 to 30, a loss of 26, which undoubtedly accounts for a part of the loss in value of products; though in consideration of the comparatively slight reduction in the amount of capital, it would appear that the loss in establishments was of the class using small capital.

Consequently, it is evident that while the larger portion of the capital remained in the business in 1900, the product was considerably below normal, thereby adding materially to the amount of capital reported for a product of $100. Other states with a product in excess of $1,000,000, which reported more than $50 invested for each $100 of product during the census year are as follows: Minnesota, $61.88 against $88.20 in 1890; Michigan, $59.32 against $47.08 in 1890; Connecticut, $52.04 against $44.50 in 1890; Wisconsin, $51.62 against $88.20 in 1890; and Pennsylvania, $51.83 against $52.10 in 1890. It will be noticed that the amount invested by Minnesota and Wisconsin in 1890 was precisely the same, $88.20 being the amount shown in each state; while in 1900 Wisconsin showed a reduction to $51.62 and Minnesota to $61.88. Wisconsin manufactured products valued at $4,791,684 in 1900 against $2,972,233 in 1890, with $147,980 less of capital than in 1890; while Minnesota produced $3,615,801 in 1900 compared with $2,032,814 in 1890, with an increase of $442,829 in capital.

Pennsylvania shows an increase in product over 1890 of nearly $3,000,000, with an increase of a little less than $1,500,000 in capital, showing a variation between the two censuses of only 27 cents in the amount required for a product of $100.

Michigan shows an increase of $12.24 in the capital invested for $100 of product; the capital for that state having increased $163,427, while the product was $150,352 less than in 1890.

Illinois shows an increase of $1,570,006 in capital and $2,678,018 in product; a capital of $46.80 was required for $100 of product in 1900 compared with $43.18 in 1890.

In Missouri the capital required for $100 of product diminished more than one-half during the past ten years, showing $76.70 in 1890 and $37.18 in 1900. During the decade the value of the products increased $6,412,198, while the capital increased only $471,064. This is probably due to the fact that about the year 1890 an extensive development of the industry began in that state and a large amount of capital was invested, the benefits of which were not fully realized until after the returns for the census of 1890.

The products of the state of New York show an increase of nearly $2,000,000, while the growth of capital is represented by the comparatively small sum of $32,348; thus reducing the amount required for a product of $100 from $50.51 in 1890 to $46.84 in 1900.

Maryland shows a material reduction in the amount of capital required for a product of $100 in 1900, $44.25 having been used against $56.33 in 1890.

New Jersey shows an increase of $6.45 in the average capital required, or from $38.74 in 1890 to $45.19 in 1900, with a small loss in value of products, and an actual increase in capital of $342,157.

Ohio reports an increase of $4.71 in the average capital employed, $42.12 having been required in 1900 against $37.41 in 1890. The product was more than doubled during the decade, and the total capital increased $4,372,824.

Virginia shows an increase of $4.92, or from $39.22 to $44.14, with small increases in production and capital.

With the exception of those located in Connecticut, the factories in the New England states reporting a product of more than $1,000,000, generally shows a smaller amount of capital required for a product of $100 than in states located in other sections of the United States. Maine reported $41.87 in 1900 against $46.49 in 1890; New Hampshire shows an increase of $1.70, or from $33.01 to $34.71, with an increase of more than 100 per cent in the amounts of product and capital; Massachusetts shows a decrease of $6.20 in the amount employed for a product of $100, or $32.09 in 1900 against $38.29 in 1890; the products increased $727,343 and the capital diminished $6,990,072.

The wide variation in the amount of capital employed in the different states where boot and shoe manufacturing is carried on is accounted for in various ways. That the Western, Middle, and Southern states employ a larger capital than the New England states is due in a measure to the fact that many of the manufacturers in those states dispose of a larger proportion of their products directly to the retail dealer than is the case in New England. This requires oftentimes longer credits than is required when the product is sold to the "jobber;" and, in addition to this, manufacturers selling to the retail trade are required to carry in stock a considerable quantity of manufactured goods in order to promptly supply their customers when the goods are wanted. Furthermore the manufacturers in the Western, Middle, and Southern states are farther from the source of supply and are generally obliged to buy their raw materials in larger quantities than the manufacturers located in the New England states.

Table 8 also shows that the average capital employed for a product of $100 in 1900 was $4.18 less than that employed in 1890. A comparison of figures indicates that the shoe manufacturers of the United States turned their capital 2.56 times in 1900, and 2.31 times in 1890. In almost every instance the capital employed in 1880 was very much less than in 1890 or in 1900. In 1880 manufacturers bought their materials on long credits and did not employ the vast amount of machinery which is to-day required to carry on a successful shoe-manufacturing business. The factories were run almost twelve months in the year, while the business as conducted to-day requires that most of the product should be made in a much shorter time, thus necessitating the use of larger capital. The business in 1880 was conducted on a much smaller scale, and was carried on in comparatively inexpensive buildings, while to-day the magnitude of the business frequently requires the occupancy of immense structures of iron, brick, and stone, representing a larger amount of capital invested.

There were 2 educational, 1 eleemosynary, and 3 penal institutions returned as engaged in the manufacture of boots and shoes during the census year, using materials costing $215,110, with products valued at $269,476.

Twenty-three idle boot and shoe factories were reported in 1900. The total capital of these establishments was $413,018, divided as follows: Land, $32,560; buildings, $103,400; machinery, tools, and implements, $154,171; and cash and sundries, $122,887.

HISTORICAL AND DESCRIPTIVE.

Early History.—Few industries, in their evolution, offer a more interesting history than the manufacture of boots and shoes. Supplying, as the shoemaker does, a necessity common to all civilized people, his progress is due to the fact that the number of wearers increases each year, and the demand for his products continues in an ever-widening ratio. The history of this branch of manufacturing, as it has progressed from the shoemaker's bench, where shoes were turned out one at a time, to the modern factory with its output of thousands of pairs daily marks, as do few others, the remarkable industrial progress of the present age.

The introduction of the boot and shoe industry in America is almost coincident with the first settlement of New England, for it is a matter of history that in the year 1629 a shoemaker named Thomas Beard, with a supply of hides, arrived on board the Mayflower. This pioneer of the American boot and shoe trade was accredited to the governor of the colony, by the company in London, at a salary of £10 per annum and a grant of 50 acres of land, upon which he should settle. Seven years after the arrival of Beard, the city of Lynn saw the inception of the industry which has given it a world-wide fame, for there, in 1636, Philip Kertland, a native of Buckinghamshire, began the manufacture of shoes and fifteen years later the shoemakers of Lynn were supplying the trade of Boston. As early as 1648, we find tanning and shoemaking mentioned as an industry in the colony of Virginia, special mention being made of the fact that a planter named Matthews employed 8 shoemakers upon his own premises. Legal restraint was placed upon the business of the cordwainer in Connecticut, in 1656 and in Rhode Island in 1706, while in New York the business of tanning and shoemaking is known to have been firmly established previous to the capitulation of the province to the English, in 1664. In 1698 the industry was carried on profitably in Philadelphia, and in 1721 the colonial legislature of Pennsylvania passed an act regulating the materials and the prices of the boot and shoe industry.[1]

During the Revolution most of the shoes worn by the Continental army, as well as nearly all ready-made shoes sold throughout the colonies, were produced in Massachusetts, and we find it recorded that "for quality and service they were quite as good as those imported from England." Immediately after the Revolution, in consequence of large importations, the business languished somewhat. It soon recovered, however, and was pursued with such vigor that in 1795 there were in Lynn 200 master workmen and 600 journeymen, who produced in the aggregate 300,000 pairs of ladies' shoes. One manufacturer in seven months of the year 1795 made 20,000 pairs. In 1778 men's shoes were made in Reading, Braintree, and other towns in the Old Colony for the wholesale trade; they were sold to dealers in Boston, Philadelphia, Savannah, and Charleston, a considerable portion being exported to Cuba and other West India islands.

About the year 1795 the business was established in Milford and other Worcester county towns, where brogans were made, and sold to the planters in the Southern states for negro wear. The custom at this time was for the manufacturer to make weekly trips to Boston with his horse and wagon, taking his goods in baskets and barrels, and selling them to the wholesale trade.[2]

Early Methods.—Prior to 1815 most of the shoes were hand sewed, a few having been copper nailed; the heavier shoes were welted and the lighter ones turned. This method of manufacture was changed, about the year 1815, by the adoption of the wooden shoe peg, which was invented in 1811 and soon came into general use. Up to this time little or no progress had been made in the methods of manufacture. The shoemaker sat on his bench, and with scarcely any tools other than a hammer, knife, and wooden shoulder stick, cut, stitched, hammered, and sewed, until the shoe was completed. Previous to the year 1845, which marked the first successful application of machinery to American shoemaking, this industry was in the strictest sense a hand process, and the young man who chose it for his vocation was apprenticed for seven years, and in that time was taught every detail of the art. He was instructed in the preparation of the insole and outsole, depending almost entirely upon his eye for the proper proportions; taught to prepare pegs and drive them, for the pegged shoe was the most common type of footwear in the first

[1] Eighth Census of United States, 1860. Manufactures, page 67.

[2] One Hundred Years of American Commerce, published 1895: The Boot and Shoe Trade; William B. Rice, Vol. II, pages 566 to 574.

half of the last century; and familiarized himself with the making of turned and welt shoes, which have always been considered the highest type of shoemaking, requiring exceptional skill of the artisan in channeling the insole and outsole by hand, rounding the sole, sewing the welt, and stitching the outsole. After having served his apprenticeship, it was the custom for the full-fledged shoemaker to start on what was known as "whipping the cat," which meant traveling from town to town, living with a family while making a year's supply of shoes for each member, and then moving on to fill engagements previously made.

The change from which has been evolved our present factory system, began in the latter part of 1700, when a system of sizes had been drafted, and shoemakers more enterprising than their fellows gathered about them groups of workmen, and took upon themselves the dignity of manufacturers. The entire shoe was then made under one roof, and generally from leather that was tanned on the premises; one workman cut the leather, others sewed the uppers, and still others fastened uppers to soles, each workman handling only one part in the process of manufacture. This division of labor was successful from the very start, and soon the method was adopted of sending out the uppers to be sewed by the women and children at their homes. Small shops were numerous throughout certain parts of Massachusetts where the shoemaker, with members of his family or sometimes a neighbor, received the uppers and understock from the factories near by, bottomed the boots and shoes, and returned them to the factories, where they were finished and sent to the market packed in wooden boxes. Thus the industry developed and prospered and was carried on without any further improvement in methods until the introduction of machinery a little more than a half century ago.

Machinery.—The first machine which proved itself of any practical value was the leather-rolling machine, which came into use about 1845 and with which it was said "a man could do in a minute what would require half an hour's hard work with a lapstone and hammer." This was closely followed by the wax-thread sewing machine, which greatly reduced the time required for sewing together the different parts that formed the upper, and the buffing machine, for removing the grain from sole leather. Then came a machine which made pegs very cheaply and with great rapidity, and this in turn was followed by a hand-power machine for driving pegs. In 1855 there was introduced the splitting machine, for reducing sole leather to a uniform thickness. Peg-making and power-pegging machines were soon perfected and there had appeared a dieing-out machine, which was used for cutting soles, taps, and heels by the use of different sized dies. The year 1860 saw the introduction of the McKay sewing machine, which has perhaps done more to revolutionize the manufacture of shoes than any other single machine. The shoe to be sewed was placed over a horn and the sewing was done from the channel in the outsole through the sole and insole. The machine made a loop stich and left a ridge of thread on the inside of the shoe, but it filled the great demand that existed for sewed shoes, and many hundreds of millions of pairs have been made by its use.

At the time of the introduction of the McKay machine inventors were busy in other directions, and, as a result, came the introduction of the cable nailing machine, which was provided with a cable of nails, the head of one being joined to the point of another; these the machine cut into separate nails and drove automatically. At about this time was introduced the screw machine which formed a screw from brass wire, forcing it into the leather and cutting it off automatically. This was the prototype of the "rapid standard screw machine," which is a comparatively recent invention and is very widely used as a sole fastener at the present time on the heavier class of boots and shoes. Very soon thereafter the attention of the trade was attracted to the invention of a New York mechanic for the sewing of soles. This device was particularly intended for the making of turn shoes and afterwards became famous as the Goodyear "turn shoe machine." It was many years before this machine became a commercial success, and mention of its progress is made later.

Closely following the Goodyear invention came the introduction of the first machine used in connection with heeling—a machine which compressed the heel and pricked holes for the nails—and this was soon followed by a machine which automatically drove the nails, the heel having previously been put in place and held by guides on the machine. Other improvements in heeling machines followed with considerable rapidity, and a machine came into use shortly afterwards which not only nailed the heel but was also provided with a hand trimmer, which the operator swung round the heel immediately after nailing. From these have been evolved the heeling machines in use at the present time.

Notable improvements had during this time been made in the Goodyear system, and a machine was made for the sewing of welts which was the foundation of the Goodyear machine now so universally used. This machine sewed from the channel of the insole through upper and welt, uniting all three, and was a machine of the chain-stitch type which left the loop on the outside of the welt. This machine was closely followed by the introduction of one which stitched the outsole, uniting it to the welt by a stitch made from the channel in the outsole, through outsole and welt. This machine afterwards became famous as the Goodyear "rapid outsole lock-stitch machine." The great demand that existed for shoes of this type made it necessary that accessory machines should be invented, and those which prepared the insole, skived the welt, trimmed the insole, rounded and channeled the outsole, as well as a machine which automatically rolled or leveled the shoe, and the stitch separating machine were soon produced. These formed the Goodyear welt system which has been the subject of constant improvement up to the present time and is now in use wherever shoes of a higher class are made.

At the time the first standard screw machine was attracting attention, the heel-trimming and forepart-trimming machines were brought out. This part of the work had previously been done by the hand workman, using a shave or knife for trimming, and as he was entirely dependent upon the eye for the proper proportions of the finished sole, the work was not often of a very uniform nature. The heel and forepart trimming machines greatly reduced this part of the labor, and their adoption was very rapid.

In the early seventies came a change in a department of shoemaking which, prior to that time, had been regarded as a confirmed hand process. This was the important part of the work known as lasting; and a machine was introduced at that time for doing this work. This machine, as well as those which followed afterwards for a period of twenty years, was known as the bed type of machine, in which the shoe upper was drawn over the last by either friction or pincers, and then tacked by the use of a hand tool. At a comparatively recent period another machine which revolutionized all previous ideas in lasting was introduced. This machine is generally in use at the present time and is known as the "consolidated hand-method lasting machine." It was fitted with pincers which automatically drew the leather round the last, at the same time driving a tack which held it in place. This machine has been so developed that it is now used for the lasting of shoes of every type, from the lowest and cheapest to the highest grade, and it is a machine that shows wonderful mechanical ingenuity.

The perfecting of the lasting machine has been followed recently by the introduction of a machine which performs in a most satisfactory way the difficult process known as "pulling over," which consists of accurately centering the shoe upper on the last and securing it temporarily in position for the work of lasting. The new machine, which is known as the hand-method pulling-over machine, is provided with pincers, which close automatically, gripping the shoe upper at sides and toe. It is fitted with adjustments by which the operator is enabled to quickly center the shoe upper on the last, and, on the pressing of a foot lever, the machine automatically draws the upper closely to the last and secures it in position by tacks, which are also driven by the machine. The introduction of this machine marked a radical change in the one important shoemaking process that had up to this time successfully withstood all attempts at mechanical improvement. At about the time that lasting was first introduced there came the finishing machines, which were used for finishing heel and forepart. These machines were fitted with a tool, which was heated by gas and which practically duplicated the labor of the hand workman in rubbing the edges with a hot tool for the purpose of finishing them. From these early machines have been evolved the edge-setting machines which are in use at the present time.

The latest machine to attract the attention of the trade is one which, in the opinion of those well qualified to judge, is destined to revolutionize the making of that class of shoes which has heretofore been made on the McKay sewing machine. It is known as the "universal double-clinch machine," and forms a fastening of wire, which is taken from a coil corrugated in the machine, and driven, one end being clinched back into the leather of the insole while the driven end is clinched into the leather of the outsole. It is further provided with an attachment which makes the channel in which the fastening is driven and afterwards closes it automatically. It makes a very comfortable, flexible, and durable shoe, and is being rapidly adopted by manufacturers.

At the present time the genius of the American inventor has provided for every detail of shoemaking, even the smallest processes being performed by mechanical devices of some kind. This has naturally made the shoemaker of to-day a specialist, who very seldom knows anything of shoemaking apart from the particular process in the performance of which he is an adept, and from which he earns a livelihood. The American shoe of to-day is the standard production of the world. It is in demand wherever shoes are worn, and although the tools which have made its production possible have been perfected in the face of most discouraging conditions and opposition, they are to-day classed among the most ingenious productions of a wonderfully productive epoch.

Power.—In 1855, William F. Trowbridge, of Feltonville, Mass. (then a part of Marlboro, now the town of Hudson), a partner in the firm of F. Brigham & Co., conceived the idea of driving by horsepower the machines then in use. In a building attached to the factory he established a sweep, around which a horse known for a score of years in that section as the "Old General" provided the first power other than manual which ever drove shoe machinery. For some years prior to that time two or three stout Irishmen had supplied the motive power in this factory. Soon afterwards steam power was used in the factory of John Hill & Co., of Stoneham; and one after another of the larger manufacturers throughout the Eastern states found it necessary to adopt modern methods, so that after the year 1860 there were very few of any pretensions who did not use either steam or water-power to drive their machinery. This opened up the way for numerous improvements. None was of more importance than the Howe sewing machine, which was now brought into general use. Waxed thread sewing machines were also introduced in 1857, by which the uppers of nearly all heavy shoes are stitched together. Buffing machines had been run by foot as far back as 1855, but were now all driven at high speed by power. Power machines for dieing out soles and heels were introduced in 1858.[1]

[1] One Hundred Years of American Commerce, published 1895: The Boot and Shoe Trade; William B. Rice, Vol. II, pages 566 to 574.

The United States Commissioner of Labor, in dealing with boot and shoe manufacture in his report for 1898, has analyzed the different operations through which the factory-made shoe passes in its making, comparing the time needed to carry on the same operation by hand. A portion of the report is reproduced here to show the part that machinery plays in the manufacture of boots and shoes at this time.

To illustrate the difference between hand and machine work, the Commissioner uses seven different and distinct styles and grades of footwear that are fairly representative of the industry. The quantity in each instance is 100 pairs. Following is the list with their unit numbers to which reference is made in making the comparisons.

BOOTS AND SHOES.

Unit No.	Article produced or work accomplished.				Year of production.		Different operations performed.		Different workmen employed.		Time worked.				Labor cost.	
	Name.	Description.		Quantity, pairs.							Hand.		Machine.			
		Hand.	Machine.		Hand.	Machine.	Hand.	Machine.	Hand.	Machine.	Hours.	Minutes.	Hours.	Minutes.	Hand.	Machine.
69...	Boots.	Men's cheap-grade, kip, pegged boots, half-double soles.	Men's cheap-grade, kip, pegged boots, half-double soles.	100...	1859	1895	83	122	2	113	1,436	40.0	154	4.9	$408.5000	$35.4008
70...	Shoes.	Men's fine-grade, calf, welt, lace shoes, single soles, soft box toes.	Men's fine-grade, calf, welt, lace shoes, single soles, soft box toes.	100...	1865	1895	76	146	1	140	2,225	......	296	38.6	556.2496	74.3904
71...	Shoes.	Men's medium-grade, calf, welt, lace shoes, single soles, soft box toes.	Men's medium-grade, calf, welt, lace shoes, single soles, soft box toes.	100...	1863	1895	73	173	1	371	1,831	40.0	234	36.3	457.9164	59.5461
72...	Shoes.	Men's grain, pegged, brogan shoes, tap soles.	Men's grain, pegged, brogan shoes, tap soles.	100...	1855	1895	45	84	1	98	283	20.0	62	4.6	56.6668	13.8246
73...	Shoes.	Women's fine-grade, kid, welt, button shoes, single soles, patent-leather tips, soft box toes.	Women's fine-grade, kid, welt, button shoes, single soles, patent-leather tips, soft box toes.	100...	1875	1896	102	140	1	140	1,996	40.0	173	29.5	499.1664	54.6535
74...	Shoes.	Women's cheap-grade, kid, turned, lace shoes, single soles, plain toes.	Women's cheap-grade, kid, turned, lace shoes, single soles, plain toes.	100...	1858	1895	67	95	1	85	1,025	20.0	80	22.3	256.3332	18.5882
75...	Shoes.	Women's cheap-grade, grain, pegged, button shoes, single soles, plain toes.	Women's cheap-grade, grain, McKay sewed, button shoes, half-double soles, plain toes.	100...	1868	1895	56	98	2	269	538	20.0	83	10.7	109.3331	20.4435

In discussing the above statement, the Commissioner says:

There is probably none of the older industries of the country in which the introduction of machinery has been more rapid, or has played a more important part in saving time and reducing labor cost, than in that pertaining to the manufacture of boots and shoes. Following the primitive shoemaker, who worked on the bench in his own home making shoes to measure for the community, the first change introduced the old-fashioned shoe shops, which were large enough to accommodate but three or four workmen. Then followed the primitive factory system, in which the greater portion of the work was done by hand and the balance by machinery, and in time this system gradually gave way to the modern factory system in vogue at the present time, in which, with the exception of the upper-cutting department, machinery has almost entirely displaced hand methods.

In 1880, when the subdivision of labor had about reached its limit and the present system had become perfected, efforts were next directed to the production of subordinate parts of the product, which up to that time had received but little attention. This departure has resulted in the gradual and steady growth of a large number of establishments which make a specialty of preparing the rough soles, heels, counters, box toes, welting, etc.

While a large proportion of the operations in each unit are quite similar, there is considerable difference in time. The reason for this will readily be understood when attention is called to the fact that the several units represent entirely different grades of shoes, and that while the description of the machine used, work done, and the occupations may be similar, yet the actual amount of time and energy expended upon each particular part and number of operations required to produce the unit are always regulated by the particular style and quality of the product.

Ordinarily the greatest efficiency is obtained in the production of the cheaper grades of shoes, and a comparison of the aggregate time for the several units shows this to be the case. It frequently happens that in some operations greater efficiency is attained in the higher-grade product. In some operations the time reported appeared somewhat inconsistent, but when the data were submitted for revision and approved by the persons who furnished the information, attention was called to these discrepancies, and in every instance corrections were made or some special reason assigned. In some cases it was due to the difference in the style or quality of the product, or to the use of more modern machinery, while in others the skill of the workmen played an important part, and in a number of instances it was found that where the workmen were paid by the piece, they performed the work in less time than those who were paid by the hour or day. But in every case the data, as published, has been revised and approved by the parties who furnished the original information, and the results shown are considered to be as nearly correct as it is possible to make them.

Lasts and Patterns.—An important feature of the boot and shoe industry is the use of lasts and the system of last measurements adopted by manufacturers. In the early fifties the methods in last and pattern making were very crude, although some of the boots and shoes made in those days were very fine in workmanship, and the amount paid to a workman for simply putting on the bottoms which was done by hand would, at the present time, purchase a good pair of shoes. Lasts were then made only in whole sizes, such a thing as half sizes being unheard of, and were of curious shapes; first, they would have very broad toes, then would go to the other extreme and run out so thin at the end that it was necessary to iron plate them. There were only two or three styles and widths, and one pattern would fit them all. Many of the women's lasts were made straight. Very little attention was given to the saving of stock in those days, and in the making of patterns one had only to get them large enough. At the present day the saving of stock in the making of patterns is of the greatest importance. The measurements must be absolutely retained. The character and style must be kept up; and the lines, proportions, and graceful curves must receive the most careful attention in all their details, as these are necessary to make up the symmetrical whole. The early method of producing patterns was largely by guess, and some, it is said, still cling to the old way. At one time what was called the English system was considerably used, the method being to take a piece of upper leather, wet and crimp it over the last, and let it dry. This gave the form of the last, and then the pattern was cut from stiff paper allowing for laps, seams, and folds. This method gave good results, providing that the person using it had good taste in putting style into the pattern. Later came the Radii system, which some are using at the present day. Still later came the Soule method, and a book was published describing that system. This method, which is said to produce very good results, is still being used by many pattern manufacturers, and also by local shoe-pattern makers in many of the shoe factories of the country. Some of the most enterprising pattern makers of to-day, however, are using more modern methods. It is conceded that America leads the world in the manufacture of shoes, principally on account of superior style and workmanship; and the American last and pattern makers are entitled to a large degree of credit in establishing the character and style of the American shoe.

Methods of manufacture.—The following gives a fair idea of how a pair of shoes is turned out under modern methods in the factory of to-day: First, the cutters are given tickets describing the style of shoe required, the thickness of sole, and whatever other details are necessary. From this ticket the vamp cutter blocks out the vamps and gives them with the ticket to the upper cutter, who shapes the vamps to the pattern and cuts the tops or quarters which accompany them. The trimming cutter then gets out the side linings, stays, facings, or whatever trimmings are needed. The whole is then made into a bundle and sent to the fitting department. Here they are arranged in classes by themselves. Pieces which are too heavy are run through a splitting machine, and the edges are beveled by means of the skiving machine. Next they are pasted together, care being taken to join them at the marks made for that purpose. After being dried they go into the hands of the machine operators. The different parts go to different machines, each of which is adjusted for its particular work. The completed upper next goes to the sole-leather room, in which department machinery also performs the major part of the work. By the use of the cutting machine the sides of leather are reduced into strips corresponding to the length of the sole required. These strips are passed through a powerful rolling machine, which hardens the leather and removes from its surface all irregularities. They are then shaved down to a uniform thickness, also by machinery, and placed under dies which cut them out in proper form. The smaller pieces are died out in the form of lifts, or heel pieces, which are joined together to the proper thickness and cemented, after which they are put in presses which give them the greatest amount of solidity. The top lift is not added to the heel until after it has been nailed to the shoe. The remaining sole leather is used for shank pieces, rands, and bottom leveling.

For the insole, a lighter grade of leather is used, which, being cut into strips and rolled, is cut by dies to the correct shape, shaved uniformly, and channeled around the under edge for receiving the upper. The counters are died out and skived, by machine, and the welts cut in strips. The uppers and soles are then sent to the bottoming department, where the first operation is that of lasting, the uppers being tacked to the insole. From the laster they go to the machine operator, where the upper, sole, and welt are firmly sewed together by the machine. The bottom is filled and leveled off and the steel shank inserted. Next, the bottom is coated with cement, and the outsole pressed on it by a machine. Thence it is sent through the rounding machine, which trims it and channels the sole for stitching. From there it goes again to the sewing machine, which stitches through the welt outside of the upper. The next step is that of leveling, then heeling, both of which processes are accomplished by machinery. The heels are nailed on in the rough and afterwards trimmed into shape by a machine operating revolving knives; a breasting machine shaping the front of the heel. Still another machine drives in the brass nails and cuts them off flush with the top pieces. The edging machine is next used, which trims the edges of both sole and heel. The sole bottom is then sandpapered, blacked, and burnished by machinery, after which the shoe is cleaned, treed, and packed.[1]

The total floor space occupied by the shoe factories of the United States is practically 24,000,000 square feet, or about 550 acres.

The statistics of boot and shoe manufacture furnish an interesting commentary upon American enterprise, showing, as they do, the evolution of an industry from the smallest beginning and with the crudest appliances to a position that up to recent years equaled in importance that of any of the great industries of the country.

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[1] O. W. Boyden in "Boot and Shoe Recorder," page 43, January 1, 1902.

TABLE 9.—COMPARATIVE SUMMARY BY STATES: 1890 AND 1900.

STATES.	Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		WAGE-EARNERS.		Miscellaneous expenses.	Cost of materials used.	Value of products.
				Number.	Salaries.	Average number.	Total wages.			
United States	1900	1,600	$101,795,233	7,843	$7,757,749	142,922	$59,175,883	$10,766,402	$169,604,054	$261,028,580
	1890	2,082	96,282,311	[1] 5,643	[1] 6,707,931	133,690	60,667,145	9,217,519	118,785,831	220,649,358
California	1900	30	1,257,746	61	55,532	994	456,927	64,373	1,098,184	1,850,511
	1890	56	1,740,176	192	152,500	2,280	1,109,419	141,266	1,524,272	3,395,043
Connecticut	1900	16	789,618	40	38,405	719	297,826	117,372	986,555	1,517,364
	1890	20	683,100	66	73,761	995	455,706	63,666	760,140	1,635,125
Georgia	1900	5	90,700	9	8,200	250	66,000	7,859	255,695	346,259
	1890	3	16,461	4	3,100	22	4,104	1,034	7,917	18,542
Illinois	1900	55	5,351,482	349	409,362	5,553	2,694,959	444,774	7,306,025	11,434,842
	1890	56	3,781,476	160	160,333	3,992	1,896,998	388,001	4,931,986	8,766,824
Indiana	1900	6	542,224	41	41,469	610	151,455	23,106	631,856	864,090
	1890	6	98,065	13	10,126	173	57,079	3,768	90,157	179,936
Iowa	1900	7	606,757	40	35,832	566	191,783	18,718	507,492	786,141
	1890	6	436,066	27	26,750	292	110,100	16,309	286,716	574,378
Kentucky	1900	7	254,382	63	37,075	207	50,819	64,313	456,018	630,358
	1890	11	280,166	29	26,515	296	112,295	33,640	266,210	526,387
Louisiana	1900	12	289,345	27	26,360	397	145,004	21,062	442,002	660,987
	1890	17	293,244	39	36,380	786	328,900	11,663	412,497	968,017
Maine	1900	48	6,148,278	345	345,556	6,432	2,664,672	402,027	8,366,747	12,295,847
	1890	53	4,804,946	215	209,966	6,382	2,868,600	397,394	6,800,682	10,335,342
Maryland	1900	19	499,609	44	50,236	896	289,194	38,480	676,359	1,129,153
	1890	28	863,965	71	61,644	1,182	459,404	30,953	723,052	1,533,761
Massachusetts	1900	640	37,577,630	2,546	2,487,013	58,645	27,745,820	4,826,896	75,751,964	117,115,243
	1890	1,057	44,567,702	2,560	2,669,799	67,374	32,379,899	5,568,233	63,928,182	116,387,900
Michigan	1900	13	1,136,961	77	69,688	1,117	386,074	200,504	1,163,863	1,915,179
	1890	12	972,534	62	86,930	1,309	495,202	89,088	1,209,387	2,065,531
Minnesota	1900	16	2,237,540	146	154,946	2,025	719,231	151,042	2,378,156	3,615,801
	1890	8	1,794,711	83	89,044	1,099	524,978	99,962	1,090,722	2,032,814
Missouri	1900	50	4,183,979	330	346,877	5,915	2,052,114	643,942	7,993,026	11,253,202
	1890	29	3,712,915	97	127,902	2,716	1,119,390	305,194	2,521,027	4,841,004
Nebraska	1900	3	43,500	6	3,300	55	17,302	2,000	47,005	73,210
	[2] 1890	......	......	......	......	......	......	......	......	......
New Hampshire	1900	67	8,123,481	362	357,046	12,007	4,971,954	453,706	16,569,725	23,405,558
	1890	64	3,966,774	167	132,741	7,912	3,337,167	256,643	6,749,322	11,986,003
New Jersey	1900	84	3,153,255	333	368,968	4,421	1,723,159	391,043	4,210,472	6,978,043
	1890	109	2,811,098	293	282,206	5,162	2,206,652	129,513	3,417,180	7,255,409
New York	1900	223	11,983,239	1,076	1,018,153	15,796	6,138,653	1,251,902	15,611,386	25,585,631
	1890	257	11,950,891	809	930,493	15,361	6,629,641	812,099	12,383,851	23,661,204
North Carolina	1900	3	37,700	3	1,618	40	14,107	1,058	53,297	73,493
	1890	4	118,000	7	5,200	95	26,720	3,473	76,670	155,900
Ohio	1900	81	7,549,142	888	960,890	12,718	3,989,744	637,537	11,074,008	17,920,854
	1890	63	3,176,318	248	269,687	5,743	2,303,393	257,369	4,480,206	8,489,728
Pennsylvania	1900	146	6,860,480	663	679,794	9,144	3,111,113	572,624	8,210,846	13,235,933
	1890	158	5,394,799	336	304,108	7,616	3,094,582	311,684	5,012,096	10,354,850
Rhode Island	1900	5	57,358	17	14,800	9	1,888	27,480	179,986	241,278
	1890	3	27,850	2	1,450	11	4,084	27,631	110,745	158,800
Utah	1900	3	124,267	17	17,432	140	52,558	5,017	156,046	225,986
	[2] 1890	......	......	......	......	......	......	......	......	......
Vermont	1900	6	478,184	40	32,114	355	128,771	25,970	561,786	792,707
	1890	7	348,827	12	12,624	227	94,766	32,450	346,557	529,486
Virginia	1900	5	641,166	45	50,509	1,153	206,119	35,122	1,159,969	1,452,480
	1890	7	501,661	20	24,474	252	115,414	83,682	874,564	1,279,069
Washington	1900	3	71,071	15	12,060	76	31,461	14,937	102,599	166,423
	[2] 1890	......	......	......	......	......	......	......	......	......
Wisconsin	1900	40	2,473,626	232	213,600	2,507	821,403	279,913	3,170,921	4,791,684
	1890	32	2,621,606	119	101,622	2,036	774,163	146,345	1,466,557	2,972,233
All other states[3]	1900	8	333,513	28	20,915	176	55,773	43,625	482,066	670,323
	1890	16	329,961	22	19,676	377	158,589	16,469	325,136	656,072

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 10.)
[2] Included "all other states."
[3] Includes establishments distributed as follows: 1900—Alabama, 1; Colorado, 1; Delaware, 1; Kansas, 1; Oregon, 2; Tennessee, 2. 1890—Alabama, 1; Delaware, 1; Kansas, 2; Nebraska, 1; Oregon, 1; South Carolina, 2; Tennessee, 2; Texas, 3; Utah, 2; Washington, 1.

TABLE 10.—BOOTS AND SHOES:

		United States.	California.	Connecticut.	Georgia.	Illinois.
1	Number of establishments	1,600	30	15	5	55
	Character of organization:					
2	Individual	618	6	5	1	15
3	Firm and limited partnership	580	15	7	2	20
4	Incorporated company	401	9	3	2	20
5	Miscellaneous	1	......	......	......	......
	Capital:					
6	Total	$101,795,233	$1,257,746	$789,618	$90,700	$5,351,482
7	Land	$2,177,426	$13,500	$12,700	$1,500	$101,445
8	Buildings	$7,008,014	$12,450	$17,900	$6,500	$381,098
9	Machinery, tools, and implements	$16,957,305	$343,633	$117,172	$23,400	$931,083
10	Cash and sundries	$75,652,488	$888,163	$641,846	$59,300	$3,937,856
11	Proprietors and firm members	2,030	82	28	10	61
	Salaried officials, clerks, etc.:					
12	Total number	7,843	61	40	9	349
13	Total salaries	$7,757,749	$55,532	$38,405	$8,200	$409,362
	Officers of corporations—					
14	Number	640	14	4	......	26
15	Salaries	$1,295,350	$17,070	$5,560	......	$96,900
	General superintendents, managers, clerks, etc.—					
16	Total number	7,203	47	36	9	323
17	Total salaries	$6,462,399	$38,462	$32,845	$8,200	$312,462
	Men—					
18	Number	5,464	39	28	9	255
19	Salaries	$5,710,279	$34,862	$29,551	$8,200	$278,334
	Women—					
20	Number	1,739	8	8	......	68
21	Salaries	$752,120	$3,600	$3,294	......	$34,128
	Wage-earners, including pieceworkers, and total wages:					
22	Greatest number employed at any one time during the year	169,912	1,211	899	256	6,681
23	Least number employed at any one time during the year	116,436	762	459	246	4,298
24	Average number	142,922	994	719	250	5,553
25	Wages	$59,175,883	$456,927	$297,826	$66,000	$2,694,959
	Men, 16 years and over—					
26	Average number	91,215	720	456	190	3,484
27	Wages	$43,301,430	$372,131	$221,629	$55,600	$1,872,402
	Women, 16 years and over—					
28	Average number	47,186	241	254	40	1,836
29	Wages	$15,068,726	$79,036	$74,932	$7,400	$783,949
	Children, under 16 years—					
30	Average number	4,521	33	9	20	233
31	Wages	$805,727	$5,760	$1,265	$3,000	$38,608
	Average number of wage-earners, including piece workers, employed during each month:					
	Men, 16 years and over—					
32	January	91,197	664	428	187	3,793
33	February	94,122	706	475	186	3,707
34	March	95,299	699	486	189	3,600
35	April	92,758	716	497	189	3,272
36	May	90,433	737	425	189	3,130
37	June	86,990	721	444	191	2,943
38	July	87,224	649	403	191	3,772
39	August	92,712	747	491	189	3,812
40	September	93,526	782	488	191	3,861
41	October	92,045	803	472	196	3,245
42	November	87,808	649	424	194	3,414
43	December	90,465	770	436	191	3,258
	Women, 16 years and over—					
44	January	47,914	241	206	40	2,089
45	February	49,304	255	220	40	2,063
46	March	49,757	239	234	40	1,749
47	April	47,840	255	240	40	1,612
48	May	46,767	252	225	40	1,592
49	June	44,693	223	262	40	1,519
50	July	44,684	198	263	40	2,104
51	August	47,647	254	315	40	2,157
52	September	47,920	253	297	40	2,156
53	October	47,166	266	284	40	1,626
54	November	45,536	216	268	40	1,713
55	December	47,005	240	229	40	1,658
	Children, under 16 years—					
56	January	4,529	30	7	20	235
57	February	4,589	32	9	20	222
58	March	4,672	35	12	20	243
59	April	4,524	33	12	20	243
60	May	4,441	31	11	20	231
61	June	4,389	30	10	20	190
62	July	4,436	31	8	20	245
63	August	4,723	37	10	20	262
64	September	4,655	37	11	20	259
65	October	4,493	38	8	20	203
66	November	4,357	25	6	20	246
67	December	4,441	34	7	20	218
	Average number of employees by classes:					
68	Cutters	19,900	128	78	23	661
69	Stitchers	41,870	288	165	35	1,702
70	Lasters	19,247	155	67	25	754
71	Bottomers	27,558	205	185	101	1,248
72	Edgemakers	6,432	47	31	12	324
73	Finishers	15,391	73	74	43	418
	Miscellaneous expenses:					
74	Total	$10,766,402	$64,373	$117,372	$7,859	$444,774
75	Rent of works	$1,000,689	$22,338	$7,691	$1,810	$52,418
76	Taxes, not including internal-revenue	$382,426	$4,874	$1,979	$1,024	$15,268
77	Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$7,631,339	$36,961	$72,702	$5,025	$326,050
78	Contract work	$1,751,948	$200	$35,000	......	$51,038

BY STATES, 1900.

Indiana.	Iowa.	Kentucky.	Louisiana.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Missouri.	
6	7	7	12	48	19	640	13	16	50	1
2	1	1	7	9	9	286	2	5	6	2
......	2	4	5	14	6	267	6	4	8	3
4	4	2	......	25	4	86	5	7	36	4
......	......	......	......	......	......	1	......	......	......	5
$542,224	$506,757	$254,382	$289,345	$5,148,278	$499,609	$37,577,630	$1,135,961	$2,237,540	$4,183,979	6
$3,000	$12,100	......	$13,000	$135,285	$12,500	$674,179	$82,148	......	$89,250	7
$13,399	$57,840	......	$25,700	$540,950	$26,800	$2,360,203	$200,150	$2,100	$456,877	8
$97,157	$86,471	$44,456	$72,933	$663,326	$167,326	$5,750,238	$150,800	$337,236	$804,568	9
$428,668	$350,346	$209,926	$177,712	$3,808,717	$292,983	$28,793,010	$702,863	$1,898,204	$2,833,284	10
2	7	12	20	41	26	897	19	13	25	11
41	40	63	27	345	44	2,546	77	146	330	12
$41,469	$35,832	$37,075	$26,360	$345,556	$50,236	$2,487,013	$69,688	$154,945	$346,877	13
8	2	2	......	44	3	146	3	4	47	14
$14,000	$1,980	$3,280	......	$89,314	$7,700	$352,163	$6,440	$4,040	$76,513	15
33	38	61	27	301	41	2,400	74	142	283	16
$27,469	$33,852	$33,795	$26,360	$256,242	$42,536	$2,134,850	$63,248	$150,905	$270,364	17
29	33	57	25	225	38	1,508	56	136	243	18
$26,169	$32,012	$32,195	$25,660	$224,087	$41,252	$1,737,419	$55,959	$147,758	$249,323	19
4	5	4	2	76	3	892	18	6	40	20
$1,300	$1,840	$1,600	$700	$32,155	$1,284	$397,431	$7,289	$3,147	$21,041	21
637	632	256	431	7,760	934	72,261	1,378	2,319	7,040	22
555	489	155	370	4,808	825	45,579	915	1,843	4,766	23
610	566	207	397	6,432	896	58,645	1,117	2,025	5,915	24
$151,455	$191,783	$50,819	$145,004	$2,664,672	$289,194	$27,745,820	$386,074	$719,231	$2,052,114	25
434	272	94	326	4,346	597	39,022	691	1,438	3,256	26
$114,988	$115,659	$30,629	$133,500	$2,014,993	$220,030	$20,873,248	$272,308	$536,988	$1,356,079	27
170	227	69	37	2,064	285	18,636	417	566	2,207	28
$35,867	$65,557	$14,664	$8,108	$645,694	$67,264	$6,686,138	$112,634	$179,428	$623,281	29
6	67	44	34	22	14	987	9	21	452	30
$600	$10,567	$5,526	$3,396	$3,985	$1,900	$186,434	$1,132	$2,815	$72,754	31
441	269	84	343	4,549	606	38,195	748	1,485	3,235	32
437	273	97	341	4,702	615	39,888	776	1,477	3,311	33
429	285	99	344	4,620	613	40,809	779	1,462	3,351	34
408	279	103	344	4,128	606	40,237	672	1,398	3,344	35
434	270	102	326	4,135	579	38,958	678	1,297	3,442	36
443	266	64	279	4,295	578	37,677	698	1,193	3,049	37
448	273	91	288	4,218	602	37,445	338	1,491	3,012	38
447	279	107	330	4,272	601	39,748	765	1,525	3,129	39
432	252	111	349	4,349	609	40,112	794	1,512	3,173	40
409	262	99	328	4,292	606	39,619	747	1,491	3,305	41
434	280	91	319	4,177	567	37,441	589	1,468	3,245	42
444	271	79	318	4,415	580	38,132	706	1,459	3,476	43
181	225	63	39	2,234	280	18,523	468	571	2,212	44
182	235	71	38	2,260	287	19,335	474	579	2,223	45
178	240	74	38	2,231	289	19,840	472	577	2,374	46
168	230	76	39	1,921	283	19,284	384	563	2,277	47
126	222	71	37	2,024	273	18,760	388	536	2,308	48
157	233	49	25	2,048	284	17,711	447	477	2,082	49
175	227	63	31	1,977	284	17,348	190	586	2,033	50
177	228	78	37	2,014	292	18,498	475	605	2,110	51
172	218	83	40	2,017	297	18,807	479	591	2,131	52
163	214	69	40	1,993	285	18,828	420	583	2,233	53
176	224	68	40	1,976	275	18,194	345	559	2,162	54
181	229	63	40	2,077	291	18,509	459	568	2,342	55
6	68	42	35	18	14	948	9	16	471	56
6	70	46	36	21	14	970	9	16	463	57
6	72	51	36	21	14	993	9	18	458	58
6	75	55	36	21	14	948	9	18	452	59
6	64	45	35	21	12	960	9	21	480	60
6	63	30	23	24	14	1,042	9	26	402	61
6	69	46	24	24	14	1,051	7	23	409	62
6	72	57	36	24	14	1,069	9	27	424	63
6	60	57	36	25	14	1,022	9	24	432	64
6	62	42	36	21	14	953	9	24	475	65
9	69	32	36	21	12	960	9	22	448	66
9	64	27	36	23	14	928	9	17	508	67
69	73	26	47	973	92	8,586	191	333	832	68
189	97	58	93	1,845	243	16,352	383	621	2,035	69
68	61	32	62	780	116	8,147	142	134	695	70
82	127	29	120	1,156	129	10,907	238	639	1,309	71
20	10	9	15	302	42	2,705	28	37	310	72
42	33	12	49	600	128	6,750	142	223	730	73
$23,106	$18,718	$64,313	$21,062	$402,027	$38,480	$4,826,896	$200,504	$151,042	$643,942	74
$520	$1,732	$3,294	$4,405	$13,297	$8,168	$399,893	$3,455	$28,936	$48,800	75
$1,199	$2,174	$14,397	$1,403	$20,380	$1,351	$192,577	$4,385	$8,060	$11,920	76
$21,387	$14,812	$4,842	$15,254	$367,350	$28,961	$3,252,789	$192,404	$100,086	$258,922	77
......	......	$41,780	......	$1,000	......	$981,637	$260	$13,960	$324,300	78

		United States.	California.	Connecticut.	Georgia.	Illinois.
	Materials used:					
79	Total cost	$169,604,054	$1,098,184	$986,555	$255,695	$7,306,025
80	Sole leather, pounds	178,504,837	1,631,874	799,381	341,000	9,187,088
81	Cost	$39,192,300	$354,251	$179,610	$78,900	$1,907,169
82	Split leather, pounds	15,817,460	34,490	116,426	100,000	134,280
83	Cost	$3,109,729	$8,131	$27,163	$20,000	$30,046
84	Calf and kip skins, pounds	10,569,581	228,298	32,645	63,120	650,972
85	Cost	$7,069,408	$119,462	$22,579	$21,920	$464,286
86	Grain and other side leather, square feet	131,542,365	717,843	573,155	534,000	4,035,946
87	Cost	$15,950,818	$109,282	$69,044	$54,800	$542,151
88	Goatskins, square feet	233,050,841	557,046	1,076,075	300,000	7,499,820
89	Cost	$35,398,638	$93,696	$206,745	$30,000	$1,255,324
90	All other upper leather, square feet	98,866,823	824,998	257,365	45,000	5,341,480
91	Cost	$15,578,659	$150,178	$72,237	$6,000	$817,659
92	Sheep and leather linings and trimmings	$7,429,156	$30,863	$66,680	$5,500	$305,016
93	Cut soles, taps, heels, etc., purchased	$17,248,898	$59,125	$87,008	$2,325	$537,954
94	Findings, purchased	$12,902,750	$93,497	$90,058	$19,400	$707,851
95	Fuel	$613,410	$6,633	$4,438	$1,070	$17,985
96	Rent of power and heat	$345,518	$4,883	$2,225	$180	$20,155
97	Mill supplies	$466,458	$2,662	$1,929	$2,145	$19,321
98	All other materials	$12,979,999	$58,596	$148,649	$6,980	$625,989
99	Freight	$1,318,313	$6,925	$8,190	$6,475	$55,119
	Products:					
100	Total value	$261,028,580	$1,850,511	$1,517,364	$346,259	$11,434,842
	Men's boots and shoes—					
101	Number of pairs	68,042,839	582,966	365,949	175,700	3,275,957
102	Value	$108,705,938	$1,225,597	$499,695	$203,500	$6,047,520
	Boys' and youths' boots and shoes—					
103	Number of pairs	21,080,479	100,263	59,446	21,000	469,839
104	Value	$20,799,297	$140,371	$85,122	$20,900	$502,390
	Women's boots and shoes—					
105	Number of pairs	65,372,653	239,583	308,557	106,900	1,952,473
106	Value	$82,504,303	$440,840	$616,358	$95,160	$2,721,582
	Misses' and children's boots and shoes—					
107	Number of pairs	42,043,202	8,583	33,563	22,000	921,207
108	Value	$30,319,611	$11,327	$30,094	$13,500	$772,518
	Men's, boys', and youths' slippers—					
109	Number of pairs	4,456,965	30,014	5,046	7,500	55,420
110	Value	$2,812,213	$20,402	$6,811	$6,000	$47,640
	Women's, misses', and children's slippers, oxfords, and low cuts—					
111	Number of pairs	12,655,876	8,577	10,095	8,000	177,706
112	Value	$10,146,393	$3,041	$7,285	$6,000	$174,377
	All other kinds—					
113	Number of pairs	5,583,405	...	5,242	...	479,380
114	Value	$2,491,511	...	$2,900	...	$538,949
115	All other products	$2,175,738	$233	$266,500	...	$621,340
116	Amount received for custom or contract work	$1,073,576	$8,700	$2,599	$1,199	$8,526
	Maximum daily capacity of factory:					
117	Number of pairs	1,301,326	5,789	5,222	1,410	45,542
	Total floor space in factory:					
118	Square feet	23,799,973	145,654	135,724	33,200	903,650
	Comparison of products:					
119	Number of establishments reporting for both years	1,411	28	14	5	47
120	Value for census year	$253,152,430	$1,845,438	$1,509,290	$346,259	$11,241,005
121	Value for preceding business year	$228,305,842	$2,522,329	$1,527,635	$179,520	$10,009,673
	Power:					
122	Number of establishments reporting	1,285	15	13	4	36
123	Total horsepower	51,073	304	379	51	2,476
	Owned—					
	Engines—					
124	Steam, number	633	3	9	2	18
125	Horsepower	34,816	160	199	45	1,429
126	Gas or gasoline, number	90	3	1	...	8
127	Horsepower	1,156	26	6	...	80
128	Water wheels, number	57	...	1	...	5
129	Horsepower	2,390	...	15	...	160
130	Electric motors, number	117	...	...	...	3
131	Horsepower	1,629	...	...	...	35
	Other power—					
132	Number	5	...	...	...	...
133	Horsepower	91	...	...	...	...
	Rented—					
134	Electric, horsepower	3,572	108	159	6	322
135	Other kind, horsepower	7,419	20	...	...	460
136	Furnished to other establishments, horsepower	1,023	...	...	...	3
	Establishments classified by number of persons employed, not including proprietors and firm members:					
137	Total number	1,600	30	15	5	55
138	No employees	24	2	...	...	5
139	Under 5	166	1	1	1	5
140	5 to 20	345	14	2	2	16
141	21 to 50	311	3	6	1	8
142	51 to 100	275	8	4	...	5
143	101 to 250	277	1	1	1	7
144	251 to 500	147	1	1	...	6
145	501 to 1,000	39	...	...	...	2
146	Over 1,000	16	...	...	...	1

BY STATES, 1900—Continued.

Indiana.	Iowa.	Kentucky.	Louisiana.	Maine.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Missouri.	
$631,856	$507,492	$456,018	$442,002	$8,366,747	$676,359	$75,751,964	$1,163,863	$2,378,166	$7,993,026	79
967,000	254,141	483,280	616,856	11,042,219	487,793	79,038,736	1,572,210	3,477,515	8,088,206	80
$212,163	$63,144	$105,229	$162,860	$2,288,904	$147,478	$16,626,246	$357,878	$809,088	$1,937,294	81
61,400	2,215	30,269	9,925	608,231	13,270	9,905,569	10,603	54,301	118,561	82
$15,823	$950	$6,052	$2,184	$119,674	$3,023	$1,865,953	$3,489	$10,521	$22,732	83
500	51,899	800	6,091	460,988	25,653	5,110,293	88,209	306,750	679,707	84
$350	$35,543	$500	$8,971	$283,600	$18,313	$3,628,419	$61,007	$47,380	$363,269	85
901,366	109,612	1,177,212	448,661	9,404,521	68,875	60,717,718	753,402	2,531,119	3,382,692	86
$108,804	$17,779	$153,766	$62,721	$1,095,744	$11,965	$7,294,397	$106,173	$317,355	$458,658	87
461,660	1,073,073	409,018	358,514	9,951,308	1,348,383	99,846,695	1,992,966	2,707,161	12,625,158	88
$58,049	$181,543	$54,752	$66,413	$1,421,795	$217,570	$14,500,991	$354,252	$480,395	$1,994,631	89
632,450	43,726	51,500	338,690	4,509,510	452,799	47,344,310	313,425	1,313,171	2,948,274	90
$93,648	$6,679	$9,850	$50,531	$585,225	$80,112	$7,273,400	$56,887	$197,130	$842,335	91
$23,137	$20,878	$14,589	$18,168	$300,311	$33,560	$3,372,122	$13,635	$50,401	$372,862	92
$31,824	$94,913	$31,502	$6,209	$566,285	$68,260	$8,876,400	$14,472	$44,545	$751,042	93
$47,400	$32,473	$34,050	$44,692	$629,141	$56,813	$5,578,443	$74,603	$265,761	$684,522	94
$3,120	$4,306	$59	$1,289	$33,094	$3,949	$264,902	$6,497	$11,966	$31,166	95
....	$357	$1,555	$5,107	$10,413	$1,372	$155,155	$1,555	$3,376	$25,896	96
$750	$2,431	$844	$780	$32,628	$2,187	$85,959	$2,867	$9,006	$39,369	97
$26,665	$37,780	$33,765	$16,729	$930,252	$26,671	$5,764,500	$99,404	$103,028	$369,251	98
$10,123	$8,716	$9,505	$5,458	$69,681	$5,086	$465,077	$11,144	$28,204	$109,999	99
$864,090	$786,141	$630,358	$660,987	$12,295,847	$1,129,153	$117,115,243	$1,915,179	$3,616,801	$11,253,202	100
279,000	88,293	1,000	366,040	6,134,268	105,570	40,004,809	325,991	1,336,793	3,083,759	101
$383,000	$182,502	$3,500	$583,029	$7,810,471	$295,677	$59,628,707	$636,944	$2,024,910	$5,453,709	102
154,428	24,162	....	17,900	1,421,682	26,872	10,665,620	107,337	339,375	425,979	103
$174,290	$30,955	....	$31,775	$1,416,844	$52,340	$9,975,116	$143,840	$464,521	$524,689	104
120,000	226,153	469,220	11,400	2,208,873	356,299	24,500,767	542,993	423,276	3,120,911	105
$150,000	$362,246	$502,970	$19,200	$2,294,565	$593,235	$28,034,460	$1,004,377	$689,096	$3,963,481	106
150,000	29,523	184,969	1,000	349,267	191,210	14,509,745	71,948	228,967	1,159,799	107
$150,000	$32,373	$123,188	$1,650	$261,919	$136,186	$9,170,140	$79,210	$291,643	$1,059,037	108
....	874	....	1,000	6,144	10,212	3,282,260	30,232	10,014	10,296	109
....	$716	....	$1,100	$4,944	$8,338	$2,057,672	$22,216	$11,131	$9,755	110
8,175	39,359	....	50,088	465,732	38,700	8,769,854	15,000	59,049	192,503	111
$5,000	$39,359	....	$19,324	$302,195	$38,127	$6,881,058	$14,000	$53,686	$164,619	112
....	43,294	....	....	162,924	16,250	999,490	18,247	59,408	254,000	113
....	$68,150	....	....	$130,339	$5,000	$360,086	$9,508	$49,805	$55,215	114
....	$69,840	....	$2,109	$74,470	....	$186,386	$2,971	$15,000	$22,037	115
$1,800	....	$700	$2,800	$100	$250	$821,618	$2,113	$16,010	$760	116
2,740	2,830	2,945	2,652	73,899	3,327	690,864	8,086	14,550	51,876	117
101,900	91,142	75,350	78,006	1,269,365	104,090	10,118,725	199,313	348,496	1,094,837	118
6	6	6	11	42	16	579	9	15	36	119
$864,090	$784,175	$600,358	$608,362	$11,934,167	$1,033,030	$115,122,299	$1,772,286	$3,614,501	$9,646,720	120
$630,549	$746,479	$458,068	$504,280	$11,199,426	$922,801	$104,606,916	$1,604,591	$3,263,400	$8,299,264	121
5	7	5	9	44	14	637	11	15	46	122
180	243	122	146	3,161	240	18,411	417	847	4,003	123
3	6	1	1	31	4	232	4	8	33	124
145	213	80	50	2,177	147	13,250	255	740	2,425	125
2	....	....	2	2	6	7	4	3	4	126
35	....	....	7	39	57	32	92	22	46	127
....	....	....	....	13	....	3	....	....	4	128
....	....	....	....	590	....	130	....	....	85	129
....	1	....	....	3	....	8	....	9	23	130
....	10	....	....	78	....	263	....	39	454	131
....	....	....	....	1	....	2	....	....	....	132
....	....	....	....	6	....	55	....	....	....	133
....	20	42	89	168	3	775	60	43	385	134
....	....	....	....	103	33	3,906	10	3	608	135
....	....	....	....	99	....	381	....	5	105	136
6	7	7	12	48	19	640	13	16	50	137
....	....	....	....	1	1	6	....	....	....	138
1	1	1	....	2	2	71	2	....	3	139
1	1	1	4	4	4	132	....	5	11	140
....	1	3	4	9	5	130	5	2	8	141
....	1	1	3	4	4	96	3	3	11	142
3	2	1	1	16	3	112	2	1	8	143
1	1	....	....	11	....	73	....	3	6	144
....	....	....	....	1	....	12	1	2	2	145
....	....	....	....	....	....	8	....	....	1	146

TABLE 10.—BOOTS AND SHOES:

		Nebraska.	New Hampshire.	New Jersey.	New York.	North Carolina.
1	Number of establishments	3	67	84	223	3
	Character of organization:					
2	Individual		18	36	111	1
3	Firm and limited partnership	3	30	23	68	
4	Incorporated company		19	25	44	2
5	Miscellaneous					
	Capital:					
6	Total	$43,500	$8,123,481	$3,153,255	$11,983,239	$37,700
7	Land	$1,000	$124,187	$68,655	$285,835	$200
8	Buildings	$9,000	$473,961	$296,541	$623,594	$1,850
9	Machinery, tools, and implements	$8,700	$1,063,569	$736,375	$2,362,396	$7,450
10	Cash and sundries	$24,800	$6,461,764	$2,051,684	$8,711,414	$28,200
11	Proprietors and firm members	6	86	86	264	1
	Salaried officials, clerks, etc.:					
12	Total number	6	362	333	1,076	3
13	Total salaries	$3,300	$357,046	$368,968	$1,018,153	$1,618
	Officers of corporations:					
14	Number		25	40	82	2
15	Salaries		$54,776	$93,432	$139,983	$918
	General superintendents, managers, clerks, etc.—					
16	Total number	6	337	293	994	1
17	Total salaries	$3,300	$302,270	$275,536	$878,170	$700
	Men—					
18	Number	6	237	241	811	1
19	Salaries	$3,300	$259,687	$252,173	$802,984	$700
	Women—					
20	Number		100	52	183	
21	Salaries		$42,583	$23,363	$75,186	
	Wage-earners, including pieceworkers, and total wages:					
22	Greatest number employed at any one time during the year	121	14,014	5,354	18,143	45
23	Least number employed at any one time during the year	33	9,874	3,958	13,398	45
24	Average number	65	12,007	4,421	15,796	40
25	Wages	$17,302	$4,971,954	$1,723,159	$6,138,653	$14,107
	Men, 16 years and over—					
26	Average number	18	7,756	2,740	9,754	40
27	Wages	$8,812	$3,540,273	$1,259,819	$4,465,363	$14,107
	Women, 16 years and over—					
28	Average number	37	3,866	1,497	5,483	
29	Wages	$8,490	$1,334,143	$427,732	$1,584,992	
	Children, under 16 years—					
30	Average number		386	184	559	
31	Wages		$97,538	$35,608	$88,298	
	Average number of wage-earners, including pieceworkers, employed during each month:					
	Men, 16 years and over—					
32	January	9	8,014	2,610	9,675	45
33	February	9	8,089	2,928	10,023	45
34	March	9	8,187	2,971	10,187	31
35	April	11	7,816	2,974	9,882	31
36	May	18	7,623	2,925	9,808	31
37	June	17	7,422	2,676	9,511	45
38	July	20	7,555	2,177	9,134	45
39	August	25	7,721	2,704	9,771	45
40	September	25	7,631	2,929	9,986	45
41	October	25	7,620	2,831	9,893	45
42	November	26	7,386	2,472	9,374	45
43	December	27	8,002	2,685	9,799	27
	Women, 16 years and over—					
44	January	12	4,006	1,429	5,498	
45	February	12	4,114	1,597	5,671	
46	March	12	4,133	1,625	6,737	
47	April	13	3,967	1,605	5,484	
48	May	35	3,833	1,576	5,407	
49	June	38	3,724	1,471	5,293	
50	July	43	3,709	1,224	5,192	
51	August	58	3,715	1,580	6,612	
52	September	64	3,737	1,561	5,710	
53	October	62	3,727	1,606	5,567	
54	November	62	3,627	1,348	5,163	
55	December	33	4,095	1,442	5,457	
	Children, under 16 years—					
56	January		382	171	585	
57	February		400	182	582	
58	March		401	202	587	
59	April		364	205	666	
60	May		370	198	512	
61	June		373	168	572	
62	July		386	142	653	
63	August		400	166	592	
64	September		372	205	586	
65	October		377	201	554	
66	November		397	195	466	
67	December		405	173	557	
	Average number of employees, by classes:					
68	Cutters	2	1,862	584	2,002	9
69	Stitchers	3	3,494	1,112	4,668	7
70	Lasters	4	1,774	637	1,891	7
71	Bottomers	2	1,933	791	3,478	10
72	Edge makers	2	457	245	688	2
73	Finishers	2	1,353	463	1,622	4
	Miscellaneous expenses:					
74	Total	$2,000	$453,706	$391,043	$1,251,902	$1,058
75	Rent of works	$250	$32,530	$19,170	$204,153	$80
76	Taxes, not including internal revenue	$205	$17,289	$8,567	$23,563	$128
77	Rent of offices, insurance, interest, and all sundry expenses not hitherto included.	$1,545	$398,957	$335,220	$924,075	$850
78	Contract work		$4,930	$28,086	$100,111	

BY STATES, 1900—Continued.

Ohio.	Pennsylvania.	Rhode Island.	Utah.	Vermont.	Virginia.	Washington.	Wisconsin.	All other states.[1]	
81	146	5	3	6	5	3	40	8	1
16	63	4	...	2	...	...	10	2	2
27	56	...	1	...	2	1	8	1	3
38	27	1	2	4	3	2	22	5	4
...	...	...	...	...	...	...	...	...	5
$7,549,142	$6,860,480	$57,358	$124,267	$478,184	$641,166	$71,071	$2,473,626	$333,513	6
$168,950	$279,602	...	$4,750	$4,800	$2,000	...	$80,536	$6,304	7
$464,713	$660,300	...	$33,036	$42,393	$7,932	...	$261,290	$31,437	8
$1,180,322	$1,309,513	$6,200	$21,743	$77,596	$47,034	$14,715	$462,255	$69,638	9
$5,735,157	$4,611,065	$51,158	$64,738	$353,395	$584,200	$56,356	$1,669,545	$226,134	10
87	209	4	2	2	5	2	29	4	11
888	663	17	17	40	45	15	232	28	12
$960,890	$579,794	$14,800	$17,432	$32,114	$50,509	$12,060	$213,600	$20,915	13
79	45	...	3	6	4	8	40	3	14
$173,953	$78,951	...	$3,500	$5,700	$10,275	$7,080	$47,022	$4,800	15
809	618	17	14	34	41	7	192	25	16
$786,937	$500,843	$14,800	$13,932	$26,414	$40,234	$4,980	$166,578	$16,115	17
662	550	17	13	26	36	6	157	20	18
$731,032	$473,450	$14,800	$13,452	$23,329	$38,650	$4,530	$154,635	$14,776	19
147	68	...	1	8	5	1	35	5	20
$55,905	$27,393	...	$480	$3,085	$1,584	$450	$11,943	$1,339	21
14,004	10,479	14	159	471	1,274	116	2,815	208	22
11,344	7,862	11	117	269	1,079	49	2,192	135	23
12,718	9,144	9	140	355	1,153	75	2,507	176	24
$3,989,744	$3,111,113	$1,888	$52,558	$128,771	$206,119	$31,461	$821,403	$55,773	25
7,289	5,291	4	98	199	1,021	50	1,494	136	26
$2,709,382	$2,157,786	$1,040	$43,275	$86,719	$187,214	$23,990	$569,246	$44,220	27
4,781	3,239	4	40	155	127	22	849	37	28
$1,175,153	$838,589	$728	$8,530	$41,952	$18,531	$7,011	$227,820	$11,103	29
648	614	1	2	1	5	3	164	3	30
$105,209	$114,738	$120	$753	$100	$374	$460	$24,337	$450	31
7,475	5,286	4	85	194	1,002	58	1,577	136	32
7,542	5,493	4	100	189	965	58	1,540	146	33
7,548	5,595	4	98	182	973	55	1,546	148	34
7,307	5,565	4	98	178	988	54	1,509	148	35
7,159	5,326	4	97	174	927	54	1,435	150	36
6,714	4,911	4	96	152	954	29	1,466	152	37
7,427	4,785	4	99	167	1,077	49	1,458	6	38
7,515	5,407	4	100	206	1,089	54	1,487	142	39
7,232	5,502	5	101	223	1,100	51	1,539	142	40
7,196	5,394	4	102	243	1,046	53	1,572	147	41
7,093	5,164	5	102	232	1,094	44	1,330	150	42
7,258	5,065	4	102	244	1,043	46	1,471	157	43
5,000	3,512	4	32	158	142	26	887	36	44
5,017	3,347	4	39	155	141	26	879	40	45
4,962	3,431	4	39	148	139	23	888	41	46
4,766	3,375	4	39	148	137	22	866	42	47
4,647	3,266	4	39	154	88	22	799	43	48
4,378	3,036	4	37	138	134	13	826	44	49
4,935	2,896	4	41	142	133	20	825	1	50
4,925	3,236	4	43	154	133	21	847	39	51
4,710	3,274	4	43	164	133	26	874	39	52
4,724	3,262	4	43	168	108	25	883	43	53
4,636	3,260	4	43	173	131	17	772	44	54
4,668	3,170	3	43	164	106	17	843	38	55
667	600	1	2	1	5	3	190	3	56
668	625	1	2	1	5	3	183	3	57
671	633	1	2	1	5	3	175	3	58
657	613	1	2	1	5	3	162	3	59
629	628	1	2	1	3	3	145	3	60
619	597	1	2	1	5	...	159	3	61
668	541	...	1	1	4	3	160	...	62
677	645	...	1	1	5	3	163	3	63
651	652	...	2	1	5	4	162	3	64
643	623	...	2	1	5	5	168	3	65
608	606	...	2	1	5	6	153	3	66
618	608	1	2	1	3	6	150	3.	67
1,726	1,009	...	12	60	228	10	266	18	68
4,460	2,476	3	44	115	336	21	988	37	69
2,008	1,059	1	22	27	149	9	384	37	70
2,257	1,643	1	25	24	170	20	708	21	71
589	355	...	11	15	41	5	129	6	72
1,390	696	2	15	56	184	8	262	17	73
$637,537	$572,624	$27,480	$5,017	$25,970	$35,122	$14,937	$279,913	$43,625	74
$77,084	$48,953	$317	...	$1,060	$760	$2,958	$15,831	$786	75
$28,256	$10,193	$145	$1,077	$547	$1,357	$206	$8,913	$989	76
$532,125	$509,079	$5,867	$3,940	$24,318	$33,005	$11,773	$143,135	$9,905	77
$72	$4,399	$21,151	...	$45	...	...	$112,034	$31,945	78

[1]Includes states having less than 3 establishments in order that the operations of individual establishments may not he disclosed. These establishments are distributed as follows: Alabama, 1; Colorado, 1; Delaware, 1; Kansas, 1; Oregon, 2; Tennessee, 2.

		Nebraska.	New Hampshire.	New Jersey.	New York.	North Carolina.
	Materials used:					
79	Total cost	$47,005	$16,569,725	$4,210,472	$15,611,386	$53,297
80	Sole leather, pounds	600	18,792,790	2,568,403	14,138,458	81,202
81	Cost	$125	$3,786,370	$749,953	$3,177,284	$17,436
82	Split leather, pounds		2,076,746	41,544	1,106,436	8,750
83	Cost		$454,849	$8,665	$226,069	$1,750
84	Calf and kip skins, pounds		578,064	486,950	450,590	1,037
85	Cost		$361,324	$383,353	$353,436	$343
86	Grain and other side leather, square feet	900	22,437,269	1,088,555	8,049,495	120,152
87	Cost	$150	$2,538,321	$137,867	$997,944	$13,519
88	Goatskins, square feet		20,416,313	8,295,255	21,785,985	
89	Cost		$2,420,750	$1,177,131	$3,864,327	
90	All other upper leather, square feet		11,141,108	2,454,725	9,158,562	65,000
91	Cost		$1,425,983	$491,902	$1,694,714	$9,000
92	Sheep and leather linings and trimmings	$7,300	$684,096	$147,288	$662,775	$1,600
93	Cut soles, tops, heels, etc., purchased	$1,000	$1,861,759	$502,782	$1,948,470	$500
94	Findings, purchased	$6,530	$1,398,043	$291,897	$1,120,682	$3,752
95	Fuel		$63,799	$24,537	$45,025	$118
96	Rent of power and heat	$797	$7,982	$1,000	$58,137	$50
97	Mill supplies	$20	$26,525	$11,902	$89,287	$75
98	All other materials	$29,075	$1,408,783	$258,352	$1,282,593	$3,700
99	Freight	$2,008	$131,141	$23,843	$90,643	$1,554
	Products:					
100	Total value	$73,210	$23,405,558	$6,978,043	$25,585,631	$73,493
	Men's boots and shoes—					
101	Number of pairs	20,300	2,716,486	599,325	3,870,221	39,554
102	Value	$22,860	$8,819,628	$2,168,635	$5,691,136	$46,447
	Boys' and youths' boots and shoes—					
103	Number of pairs		3,758,750	156,977	1,402,066	9,842
104	Value		$2,902,094	$188,041	$1,909,081	$10,026
	Women's boots and shoes—					
105	Number of pairs		9,064,178	845,575	5,896,367	7,935
106	Value		$7,656,405	$1,065,363	$11,098,205	$9,725
	Misses' and children's boots and shoes—					
107	Number of pairs		4,505,367	4,257,280	5,352,693	3,569
108	Value		$3,154,316	$3,050,119	$4,356,000	$2,857
	Men's, boys', and youths' slippers—					
109	Number of pairs		466,466	37,740	435,215	
110	Value		$238,578	$64,605	$250,514	
	Women's, misses', and children's slippers—					
111	Number of pairs		661,444	183,547	1,232,195	
112	Value		$407,617	$131,343	$1,179,788	
	All other kinds—					
113	Number of pairs			796,640	1,265,166	
114	Value			$298,815	$446,019	
115	All other products	$50,350	$172,858	$797	$617,760	$3,750
116	Amount received for custom or contract work		$54,062	$10,325	$37,128	$688
	Maximum daily capacity of factory:					
117	Number of pairs	20	54,120	40,717	115,885	261
	Total floor space in factory:					
118	Square feet	1,200	713,140	587,641	4,083,407	3,930
	Comparison of products:					
119	Number of establishments reported for both years	2	64	69	203	3
120	Value for census year	$72,500	$23,361,332	$6,288,295	$25,244,246	$73,493
121	Value for preceding business year	$63,500	$19,674,065	$5,870,319	$22,643,175	$71,462
	Power:					
122	Number of establishments reporting	2	64	57	153	2
123	Total horsepower	15	4,601	1,524	5,575	58
	Owned—					
	Engines—					
124	Steam, number		53	44	47	1
125	Horsepower		3,685	1,407	2,954	5
126	Gas or gasoline, number		1	6	11	
127	Horsepower		5	63	144	
128	Water wheels, number		18		8	2
129	Horsepower		691		590	48
130	Electric motors, number		1	1	14	1
131	Horsepower		30	5	277	5
	Other power—					
132	Number		2			
133	Horsepower		30			
	Rented—					
134	Electric, horsepower	7	60	11	757	
135	Other kind, horsepower	8	100	38	853	
136	Power furnished to other establishments		126	34	55	
	Establishments classified by number of persons employed, not including proprietors and firm members:					
137	Total number	3	67	84	223	3
138	No employees			3	2	
139	Under 5		4	16	23	
140	5 to 20	1	5	21	54	2
141	21 to 50	1	9	16	46	1
142	51 to 100	1	10	9	50	
143	101 to 250		20	12	31	
144	251 to 500		10	6	13	
145	501 to 1,000		8	1	3	
146	Over 1,000		1		1	

BY STATES, 1900—Continued.

Ohio.	Pennsylvania.	Rhode Island.	Utah.	Vermont.	Virginia.	Washington.	Wisconsin.	All other states.[1]	
$11,074,008	$8,210,846	$179,986	$156,046	$561,786	$1,159,969	$102,599	$3,170,921	$482,066	79
10,096,256	7,316,863	605,999	265,595	667,398	842,295	164,200	4,006,215	971,264	80
$2,945,113	$1,853,124	$78,010	$57,941	$122,803	$230,611	$41,070	$724,643	$177,613	81
177,262	731,574	214,370	9,300	49,400	5,450	4,500	106,129	86,468	82
$36,829	$144,990	$50,073	$1,783	$11,089	$1,400	$946	$20,999	$14,546	83
566,336	541,598		15,630	3,900	4,815	11,628	186,478	16,630	84
$366,116	$395,003		$8,058	$2,792	$3,065	$7,819	$121,165	$6,335	85
2,583,206	2,902,687	179,068	290,068	1,327,524	1,284,017	192,800	4,552,297	1,178,205	86
$342,050	$388,565	$21,395	$35,305	$148,038	$130,560	$26,061	$636,800	$131,604	87
22,694,287	15,353,878		17,666	151,210	1,821,821	10,000	2,157,154	150,400	88
$3,873,520	$2,473,393		$3,400	$17,033	$229,058	$2,200	$400,196	$21,474	89
4,777,895	3,302,975	6,000	54,118	621,139	951,497	30,000	1,827,661	59,445	90
$738,577	$519,281	$471	$8,219	$67,348	$75,050	$5,400	$292,268	$8,575	91
$784,762	$348,247	$1,820	$6,651	$23,964	$28,648	$886	$97,539	$10,958	92
$461,927	$813,857	$1,331	$1,200	$57,754	$89,929		$314,391	$22,134	93
$717,723	$564,344	$17,017	$12,951	$39,869	$67,008	$9,367	$250,684	$44,279	94
$27,044	$36,454	$1,005	$2,624	$1,481	$3,877	$15	$15,717	$1,240	95
$21,471	$15,803	$105	$650	$1,750		$780	$4,489	$275	96
$48,822	$56,980	$250	$1,162	$2,195	$12,693	$55	$11,558	$2,056	97
$599,192	$535,715	$6,112	$6,210	$55,148	$272,962	$5,000	$243,302	$25,596	98
$110,862	$65,090	$2,397	$9,892	$10,522	$15,108	$3,000	$37,170	$15,381	99
$17,920,854	$13,235,933	$241,278	$225,986	$792,707	$1,452,480	$166,423	$4,791,684	$670,323	100
527,241	1,632,913	242,347	63,044	55,220	40,928	98,509	1,428,720	581,936	101
$1,044,926	$2,655,753	$212,264	$114,920	$65,518	$77,742	$155,550	$2,056,314	$595,484	102
974,257	449,297	23,568	45,400	70,476	2,930	9,000	330,007	14,006	103
$1,181,465	$509,136	$20,937	$62,657	$68,450	$3,662	$10,130	$356,206	$14,259	104
8,204,972	3,506,682	6,700	9,642	532,474	1,450,989		1,226,134	33,600	106
$12,096,360	$5,709,409	$5,155	$14,263	$396,839	$1,149,882		$1,754,648	$60,480	106
3,801,508	5,389,475		28,744	299,750	297,214		245,821		107
$3,272,732	$3,765,888		$30,196	$176,635	$134,969		$243,114		108
36,300	13,720					780	17,732		109
$34,490	$12,103					$743	$14,455		110
239,691	261,946	7,450		22,600	19,400		184,865		111
$252,245	$226,214	$2,677		$22,500	$10,620		$205,418		112
65,710	1,224,023	700	1,500	7,500	84,983		98,948		113
$34,657	$300,750	$245	$3,950	$7,500	$64,158		$115,465		114
$3,954	$8,294				$11,447		$45,542	$100	115
$25	$48,386			$55,265			$522		116
70,697	64,145	1,195	800	6,460	8,244	980	17,420	7,650	117
1,582,638	1,175,546	33,981	44,891	93,769	153,089	43,600	493,009	90,680	118
68	125	2	3	4	4	2	38	4	119
$17,221,399	$12,408,059	$237,201	$225,986	$666,357	$1,429,460	$106,423	$4,629,673	$266,026	120
$14,520,783	$11,682,181	$231,291	$198,356	$501,050	$1,514,035	$74,151	$4,543,597	$242,946	121
74	116	4	3	6	4	2	31	6	122
3,632	2,790	45	64	268	287	25	958	251	123
24	80	3	1	3	3		16	3	124
1,865	2,311	43	44	140	235		637	185	125
16	6				2		5	1	126
347	57				32		56	10	127
				2			1		128
				80			11		129
44	4			4	1				130
335	40			38	20				131
									132
									133
240	89		20			25	127	56	134
845	293	2		10			127		135
152	55	5					3		136
81	146	5	3	6	5	3	40	8	137
1	1						1	1	138
8	13	4					5	2	139
13	42	1				1	6	2	140
9	28		2	2	2	1	7	2	141
13	30		1	3	2	1	12		142
22	25			1			6	1	143
8	4						3		144
4	3								145
3					1				146

[1] Includes states having less than 3 establishments in order that the operations of individual establishments may not be disclosed. These establishments are distributed as follows: Alabama, 1; Colorado, 1; Delaware, 1; Kansas, 1; Oregon, 2; Tennessee, 2.

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 222. WASHINGTON, D. C. July 2, 1902.

AGRICULTURE.

UTAH.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Utah, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides and all other buildings used by him in connection with his farming operations.

The farms of Utah, June 1, 1900, numbered 19,387, and were valued at $50,778,350. Of this amount $10,651,790, or 21.0 per cent, represents the value of buildings, and $40,126,560, or 79.0 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $2,922,550, and of live stock $21,474,241. These values, added to that of farms, give $75,175,141, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of all such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $16,502,051, of which amount $8,259,080, or 50.0 per cent, represents the value of animal products, and $8,242,971, or 50.0 per cent, the value of crops, including forest products cut or produced on farms. The "total value of farm products" for 1899 exceeds that for 1889 by $11,610,591, or 237.4 per cent, but a part of this gain is due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $2,959,390, leaving $13,542,661 as the gross farm income for that year. The percentage which this amount is of the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Utah in 1899 it was 18.0 per cent.

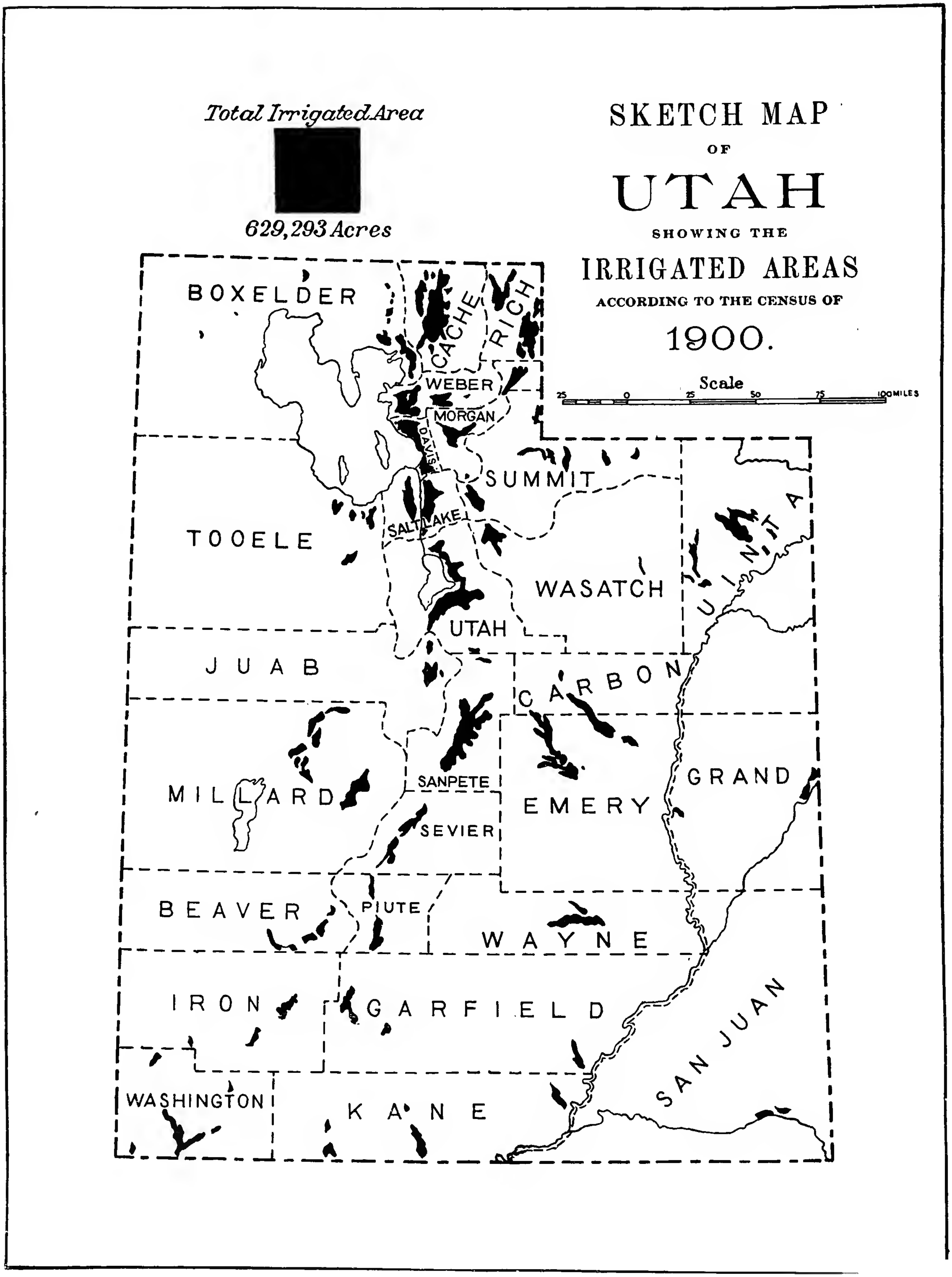
As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

Special reports as to the dimensions and cost of the leading irrigation ditches and canals, the area of land under them, methods for the artificial application of water to the growing crops, and other facts relating to irrigation were obtained by correspondence with farmers, engineers, and others. This correspondence was under the joint direction of Mr. F. H. Newell, chief hydrographer of the Geological Survey, acting as expert special agent for the division of agriculture, and Mr. Clarence J. Blanchard.

The statistics presented in this bulletin will be treated in greater detail in the final report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Utah.

Very respectfully,

L. G. Powers.
Chief Statistician for Agriculture.


Total Irrigated Area
629,293 Acres
SKETCH MAP
OF
UTAH
SHOWING THE
IRRIGATED AREAS
ACCORDING TO THE CENSUS OF
1900.
Scale
25 0 25 50 75 100 MILES
BOXELDER
CACHE
RICH
WEBER
MORGAN
DAVIS
SUMMIT
TOOELE
SALT LAKE
WASATCH
UINTA
UTAH
JUAB
CARBON
MILLARD
SANPETE
EMERY
GRAND
SEVIER
BEAVER
PIUTE
WAYNE
IRON
GARFIELD
SAN JUAN
WASHINGTON
KANE

AGRICULTURE IN UTAH.

GENERAL STATISTICS.

The total land area of Utah is 82,190 square miles, or 52,601,600 acres, of which 4,116,951 acres, or 7.8 per cent, are included in farms.

Utah belongs to the great plateau of the Rocky Mountains, its valleys being 2,700 feet above sea level and its mountain peaks reaching a height of from 12,000 to 15,000 feet.

East of the Wasatch Mountains, which bisect the state from north to south, the land is high and rocky, cut into canyons and gorges, and drained by rivers and mountain streams, which, with the exception of the Green and the Grand that unite to form the headwaters of the Colorado River, only attain volume and strength during the spring thaws.

West of the mountains is a succession of small valleys, and the drainage is into sinks and lakes which have no outlet, the largest of these being the Great Salt Lake.

The soil of the mountains and more elevated valleys is hard, clayey, and generally poor, but produces succulent grasses which furnish good ranges for live stock. In the lower parts the soil is sedimentary and not difficult of reclamation. Agriculture, however, is almost entirely dependent upon irrigation, the rainfall being slight and uncertain.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the total and average acreage, and the per cent of farm land improved.

Table 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS. Total.	Improved.	Unimproved.	Average.	Per cent of farm land improved.
1900	19,387	4,116,951	1,032,117	3,084,834	212.4	25.1
1890	10,517	1,323,705	548,223	775,482	125.9	41.4
1880	9,452	655,524	416,105	239,419	69.3	63.5
1870	4,908	148,361	118,755	29,606	30.2	80.0
1860	3,635	89,911	77,219	12,692	24.7	85.9
1850	926	46,849	16,333	30,516	50.6	34.9

The number of farms in Utah in 1900 was more than twenty times as great as in 1850, and 84.3 per cent greater than in 1890. The total farm area has also increased very rapidly, the rate of gain for the last decade being 211.0 per cent. The large increase in farm area is due to the extensive additions to private ranges from land formerly embraced in the public domain. This has led to an increase in the average size of farms and, as most of the new land is unimproved, a corresponding decrease is shown in the per cent of farm land improved. The actual area improved has increased rapidly, nearly doubling in the last decade.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

Table 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$75,175,141	$50,778,350	$2,922,550	$21,474,241	$16,502,051
1890	36,381,270	28,402,780	1,164,660	[2] 6,813,830	4,891,460
1880	18,268,569	14,015,178	946,753	[2] 3,306,638	3,337,410
1870 [3]	4,739,126	2,297,922	291,390	2,149,814	[4] 1,973,142
1860	3,092,951	1,333,355	242,889	1,516,707	....
1850	943,055	311,799	84,288	546,968	....

[1] For year preceding that designated.
[2] Exclusive of the value of animals on ranges.
[3] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished by one-fifth.
[4] Includes betterments and additions to live stock.

Since 1850 the total value of farm property has increased $74,232,086, and in the last decade $38,793,871, or 106.6 per cent. The gain in value of land, improvements, and buildings between 1890 and 1900 was $22,375,570, or 78.8 per cent; in that of implements and machinery, $1,757,890, or 150.9 per cent; and in that of live stock, $14,660,411, or 215.2 per cent. The value of farm products in 1899 was 237.4 per cent greater than in 1889, but a portion of this increase is doubtless the result of a more detailed enumeration in 1900 than formerly. The most important item which was enumerated in 1900, but not in 1890 is the value of animals sold and animals slaughtered on farms, which amounted, for 1899, to $3,354,873, or 28.9 per cent of the increase.

COUNTY STATISTICS.

Table 3 gives a summary of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	19,387	18,224	4,116,951	1,032,117	$40,126,560	$10,651,790	$2,922,550	$21,474,241	$13,542,661	$1,837,900	$14,300
Beaver	301	290	29,239	14,821	414,920	174,010	42,610	286,128	165,124	11,510	90
Boxelder	1,017	975	570,669	90,703	2,636,160	510,990	204,990	1,076,976	710,894	128,890	990
Cacbe	1,795	1,689	316,662	166,272	4,089,700	850,700	300,410	1,107,185	1,083,149	137,440	200
Carbon	144	115	27,975	8,780	173,920	61,010	16,190	208,141	94,488	18,390	50
Davis	938	907	225,957	59,575	3,040,200	736,800	153,370	885,449	905,646	152,160	1,060
Emery	458	446	54,181	25,918	564,750	213,550	90,600	403,368	228,309	17,380	350
Garfield	237	227	28,800	13,652	255,850	122,810	33,930	507,014	203,829	13,670	80
Grand	121	109	15,686	4,748	278,250	46,140	19,810	371,459	134,016	26,980	....
Iron	235	208	23,562	7,746	220,840	108,000	26,520	256,246	167,136	5,900	....
Juab	356	303	79,317	26,351	806,130	153,980	75,540	556,319	315,116	31,450	200
Kane	213	204	23,950	6,214	223,000	134,990	30,100	318,677	152,436	14,380	20
Millard	676	643	108,009	39,153	1,364,010	344,360	110,720	715,054	423,922	55,330	55
Morgan	299	289	138,628	11,368	493,380	140,680	35,720	244,776	166,711	14,780	110
Piute	189	185	27,548	12,349	241,420	67,840	31,850	218,165	118,998	8,660	90
Rich	276	267	160,866	48,053	877,730	146,820	95,930	1,271,883	468,521	84,470	....
Salt Lake	2,208	2,095	275,939	74,042	6,787,270	1,709,810	318,540	2,296,064	1,768,431	259,090	2,510
San Juan	85	56	18,846	4,360	78,390	27,940	12,140	400,246	136,143	13,370	....
Sanpete	1,618	1,484	188,659	91,971	3,010,100	867,970	218,340	2,528,328	1,090,253	227,680	30
Sevier	946	905	75,207	41,315	1,257,860	398,350	118,120	832,888	482,747	49,190	570
Summit	608	567	289,651	35,296	1,148,670	318,100	90,880	1,034,930	447,519	101,180	225
Tooele	487	457	116,016	27,057	944,670	293,710	77,720	833,862	424,388	63,560	....
Uinta	559	539	340,326	24,089	901,900	250,110	92,100	800,245	381,300	72,750	130
Utah	2,760	2,583	223,836	100,170	5,111,280	1,455,700	351,140	1,969,889	1,725,139	182,980	4,200
Wasatch	492	471	93,480	21,947	687,820	279,390	60,970	596,926	275,147	26,540	40
Washington	477	463	21,886	10,866	495,710	256,150	73,100	263,940	233,142	6,460	100
Wayne	271	251	29,354	12,202	210,400	70,080	34,310	226,689	122,172	7,830	....
Weber	1,479	1,399	186,632	48,208	3,208,580	876,880	196,290	949,344	1,070,920	105,390	3,200
Uinta Valley and Uncompabgre[1]	142	97	426,070	4,891	603,650	34,920	10,610	314,050	47,065	490	....

[1] Indian reservation.

In all counties the number of farms increased in the last ten years, and about one-third of the counties report more than twice as many farms. The total acreage in farm land increased to over three times that reported in 1890, and the improved area also shows a substantial increase, every county contributing to these gains. The average size of farms for the state is 212.4 acres, and varies from 45.9 acres in Washington county to 608.8 acres in Uinta county. In general the northern counties report the largest farms.

There was a marked increase in the value of farms in all counties in the last decade. In 1900 the average value of farms was $2,619. The northwestern counties report the highest values, but in no county does the average per farm fall below $1,000.

A general increase is reported in the value of implements and machinery. The total value of live stock was over three times as great in 1900 as in 1890, and averaged $1,108 per farm. In all except three counties the value reported in 1900 was more than twice as great as that in 1890.

FARM TENURE.

Table 4 gives a comparative statement of farm tenure for 1880, 1890, and 1900. The farms operated by tenants are divided into two groups, designated as farms operated by "cash tenants," who pay a rental in cash or a stated amount of labor or farm products, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer. The farms under the classification "owner" are subdivided into four groups, designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	19,387	17,674	506	1,207	91.2	2.6	6.2
1890	10,517	9,974	121	422	94.8	1.2	4.0
1880	9,452	9,019	60	373	95.4	0.6	4.0

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	19,387	15,177	2,051	135	311	506	1,207
White	19,144	14,979	2,045	135	311	472	1,202
Colored	243	198	6	....	....	34	5
Chinese	33	....	....	....	....	33	....
Indian	199	190	6	....	....	....	3
Negro	11	8	....	....	....	1	2

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	78.3	10.6	0.7	1.6	2.6	6.2
White	100.0	78.2	10.7	0.7	1.6	2.5	6.3
Colored	100.0	81.5	2.5	....	....	14.0	2.0

In the period from 1880 to 1900 the total number of farms increased 105.1 per cent, the greater part of the increase having occurred in the last decade. Since 1890 the number of farms operated by owners has increased 7,700, or 77.2 per cent; by cash tenants, 385, or 318.2 per cent; and by share tenants, 785, or 186.0 per cent. The percentages in Table 4 show that the number of farms operated by owners has not increased as rapidly during the last decade as the number operated by tenants.

In 1900, 98.7 per cent of all farms were operated by white farmers and 1.3 per cent by colored farmers. Of the white farmers 89.6 per cent own all or a part of the farms they operate, and 10.4 per cent operate farms owned by others. The corresponding percentages for colored farmers are 84.0 and 16.0. The Indians, who comprise the greater part of the colored farmers, generally own the farms they operate, as do 8 of the 11 negro farmers, while all the Chinese farmers are cash tenants.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," and "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	19,387	212.4	4,116,951	100.0	$75,175,141	100.0
White	19,144	214.0	4,097,153	99.5	74,768,044	99.5
Negro	11	58.9	648	(1)	20,675	(1)
Indian	199	95.4	18,983	0.5	324,287	0.4
Chinese	33	5.1	167	(1)	62,135	0.1
Owners	15,177	116.2	1,763,619	42.8	52,238,977	69.5
Part owners	2,051	399.7	819,696	19.9	9,814,427	13.1
Owners and tenants	135	135.1	18,239	0.4	628,807	0.8
Managers	311	2,988.1	929,298	22.6	6,082,323	8.1
Cash tenants	506	924.5	467,795	11.4	2,469,915	3.3
Share tenants	1,207	98.0	118,304	2.9	3,940,692	5.2

[1] Less than one-tenth of 1 per cent.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,070	$549	$151	$1,108	$698	18.0
White	2,087	554	152	1,113	705	18.0
Negro	1,391	259	74	156	194	10.3
Indian	550	175	80	825	118	7.2
Chinese	1,721	81	54	26	756	40.1
Owners	1,776	543	145	979	588	17.1
Part owners	2,965	598	180	1,042	946	19.8
Owners and tenants	3,214	626	165	653	640	13.7
Managers	7,417	1,012	391	10,737	4,956	25.3
Cash tenants	3,516	444	122	799	886	18.2
Share tenants	2,147	461	126	531	506	15.5

The average area, the average value of property and products, and the per cent of gross income are higher for white than for colored farmers, with the exception of the average and per cent of gross income for farms operated by Chinese farmers. Most of the last group report intensively cultivated vegetable farms.

The farms of managers show the highest average value of property, and the highest average and per cent of gross income. Most of these farms are devoted to live stock or grain.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	19,387	212.4	4,116,951	100.0	$75,175,141	100.0
Under 3 acres	595	2.5	1,487	(1)	2,512,763	3.3
3 to 9 acres	1,407	5.9	8,258	0.2	2,082,224	2.8
10 to 19 acres	2,202	14.1	30,987	0.8	4,138,535	5.5
20 to 49 acres	5,261	32.9	173,303	4.2	13,483,291	17.9
50 to 99 acres	3,741	71.9	268,889	6.5	13,232,924	17.6
100 to 174 acres	3,363	142.7	480,041	11.7	12,486,808	16.6
175 to 259 acres	1,194	212.7	254,021	6.2	6,163,802	8.2
260 to 499 acres	1,008	346.3	349,074	8.5	7,351,851	9.8
500 to 999 acres	368	663.8	244,291	5.9	4,323,194	5.8
1,000 acres and over	248	9,300.8	2,306,600	56.0	9,399,749	12.5

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock.)	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,070	$549	$151	$1,108	$698	18.0
Under 3 acres	313	254	63	3,593	1,473	34.9
3 to 9 acres	691	390	68	331	306	20.7
10 to 19 acres	1,038	424	87	330	324	17.2
20 to 49 acres	1,470	488	121	484	389	15.2
50 to 99 acres	2,047	576	152	762	502	14.2
100 to 174 acres	2,031	519	164	999	690	18.6
175 to 259 acres	2,860	717	204	1,381	926	17.9
260 to 499 acres	4,022	832	282	2,158	1,283	17.6
500 to 999 acres	6,096	1,145	343	4,164	2,491	21.3
1,000 acres and over	19,152	1,755	759	16,236	7,929	20.9

The group of farms containing from 20 to 49 acres each comprises a greater part of the total number of farms than any other. The group "1,000 acres and over" contains more than one-half of the total acreage, but only 12.5 per cent of the total value of farm property.

With few exceptions, the average values of the several forms of farm property and products increase with the size of the farms. The high average value of live stock for farms under 3 acres and the large gross income for the same class are due to the fact that most of them are ranges consisting almost entirely of public lands. Some of them are city dairies and market gardens. The incomes from these industries are determined not so much by the acreage of land used, as by the capital invested in buildings, implements, and live stock, and the amounts expended for labor and similar items.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes at least 40.0 per cent of the value of the products not fed to live stock, the farm is designated as a "hay and grain" farm. If vegetables are the leading crop, constituting 40.0 per cent of the value of products, the farm is designated a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive their principal income from any one class of farm products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	19,387	212.4	4,116,951	100.0	$75,175,141	100.0
Hay and grain	6,857	172.3	1,181,514	28.7	23,372,694	31.1
Vegetables	729	43.7	31,833	0.8	2,035,087	2.7
Fruits	412	36.7	15,116	0.4	1,228,871	1.6
Live stock	5,458	453.5	2,475,256	60.1	32,633,667	43.4
Dairy produce	1,815	88.0	159,773	3.9	4,928,736	6.6
Sugar	440	38.1	16,771	0.4	1,221,282	1.6
Flowers and plants	20	2.2	44	(1)	80,960	0.1
Nursery products	17	58.5	995	(1)	137,500	0.2
Miscellaneous	3,639	64.8	235,649	5.7	9,536,344	12.7

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,070	$549	$151	$1,108	$698	18.0
Hay and grain	2,296	539	159	415	527	15.5
Vegetables	1,833	604	102	253	565	20.2
Fruits	2,041	584	113	245	641	21.5
Live stock	2,298	592	177	2,912	1,196	20.0
Dairy produce	1,506	535	125	550	401	14.8
Sugar	1,845	512	124	295	601	21.7
Flowers and plants	2,213	1,670	120	45	1,690	41.8
Nursery products	6,386	1,097	337	268	7,178	88.8
Miscellaneous	1,641	493	125	362	433	16.5

For the several classes of farms the average value per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $768.23; nursery products, $122.65; fruits, $17.46; sugar, $15.77; vegetables, $12.94; miscellaneous, $6.69; dairy produce, $4.56; hay and grain, $3.06; and live stock, $2.64. The wide variations in the averages and percentages of gross income are largely due to the fact that in computing gross income no deductions are made for expenses involved in operation. For florists' establishments and nurseries the average expenditures for such items as labor and fertilizers represent a far greater percentage of the gross income than for "live-stock" and "miscellaneous" farms. If it were possible to present the average net income, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	19,387	212.4	4,116,951	100.0	$75,175,141	100.0
$0	230	91.2	20,987	0.5	453,510	0.6
$1 to $49	466	60.9	28,393	0.7	454,900	0.6
$50 to $99	1,089	55.9	60,907	1.5	1,385,260	1.8
$100 to $249	4,408	60.9	268,565	6.5	7,195,780	9.6
$250 to $499	5,685	76.1	432,681	10.5	14,117,390	18.8
$500 to $999	4,625	144.6	668,957	16.3	18,212,320	24.2
$1,000 to $2,499	2,069	250.5	518,341	12.6	15,088,541	20.1
$2,500 and over	815	2,598.9	2,118,120	51.4	18,267,440	24.3

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,070	$549	$151	$1,108	$698	18.0
$0	614	108	40	1,210	....	....
$1 to $49	557	197	56	166	29	3.0
$50 to $99	730	280	64	198	70	5.5
$100 to $249	931	349	86	266	169	10.4
$250 to $499	1,503	467	128	385	355	14.3
$500 to $999	2,420	651	175	692	680	17.3
$1,000 to $2,499	4,062	948	252	2,031	1,427	19.6
$2,500 and over	8,202	1,303	468	12,441	5,637	25.1

That many of the farms were homesteads taken up too late for cultivation that year is indicated by the fact that of the 230 farms of the state reporting no income for 1899, 204 were operated by owners and 53 were of 100 to 175 acres in size. There were some farms also from which no reports of the products of 1899 could be secured, as the persons in charge June 1, 1900, did not operate the farms the preceding year, and could give no information concerning the products of that year. To this extent the reports fall short of giving a complete report of farm products in 1899.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping of neat cattle was determined by their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS AND RANGES, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age, in years.	ON FARMS AND RANGES.			NOT ON FARMS OR RANGES
		Number.	Value.	Average value.	Number.
Calves	Under 1	78,940	$729,551	$9.24	2,592
Steers	1 and under 2	32,505	544,555	16.75	379
Steers	2 and under 3	17,512	413,679	23.62	121
Steers	3 and over	6,073	174,487	28.73	104
Bulls	1 and over	5,445	219,312	40.28	73
Heifers	1 and under 2	40,461	681,040	16.83	732
Cows kept for milk	2 and over	65,905	2,037,367	30.91	8,379
Cows and heifers not kept for milk.	2 and over	96,849	2,352,853	24.29	551
Colts	Under 1	11,395	122,843	10.78	277
Horses	1 and under 2	13,515	247,348	18.30	287
Horses	2 and over	90,974	3,026,122	33.26	12,438
Mule colts	Under 1	458	6,279	13.71	15
Mules	1 and under 2	380	9,775	25.72	20
Mules	2 and over	1,278	42,796	33.49	126
Asses and burros	All ages	888	15 555	17.52	39
Lambs	Under 1	1,265,289	2,318,866	1.83	513
Sheep (ewes)	1 and over	1,893,802	5,695,818	3.01	2,509
Sheep (rams and wethers).	1 and over	659,332	2,241,804	3.40	393
Swine	All ages	65,732	293,115	4.46	6,036
Goats	All ages	1,427	2,702	1.89	42
Fowls:[1]					
Chickens[2]	....	534,842	186,922	....	....
Turkeys	....	10,649			
Geese	....	2,759			
Ducks	....	8,503			
Bees (swarms of)	....	33,818	111,452	3.30	....
Value of all live stock.	....	....	21,474,241	....	....

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The total value of all live stock on farms and ranges, June 1, 1900, was $21,474,241, of which 47.8 per cent represents the value of sheep, 23.8 per cent the value of neat cattle other than dairy cows, 15.8 per cent the value of horses, 9.5 per cent that of dairy cows, and 3.1 per cent that of all other live stock.

No reports were secured of the value of live stock not on farms or ranges, but it is probable that such animals have higher average values than those on farms. Allowing the same average value, however, the total value of the domestic animals not on farms or ranges is $788,159. Exclusive of poultry and bees not on farms the total value of live stock in the state is approximately $22,262,400.

CHANGES IN LIVE STOCK KEPT ON FARMS AND RANGES.

The following table shows the changes since 1860 in the numbers of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS AND RANGES: 1850 TO 1900.

YEAR.	Dairy Cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	65,905	277,785	115,884	3,004	2,553,134	65,732
1890[2]	45,982	154,284	65,057	1,554	1,014,176	27,046
1880[2]	32,768	62,648	38,131	2,898	233,121	17,198
1870	17,563	21,617	11,068	2,879	59,672	3,150
1860	11,967	22,127	4,565	851	37,332	6,707
1850	4,861	7,755	2,429	325	3,262	914

[1] Lambs not included.
[2] Exclusive of animals on ranges.

The live-stock enumerations in 1880 and in 1890 did not include domestic animals on ranges, and hence the figures for those years presented in the table are not strictly comparable with the figures for 1900. The number of animals on ranges in 1890 was estimated by special agents to be as follows: All neat cattle, 78,047; horses, 22,243; sheep, 922,730. In comparing the number of animals reported in 1900 with the number reported in 1890 these estimates are disregarded. Nearly fourteen times as many dairy cows were reported in 1900 as in 1850, the gain in the last decade being 43.3 per cent. Nearly thirty-six times as many other neat cattle were reported in 1900 as in 1850, the gain since 1890 being 80.0 per cent. Horses have increased nearly fiftyfold since 1850 and 78.1 per cent since 1890. Nine times as many mules were kept in 1900 as in 1850, the increase in the last decade being 93.3 per cent. No other class of animals shows so great a numerical change as sheep, the rate of gain since 1890 being 151.7 per cent. Swine show large increases from decade to decade. Nearly ten times as many were reported in 1900 as in 1860, the gain in the last ten years being 143.0 per cent.

In comparing the poultry report of 1900 with that of the Eleventh Census, it should be borne in mind that in 1900 the enumerators were instructed not to report fowls less than three months old, while in 1890 no such limitation was made. Notwithstanding this fact, poultry of all kinds show increases since 1890, as follows: Chickens, 91.3 per cent; all other poultry, 33.4 per cent.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the animal products of 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	17,050,977	$2,599,638
Mohair and goat hair	Pounds	459	142
Milk	Gallons	[1] 25,124,642	[2] 1,522,932
Butter	Pounds	2,812,122	
Cheese	Pounds	169,251	
Eggs	Dozens	3,387,340	424,628
Poultry			262,503
Honey	Pounds	1,292,118	94,364
Wax	Pounds	23,740	
Animals sold			2,695,504
Animals slaughtered			659,369
Total			8,259,080

[1] Comprises all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of all milk sold or consumed and of butter and cheese made.

The value of the animal products in 1899 was $8,259,080, or 50.0 per cent of the value of all farm products, and 61.0 per cent of the gross farm income. Of the total value given, 40.6 per cent represents the value of animals sold and animals slaughtered on farms; 31.5 per cent the value of wool, mohair and goat hair; 18.4 per cent the value of dairy products; 8.3 per cent the value of poultry and eggs; and 1.2 per cent that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The operators of 9,895 farms, or 52.5 per cent of all having domestic animals, report sales of live stock on farms. The average value per farm of live animals sold was $272.41, and the average value per farm of animals slaughtered was $49.32. In securing the reports of sales of live animals the enumerators were instructed to obtain from each farm operator a statement of the amount received from sales in 1899, less the amount paid for animals purchased the same year.

DAIRY PRODUCTS.

The progress of dairying corresponds with that of other branches of agriculture. In the last ten years the production of milk has increased 191.6 per cent; that of butter made on farms, 59.8 per cent; that of cheese made on farms, 3.5 per cent.

Of the $1,522,932 given in Table 16 as the value of dairy products in 1899, $875,746, or 57.5 per cent, represents dairy products sold, and $647,186, or 42.5 per cent, that of dairy products consumed on farms. Of the former amount, $645,550 was received from the sale of 9,964,903 gallons of milk; $3,013 from 3,312 gallons of cream; $214,910, from 1,125,377 pounds of butter; and $12,273, from 122,933 pounds of cheese.

POULTRY AND EGGS.

The total value of the products of the poultry industry in 1899 was $687,131, of which amount 61.8 per cent represents the value of eggs produced, and 38.2 per cent the value of fowls raised. In 1899, 3,387,340 dozen eggs were produced, three times as many as ten years before.

WOOL.

For half a century the production of wool has increased rapidly. By the Twelfth Census 17,050,977 pounds were reported, nearly four times as much as in 1890, but a part of this increase is probably only apparent, as the fleeces of a large number of sheep were omitted from the table in 1890, but included in a general estimate of wool shorn after the census enumeration. The average weight of the fleeces increased from 5.0 pounds in 1890 to 6.4 pounds in 1900, indicating improvement in the grade of sheep kept. Wool growing is a leading industry throughout the state, as the dry climate keeps the sheep in good health and improves the texture and cleanliness of the wool. San Pete county shows the greatest production in both 1890 and 1900, but Grand county shows the greatest increase.

HONEY AND WAX.

The quantity of honey produced in 1899 was 1,292,118 pounds, nearly three times the product of 1889. The quantity of wax reported in 1899 was 23,740 pounds, while in 1889 it was but 11,708 pounds.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	17,806	115,884	6.5	16,581	65,905	4.0
White farmers	17,581	109,907	6.3	16,562	65,838	4.0
Colored farmers	225	5,977	26.6	19	67	3.5
Owners[1]	16,104	100,473	6.2	15,128	60,218	4.0
Managers	265	7,029	26.5	173	930	5.4
Cash tenants	409	1,890	4.6	324	1,272	3.9
Share tenants	1,028	6,492	6.3	956	3,485	3.6
Under 20 acres	3,428	15,918	4.6	3,114	6,438	2.1
20 to 99 acres	8,487	38,363	4.5	8,041	28,471	3.5
100 to 174 acres	3,169	24,027	7.6	2,886	13,624	4.7
175 to 259 acres	1,160	9,592	8.3	1,096	6,450	5.9
260 acres and over	1,562	27,984	17.9	1,444	10,922	7.6
Hay and grain	6,146	34,677	5.6	5,506	18,932	3.4
Vegetables	659	2,472	3.8	554	1,330	2.4
Fruit	357	1,216	3.4	308	678	2.2
Live stock	5,109	52,591	10.3	4,697	21,145	4.5
Dairy	1,698	8,878	5.2	1,807	11,841	6.6
Sugar	395	1,394	3.5	376	1,035	2.8
Miscellaneous[2]	3,442	14,656	4.3	3,333	10,944	3.3

[1] Including "part owners" and "owners and tenants."
[2] Including florists' establishments and nurseries, and tobacco, cotton, and rice farms.

CROPS.

The following table gives the statistics of the principal crops grown in 1899:

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	11,517	Bushels	250,020	$121,872
Wheat	189,235	Bushels	3,413,470	1,575,064
Oats	43,394	Bushels	1,436,225	553,847
Barley	8,644	Bushels	252,140	121,826
Rye	2,866	Bushels	28,630	13,761
Buckwheat	43	Bushels	640	419
Flaxseed	1	Bushels	20	40
Clover seed		Bushels	35,328	127,901
Grass seed		Bushels	39	87
Hay and forage	388,043	Tons	851,864	3,862,820
Cotton	10	Bales	5	250
Cotton seed		Tons	2	12
Broom corn	19	Pounds	4,830	259
Peanuts	2	Bushels	151	73
Dry beans	176	Bushels	1,806	4,085
Dry pease	143	Bushels	2,694	3,504
Potatoes	10,433	Bushels	1,483,570	487,816
Sweet potatoes	40	Bushels	4,958	1,635
Onions	175	Bushels	53,440	33,317
Miscellaneous vegetables	5,848			362,782
Sorghum cane	371	Tons	101	442
Sorghum sirup		Gallons	28,017	12,993
Sugar beets	7,546	Tons	85,914	365,163
Small fruits	1,052			117,489
Orchard fruits	[1]16,013	Bushels		[2]263,098
Grapes	[1]446	Centals	9,200	[3]27,736
Figs	[1]7	Pounds	5,425	190
Nuts				878
Forest products				13,311
Flowers and plants	14			34,173
Seeds	84			10,330
Nursery products	236			120,648
Miscellaneous	16			[4]5,150
Total	686,374			8,242,971

[1] Estimated from number of vines or trees.
[2] Including value of cider, vinegar, etc.
[3] Including value of wine, raisins, etc.
[4] The greater part of this value was derived from products for which no acreage was reported.

Of the total value of crops, hay and forage contributed 46.9 per cent; cereals, 29.0 per cent; potatoes, 5.9 per cent; fruits and nuts, 5.0 per cent; vegetables, including sweet potatoes and onions, 4.8 per cent; sugar beets, 4.4 per cent; and all other crops, 4.0 per cent.

The average values per acre of, the various crops are as follows: Flowers and plants, $2,441; nursery products, $511; onions, $190; seeds, $123; small fruits, $112; grapes, $62; miscellaneous vegetables, $62; sugar beets, $48; potatoes, $47; orchard fruits, $16; hay and forage, $10; and cereals, $9. The crops yielding the highest average returns per acre were grown upon highly improved land. Their production requires a relatively great amount of labor and large expenditures for fertilizers.

CEREALS.

The following table is a statement of the changes in cereal production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	8,644	43	11,517	43,394	2,866	189,235
1889	6,440	15	5,782	22,747	3,389	84,505
1879	11,268		12,007	19,525	1,153	72,542

[1] No statistics of acreage were secured prior to 1879.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899—Continued.

PART 2.—BUSHELS PRODUCED.

YEAR.[1]	Barley.	Buck-wheat.	Corn.	Oats.	Rye.	Wheat.
1899	252,140	640	250,020	1,436,225	28,630	3,413,470
1889	163,328	316	84,760	597,947	33,928	1,515,465
1879	217,140	....	163,342	418,082	9,605	1,169,199
1869	49,117	178	95,557	65,650	1,312	558,473
1859	9,976	68	90,482	63,211	754	384,892
1849	1,799	332	9,899	10,900	210	107,702

[1] No statistics of acreage were secured prior to 1879.

The total area devoted to cereals in 1879 was 116,495 acres; in 1889, 122,878 acres; and in 1899, 255,699 acres. The acreages devoted to wheat and corn in 1899 were approximately twice as large, and that to buckwheat nearly three times as large as in 1889. The acreage under oats increased 90.8 per cent, that under barley increased 34.2 per cent, and that under rye decreased 15.4 per cent in the same period. The total production of cereals in 1849 was 130,842 bushels and that of 1899 was 5,381,125 bushels, or over 41 times as great.

Of the total area under cereals in 1899, 74.0 per cent was devoted to wheat, 17.0 per cent to oats, 4.5 per cent to corn, 3.4 per cent to barley, and 1.1 per cent to rye and to buckwheat.

HAY AND FORAGE.

In 1900, 17,042 farmers, or 87.9 per cent of the total number, reported hay and forage. Excluding cornstalks, they obtained an average yield of 2.2 tons per acre. The total area in hay and forage for 1899 was 388,043 acres, or 143.5 per cent greater than ten years before. Of this area, 268,229 acres, or 69.1 per cent, produced 681,515 tons of lucern or alfafa.

In 1899 the acreages and yields of the various other kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 71,065 acres and 88,690 tons; millet and Hungarian grasses, 2,604 acres and 3,376 tons; clover, 1,357 acres and 2,995 tons; other tame and cultivated grasses, 38,999 acres and 66,587 tons; grains cut green for hay, 3,324 acres and 4,290 tons; crops grown for forage, 2,465 acres and 3,509 tons; and cornstalks, 603 acres and 902 tons.

In Table 18 the production of cornstalks is included under "hay and forage," but the acreage is a part of that given for corn, as this forage was only an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table.

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	715,778	112,396	189,882	56,633
Apricots	27,927	6,473	5,272	4,178
Cherries	66,215	4,259	9,905	973
Peaches	409,665	68,121	85,315	69,910
Pears	229,310	9,564	59,982	6,198
Plums and prunes	298,808	23,027	45,984	9,663

In the decade from 1890 to 1900 great progress was made in fruit growing. Nearly seven times as many apple trees, over six times as many peach trees, almost thirteen times as many plum and prune trees, and almost twenty-four times as many pear trees were reported in 1900 as in 1890. The total number of trees increased from 223,840 to 1,786,412.

Of the number reported in 1900, 40.1 per cent were apple trees, 22.9 per cent peach trees, 16.7 per cent plum and prune trees, 12.8 per cent pear trees, 3.7 per cent cherry trees, 1.6 per cent apricot trees, and 2.2 per cent unclassified fruit trees. The last-named class, which is not given in the table, numbered 38,709, and yielded 1,523 bushels of fruit.

The northwestern counties of Weber, Salt Lake, Utah, and Boxelder report the greatest numbers of fruit trees, and Weber county alone contributed $100,179 of the $263,098, which was the total value of orchard products in 1899. In this total value is included the value of 439 barrels of cider, 194 barrels of vinegar, and 145,380 pounds of dried and evaporated fruits produced on farms.

VEGETABLES.

The value of vegetables grown in 1899, including potatoes, sweet potatoes, and onions, was $885,550. Of this amount, 55.1 per cent represents the value of potatoes and 3.8 per cent that of onions. Aside from the land devoted to potatoes, sweet potatoes, and onions, 5,848 acres were used in the growing of miscellaneous vegetables. Of this area the products of 3,139 acres were not reported in detail. Of the remaining 2,709 acres concerning which detailed reports were received, 1,318 acres were devoted to tomatoes, 380 to cabbages, 304 to watermelons, 181 to sweet corn, 113 to muskmelons, 97 to cucumbers, 84 to squashes, and 232 to other vegetables.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 1,052 acres, distributed among 4,003 farms. The value of the fruits grown was $117,489, an average of $29.35 per farm.

The acreage and production of the different berries were as follows: Strawberries, 345 acres and 663,190 quarts; raspberries and Logan berries, 284 acres and 426,000 quarts; currants, 194 acres and 304,850 quarts; gooseberries, 110 acres and 173,460 quarts; blackberries and dewberries, 72 acres and 80,110 quarts, and other small fruits, 47 acres and 47,120 quarts.

SUGAR BEETS.

The beet-sugar industry is an important branch of agriculture in Utah. In 1899, 1,753 farmers devoted to this crop an area of 7,546 acres, an average of 4.3 acres per farm. They obtained and sold 85,914 tons of beets, an average yield of 11.4 tons per acre, and received therefore $365,163, or an average of $208.31 per farm, $48.39 per acre, and $4.25 per ton. Utah, Weber, and Salt Lake counties report 88.7 per cent of the acreage, with a product valued at $340,290, or 93.2 per cent of the total receipts from this crop.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 14 acres, and the value of the products sold therefrom was $34,173. These flowers and plants were grown by 36 farmers and florists, of whom 20 made commercial floriculture their principal business. They had invested in land, buildings, implements, and live stock $80,960, of which $33,400 represents the value of buildings. Their sales of flowers and plants amounted to $32,922, and they obtained other products valued at $880. They expended $6,645 for labor, and $615 for fertilizers. The average income for each farm reporting, including products fed to live stock, was $1,695.

In addition to the 20 principal florists' establishments, 289 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 71,348 square feet, making, with the 79,672 square feet belonging to the florists' establishments, a total of 151,020 square feet of land under glass.

NURSERIES.

The total value of nursery products sold in 1899 was $120,648, reported by the operators of 47 farms and nurseries. Of this number 17 derived their principal income from the nursery business. They had 995 acres of land, valued at $108,565, buildings worth $18,650, implements and machinery worth $5,725, and live stock worth $4,560. The value of their products in 1899 was $122,035, of which $118,575 represents the value of nursery stock, and $3,460, that of other products. The expenditure for labor was $22,315, and for fertilizers, $515. The average income for each farm reporting, including products fed to live stock, was $7,222.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $1,837,900, an average of $95 per farm. The average expenditure was $1,313 for nurseries, $332 for florists' establishments, $198 for live-stock farms, $65 for hay and grain farms, $64 for sugar farms, $57 for fruit farms, and $39 for vegetable and for dairy farms. "Managers" expended on an average $1,238; "cash tenants," $94; "owners," $72; and "share tenants," $59. White farmers expended $96 per farm, and colored farmers $20.

Fertilizers purchased in 1899 cost $14,300, an average of $0.74 per farm, and a decrease since 1890 of 38.4 per cent. The average expenditure was $31 for florists' establishments, $30 for nurseries, and $2 for sugar farms; and hay and grain, vegetable, live stock, fruit, and dairy farms expended less than $1 each.

UINTA VALLEY AND UNCOMPAHGRE RESERVATIONS.

Uinta Valley and Uncompahgre reservations are located in the northeastern part of Utah, in Uinta and Wasatch counties. Uinta Valley reserve comprises an area of 3,186 square miles. Uncompahgre, with the exception of 20 square miles allotted to 83 Indians and a reserve of the mineral lands by the Government, has been opened up to settlement. The valleys of the Uinta river and its tributaries are fertile, well watered, and timbered. Agriculture is successful only through irrigation. Approximately one-tenth of the Uinta Valley reservation has a water supply sufficient to make it suitable for agriculture, but the remainder is well adapted to stock raising.

This is the home of the Uinta, White River, and Uncompahgre Ute, of Shoshonean stock, having a total population of 1,637. They have begun to realize that industry is essential to their existence, and their desire to become self-supporting is constantly increasing. Agriculture is their principal occupation, and a continual improvement is perceptible. A few raise stock, others find employment in freighting Government supplies and in cutting and hauling logs. The majority still live in the "tepee," although a few log huts have been constructed. The Uinta and White River bands are dependent upon Government rations for 60.0 per cent of their subsistence, and the Uncompahgre for but 45.0 per cent, while annuity payments provide 10.0 per cent of the sustenance of the entire number.

Alfalfa is the most extensive crop of the Utah Indians, while wheat and oats constituted their product of cereals. Many cultivated gardens in which they raised potatoes, onions, melons, pumpkins and turnips, while a few also reported pease, beans, cabbages, and sweet corn. The majority of the 131 Indian farmers had from

10 to 50 acres each under cultivation, but a few had over 100 acres, and their farms compared favorably with those of white farmers in the same vicinity. All crops were raised by the aid of irrigation, and their system is in fairly good condition. There is approximately 65 miles of ditch on the reserve, covering about 60,000 acres of land.

These Indians have not taken advantage of the opportunity for stock raising which their land affords, and although a number have undertaken the industry, their herds are not large enough as yet to yield profit to the owners. The Uncompahgre possess small flocks of sheep, but by far the larger number on the reserve are owned by white renters. Their horses consist largely of Indian ponies, and of these they have an excessive number.

IRRIGATION STATISTICS.

More than one-half of Utah belongs to the Great Basin, an ancient lake bed extending from the middle to the western portion of the state and across Nevada into California, where the lofty Sierras interpose—a barrier to the plain. On the eastern borders of the basin, the wall-like Wasatch range divides the state into two great parts, widely different in topography and climate. East of this range is an extension of the plateau region of the Colorado, similar in many respects to that of Arizona. The plateau culminates at the foot of the Uinta Mountains, a lofty range extending across the northern boundaries of the state. Its surface is deeply scored by the streams rising among the snow-clad peaks, and its configuration renders impossible the reclamation of extensive areas by irrigation.

The rivers for the most part of their courses flow across the plateau in deep canyons having precipitous sides, and it is only at points where they emerge in narrow valleys that the water can be utilized for irrigation. With the exception of a few favorable localities, the plateau region figures but slightly in the agricultural economy of the state. Its vast area is used only for grazing. All of the streams of the eastern slope of the Wasatch Mountains belong to the system of the Colorado of the West, and all of the precipitation not lost by evaporation finally reaches the Pacific Ocean.

The Great Basin has an elevation of from 4,000 to 6,000 feet above sea level, and is surrounded by mountains attaining altitudes of from 8,000 to 13,000 feet. It is a broad area of varied surface, containing many independent drainage districts. Within its boundaries are a number of mountain ridges of no great length, having a general northerly trend. Between these ranges are smooth valleys, the floors of which are built up of the débris washed from the mountains. Within the basin are several lofty plains areas which are called deserts. The largest are the Great Salt Lake and Carson deserts, on the north; and the Mojave and Colorado deserts, on the south. Of lesser importance are the Escalante, the Sevier, the Amargosa, and the Ralston deserts. The general slope of the Great Basin is toward the south, its surface at the lower end lying below that of the ocean. It is a region essentially arid, with markedly deficient rainfall.

A peculiar interest is attached to the Great Basin in Utah from the fact that it is the location of the first irrigation enterprise of considerable importance in the arid West by the Anglo-Saxons. In 1847 the Mormon pioneers turned the waters of City Creek upon the parched soil of Salt Lake Valley. These pioneers came from the Middle West, and were wholly unacquainted with irrigation. Their hardships were numerous and severe in the first years of their settlement. The development of agriculture and irrigation in this valley presents the best example of the value of coöperation in the construction of irrigation works and in the distribution of water. Agriculture by the Mormons was intensive, the tendency from the first being to restrict the areas and to establish small communities. Naturally, the scanty water supply influenced this form of farming in no slight degree. The valley in which the first settlement was made continues to hold first place in the state, in points of population, wealth, and agricultural development. More than one-third of the population resides in this section. In 1899 the value of the land and buildings was nearly 30 per cent, and the value of products more than 25 per cent of that reported for the whole state.

Comparing the agricultural development of the Great Basin with the Plateau region of the state, it is noted that nearly 90 per cent of the total area reclaimed belongs to the former; and of the total of 629,293 acres irrigated in 1899, only 65,889 acres are outside of the Great Basin. This acreage is widely distributed, being found in isolated tracts extending from Uinta county in the northeast to Washington county in the southwest.

Table A is an exhibit, by counties, of the number of irrigators and the acreage irrigated in 1899 and 1889, with percentages of increase.

Table A.—NUMBER OF IRRIGATORS AND ACRES IRRIGATED IN 1899 AND 1889, WITH PERCENTAGES OF INCREASE, BY COUNTIES.

COUNTIES.	NUMBER OF IRRIGATORS. 1899	1889	Per cent increase.	ACRES IRRIGATED. 1899	1889	Per cent increase.
The State [1]	17,924	9,724	84.3	629,293	263,473	138.8
Beaver	293	200	46.5	11,462	7,682	49.2
Boxelder	794	359	121.2	29,708	10,472	183.7
Cache	1,582	908	74.2	58,658	30,923	89.7
Carbon [2]	122	......	116.3	6,356	......	283.9
Emery [2]	449	264		21,840	7,344	
Davis	902	585	54.2	25,106	12,866	95.1
Garfield	215	82	162.2	10,745	2,234	381.0
Grand	97	56	73.2	2,992	1,139	162.7
Iron	203	193	5.2	5,620	3,539	58.8
Juab	312	85	267.1	10,612	1,946	445.3
Kane	193	107	80.4	3,321	1,798	84.7
Millard	627	304	106.2	30,535	8,199	272.4
Morgan	277	233	18.9	8,649	5,298	63.3
Piute [3]	187	143	209.8	10,161	5,299	263.4
Wayne [3]	256	......		9,095	......	
Rich	265	184	44.0	38,901	17,266	125.3
Salt Lake	2,110	1,264	66.9	54,598	25,392	115.0
San Juan	49	38	28.9	1,573	777	102.4
Sanpete	1,550	1,155	34.2	61,460	30,938	98.7
Sevier	921	311	196.1	36,133	11,547	212.9
Summit	553	276	100.4	28,595	10,140	182.0
Tooele	408	267	52.8	9,487	5,766	64.5
Uinta	531	186	185.5	20,185	7,611	165.2
Utah	2,675	1,161	130.4	74,872	25,236	196.7
Wasatch	483	259	86.5	17,614	6,475	172.0
Washington	453	176	157.4	7,904	2,251	251.1
Weber	1,417	928	52.7	33,111	21,335	55.2

[1] Exclusive of Indian reservations.
[2] Part of Emery taken to form Carbon in 1894.
[3] Wayne county formed from part of Piute in 1892.

During the ten years ending with 1899 the number of irrigators in the state, exclusive of Indian reservations, increased from 9,724 to 17,924, or 84.3 per cent, and the number of acres irrigated, from 263,473 to 629,293, or 138.8 per cent.

In Table B the number of irrigated farms is compared with the total number of farms, and the number of irrigated acres with the total number of improved acres.

Table B.—COMPARISON OF IRRIGATED FARMS WITH TOTAL NUMBER OF FARMS AND OF IRRIGATED ACREAGE WITH TOTAL IMPROVED ACREAGE, JUNE 1, 1900.

COUNTIES.	NUMBER OF FARMS. Total.	Irrigated.	Per cent irrigated.	NUMBER OF IMPROVED ACRES. Total	Irrigated.[1]	Per cent irrigated.
The State [2]	19,245	17,924	93.1	1,027,226	629,293	61.2
Beaver	301	293	97.3	14,821	11,462	77.3
Boxelder	1,017	794	78.1	90,703	29,708	32.8
Cache	1,795	1,582	88.1	166,272	58,658	35.3
Carbon	144	122	84.7	8,780	6,356	72.4
Davis	938	902	96.2	59,575	25,106	42.1
Emery	458	449	98.0	25,918	21,840	84.3
Garfield	237	215	90.7	13,652	10,745	78.7
Grand	121	97	80.2	4,748	2,992	63.0
Iron	235	203	86.4	7,746	5,620	72.6
Juab	356	312	87.6	26,351	10,612	40.3
Kane	213	193	90.6	6,214	3,321	53.4
Millard	676	627	92.8	39,153	30,535	78.0
Morgan	299	277	92.6	11,368	8,649	76.1
Piute	189	187	98.9	12,349	10,161	82.3
Rich	276	265	96.0	48,053	38,901	81.0
Salt Lake	2,208	2,110	95.6	74,042	54,598	73.7
San Juan	85	49	57.6	4,360	1,573	36.1
Sanpete	1,618	1,550	95.8	91,971	61,460	66.8
Sevier	946	921	97.4	41,315	36,133	87.5
Summit	608	553	91.0	35,296	28,595	81.0
Tooele	487	408	83.8	27,057	9,487	35.1

[1] 1899.
[2] Exclusive of Indian reservations.

Table B.—COMPARISON OF IRRIGATED FARMS WITH TOTAL NUMBER OF FARMS AND OF IRRIGATED ACREAGE WITH TOTAL IMPROVED ACREAGE, JUNE 1, 1900—Continued.

COUNTIES.	NUMBER OF FARMS. Total.	Irrigated.	Per cent irrigated.	NUMBER OF IMPROVED ACRES. Total.	Irrigated.[1]	Per cent irrigated.
Uinta	559	531	95.0	24,089	20,185	83.8
Utah	2,760	2,675	96.9	100,170	74,872	74.7
Wasatch	492	483	98.2	21,947	17,614	80.3
Washington	477	453	95.0	10,866	7,904	72.7
Wayne	271	256	94.5	12,202	9,095	74.5
Weber	1,479	1,417	95.8	48,208	33,111	68.7

[1] 1899.

Of the total number of farms in the state, irrigation was practiced on 17,924, or 93.1 per cent. Of the total improved area, 1,027,226 acres, 629,293 acres, or 61.2 per cent, were irrigated during the year 1899.

In Table C is shown the acreage and production of all crops and of irrigated crops in 1899.

Table C.—ACREAGE AND PRODUCTION OF ALL CROPS AND OF IRRIGATED CROPS, 1899.

CROPS.	ACREAGE. Total.	Irrigated.	Per cent irrigated.	Unit of measure.	PRODUCTION. Total.	Irrigated.	Per cent irrigated.
All crops	686,374	537,588	78.3	....	....	....	......
Corn	11,517	9,684	84.1	Bushels	250,020	226,858	90.7
Wheat	189,235	108,630	57.4	Bushels	3,413,470	2,554,248	74.8
Oats	43,394	40,351	93.0	Bushels	1,436,225	1,362,746	94.9
Barley	8,644	6,085	70.4	Bushels	252,140	216,416	85.8
Rye	2,866	1,219	42.5	Bushels	28,630	17,165	60.0
Wild, salt, or prairie grasses.	71,065	55,162	77.6	Tons	88,690	82,211	92.7
Millet and Hungarian grasses.	2,604	1,934	74.3	Tons	3,376	2,681	79.4
Alfalfa or lucerne.	268,229	233,218	86.9	Tons	681,515	637,360	93.5
Clover	1,357	1,334	98.3	Tons	2,995	2,977	99.4
Other tame and cultivated grasses.	38,999	34,972	89.7	Tons	66,587	61,872	92.9
Grains cut green for hay.	3,324	2,551	76.7	Tons	4,290	3,479	81.1
Forage crops	[1]2,465	[1]1,407	57.1	Tons	[2]4,111	[2]3,135	71.1
Dry beans	176	163	92.6	Bushels	1,806	1,727	95.6
Dry pease	143	138	96.5	Bushels	2,694	2,640	98.0
Potatoes	10,433	9,792	93.9	Bushels	1,483,570	1,418,771	95.6
Onions	175	167	95.4	Bushels	53,440	51,777	96.9
Miscellaneous vegetables.	5,848	5,424	92.7	....	....	....	......
Sorghum cane	371	290	78.2	Tons	[3]101	[3]46	45.5
Sorghum sirup	....	....	......	Gallons	28,017	24,950	89.1
Sugar beets	7,546	7,546	100.0	Tons	[3]85,914	[3]85,914	100.0
Small fruits	1,052	960	91.3	....	....	....	......
Grapes	[4]446	[4]428	96.0	Centals	9,200	8,854	96.2
Orchard fruits	[4]16,013	[4]16,013	100.0	Bushels	397,863	397,863	100.0
Other crops	472	120	25.4	....	....	....	......

[1] Not including area of "duplicate forage crops" (cornstalks and cornstrippings.)
[2] Including cornstalks and corn strippings.
[3] Amount sold.
[4] Estimated from number of vines or trees.

Of the 686,374 acres in crops, 537,588 acres, or 78.3 per cent, were irrigated. The crops produced on irrigated land were, hay and forage, 330,578 acres, or 61.5 per cent of the total; cereals, 165,969 acres, or 30.9 per cent; vegetables, 15,684 acres, or 2.9 per cent; orchard fruits, 16,013 acres, or 3.0 per cent; other crops, 9,344 acres, or 1.7 per cent. The value of irrigated crops was, total, $7,462,370; hay and forage, $3,654,114; cereals, $1,940,012; vegetables, $840,814; orchard fruits, $261,155; other crops, $766,275. The principal crops represented in the value of "other crops" were sugar beets, $365,163; flowers and nursery products, $164,977; grass seed, $114,238.

Of the total irrigated area, 624,186 acres were watered from streams by gravity diversion ditches and 5,177 acres were irrigated from wells. The total cost of construction of the well systems was $142,996.

In Table D is shown the principal statistics of irrigation from streams in 1899.

TABLE E.—ACREAGE IRRIGATED FROM STREAMS IN 1899, WITH NUMBER AND LENGTH OF DITCHES, AND COST OF IRRIGATION SYSTEMS SUPPLIED WITH WATER FROM STREAMS BY GRAVITY DIVERSION.

COUNTIES.	Number of ditches.	Length of ditches in miles.	Number of acres irrigated from streams.	COST OF CONSTRUCTION OF IRRIGATION SYSTEMS.	
				Total.	Average per acre irrigated in 1899.
The State	928	2,838	624,186	$5,722,306	$9.17
Beaver	43	64	11,452	45,724	3.99
Boxelder	41	191	29,671	1,291,773	43.54
Cache	31	129	58,532	162,250	2.77
Carbon	22	42	6,329	29,335	4.64
Davis	41	116	23,417	283,894	12.12
Emery	22	154	21,840	385,750	17.66
Garfield	35	93	10,745	33,560	3.12
Grand	18	36	2,817	10,765	3.82
Iron	19	28	5,416	5,530	1.02
Juab	20	61	10,607	147,720	13.93
Kane	16	29	3,321	22,825	6.87
Millard	35	131	30,374	225,800	7.43
Morgan	25	27	8,649	28,057	3.24
Piute	32	58	10,154	32,180	3.17
Rich	31	130	38,901	117,080	3.01
Salt Lake	40	222	54,212	806,675	14.88
San Juan	9	21	1,567	47,150	30.09
Sanpete	78	208	61,268	272,500	4.45

TABLE E.—ACREAGE IRRIGATED FROM STREAMS IN 1899, WITH NUMBER AND LENGTH OF DITCHES, AND COST OF IRRIGATION SYSTEMS SUPPLIED WITH WATER FROM STREAMS BY GRAVITY DIVERSION—Continued.

COUNTIES.	Number of ditches.	Length of ditches in miles.	Number of acres irrigated from streams.	COST OF CONSTRUCTION OF IRRIGATION SYSTEMS.	
				Total.	Average per acre irrigated in 1899.
Sevier	32	205	35,982	$295,240	$8.21
Summit	110	133	28,424	99,805	3.51
Tooele	18	110	9,281	42,600	4.59
Uinta	15	91	20,185	121,825	6.03
Utah	83	155	73,643	572,905	7.78
Wasatch	19	67	17,614	64,160	3.64
Washington	32	101	7,886	123,115	15.61
Wayne	26	70	9,095	63,505	6.98
Weber	35	166	32,804	390,583	11.91

In 1899 there were operated 928 irrigation systems receiving water from streams by gravity diversion. The total cost of construction was $5,722,306, or an average cost per acre irrigated in 1889 of $9.17. Bear River canal system, which cost $1,250,000 and which was designed to irrigate 75,000 acres, is of comparatively recent construction, and in 1899 only 17,000 acres of the land under the system were irrigated. Exclusive of this system, the average cost of construction per acre irrigated was $7.37. The average cost of maintenance per acre for the state was $0.24. The total length of the main canals and ditches operated in 1899 was 2,838 miles.

The average value per acre of all farms, June 1, 1900, was $9.75, and of farms on which irrigation was practiced, $10.42. The average value per acre of irrigated land was $37.40.

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 223. WASHINGTON, D. C. July 2, 1902.

AGRICULTURE.

VIRGINIA.

Hon. WILLIAM R. MERRIAM,

Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Virginia, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Virginia, June 1, 1900, numbered 167,886, and were valued at $271,578,200. Of this amount, $70,963,120, or 26.1 per cent, represents the value of buildings, and $200,615,080, or 73.9 per cent, the value of land and improvements other than buildings. On the same date the value of farm implements and machinery was $9,911,040, and of live stock, $42,026,737. These values, added to that of farms, give $323,515,977, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of all such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $86,548,545, of which amount $27,846,803, or 32.2 per cent, represents the value of animal products, and $58,701,742, or 67.8 per cent, the value of crops, including forest products cut or produced on farms. The "total value of farm products" for 1899 exceeds that for 1889 by $44,304,087, or 104.9 per cent.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $13,002,810, leaving $73,545,735 as the gross farm income for that year. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Virginia, in 1899, it was 22.7 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the final report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Virginia.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

GENERAL STATISTICS.

Virginia has a total land area of 40,125 square miles, or 25,680,000 acres, of which 19,907,883 acres, or 77.5 per cent, are included in farms.

The surface of the state is level in the southeast, and mountainous in the northwest and west, where it is traversed by the Blue Ridge and other ranges of the Appalachian Mountains. Extending westward from the Atlantic Ocean, the state is divided into six physical regions, known as Tidewater, Midland, Piedmont, Blue Ridge, Great Valley, and Appalachian, which rise in successive terraces, and, differing in altitude, soil, and products, have all the climatic variations of the temperate zone.

The soil is especially adapted to truck farming in the Tidewater and Midland, to tobacco in the south central portion of the state, and to orchard fruits, cereals, and grasses in the Piedmont and the Shenandoah Valley. Stock raising is an important and growing industry in the north central and western parts, where the blue grass flourishes. The Potomac, Rappahannock, York, James, and New rivers, together with their tributaries, afford excellent drainage.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the percentage of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	167,886	19,907,883	10,094,805	9,813,078	118.6	50.7
1890	127,600	19,104,951	9,125,545	9,979,406	149.7	47.8
1880	118,517	19,835,785	8,510,113	11,325,672	167.4	42.9
1870	73,849	18,145,911	8,165,040	9,980,871	245.7	45.0
1860[1]	92,605	31,117,036	11,437,821	19,679,215	336.0	36.8
1850[1]	77,013	26,152,311	10,360,135	15,792,176	339.6	39.6

[1] Including the territory now embraced in West Virginia.

During the Civil War period one-third of Virginia was incorporated in the new state of West Virginia. The territory withdrawn contained 10,896,379 acres in farms, consisting of 2,346,127 acres of improved land and 8,550,252 acres of unimproved land, which should be considered in comparing the figures for the various census years. Making allowance for this reduction in area, the tables show a loss in total farm acreage during the decade, 1860 to 1870, of 2,074,746 acres, of which the state has recovered all but about 300,000 acres.

Between 1850 and 1900 the number of farms more than doubled, the decade from 1860 to 1870 being the only one reporting a decrease. During the last ten years there was a gain of 40,286 farms, or 31.6 per cent. The number of farms has increased faster than the total acreage, involving a decrease in the average size, which has been continuous since 1850.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$323,515,977	$271,578,200	$9,911,040	$42,026,737	$86,548,545
1890	294,488,569	254,490,600	6,593,688	33,404,281	42,244,458
1880	247,476,536	216,028,107	5,495,114	25,953,315	45,726,221
1870[2]	246,132,550	213,020,845	4,924,036	28,187,669	[3]51,774,801
1860[4]	428,957,006	371,761,661	9,392,296	47,803,049	....
1850[4]	257,079,974	216,401,543	7,021,772	33,656,659	....

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.
[4] Including the territory now embraced in West Virginia.

Great development is shown for the decade from 1850 to 1860, but on account of the territorial change previously mentioned, the state lost territory whose farm property was valued in 1860 at $101,891,915, of which $87,526,087 represented the value of land, buildings, and improvements; $12,392,680, that of live stock; and $1,973,148, that of implements and machinery. Taking these deductions into consideration, the table shows that since 1860 there have been gains of $6,616,368 in the value of live stock, and $2,491,892 in the value of implements and machinery; but a decrease in the value of land, buildings, and improvements of $12,657,374. The total value of farm property is $3,549,114 less than in 1860.

In the last ten years the total value of farm property has increased $29,027,408, or 9.9 per cent; that of land, improvements, and buildings, $17,087,600, or 6.7 per cent; that of implements and machinery, $3,317,352, or 50.3 per cent; and that of live stock, $8,622,456, or 25.8 per cent. The value of farm products for 1899 is more than double that of ten years before. Part of this increase, and of that in implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than heretofore.

COUNTY STATISTICS.

Table 3 gives a statement of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH GROSS INCOME (PRODUCTS OF 1899 NOT FED TO LIVE STOCK) AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Gross income (products of 1899 not fed to live stock).	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	167,886	164,074	19,907,883	10,094,805	$200,615,080	$70,963,120	$9,911,040	$42,026,737	$73,545,735	$7,790,720	$3,681,790
Accomac	2,772	2,706	190,861	93,210	3,947,030	1,320,090	181,270	499,426	1,710,674	217,530	119,100
Albemarle	2,636	2,590	396,624	249,409	4,143,410	2,210,160	227,290	857,452	1,228,584	194,780	38,410
Alexandria	379	355	11,561	8,074	2,086,820	464,890	41,870	73,266	188,644	32,860	6,840
Alleghany	516	499	110,328	30,861	824,870	221,120	39,900	169,325	200,366	19,360	2,860
Amelia	1,361	1,339	193,183	79,571	917,900	461,100	66,310	199,621	451,210	40,350	33,790
Amherst	2,159	2,076	241,685	132,140	1,637,720	646,380	87,630	407,928	928,943	57,520	22,210
Appomattox	1,278	1,262	193,932	84,602	775,880	393,300	54,810	190,495	568,152	31,180	34,650
Augusta	2,768	2,714	410,978	276,459	8,290,170	3,173,950	439,090	1,375,140	2,022,169	287,240	137,810
Bath	561	501	182,603	46,443	1,105,260	367,090	49,720	258,245	240,770	22,080	3,630
Bedford	4,030	3,990	432,479	249,956	3,205,810	1,272,230	188,260	861,408	1,738,159	79,730	38,640
Bland	660	619	149,499	54,210	1,464,720	220,030	38,970	357,341	338,884	27,810	4,300
Botetourt	1,374	1,357	190,578	103,953	2,260,880	726,810	134,290	452,957	708,322	89,940	23,010
Brunswick	2,372	2,344	320,072	132,408	1,026,410	482,960	99,710	317,686	898,394	91,220	54,230
Buchanan	1,542	1,508	200,918	40,722	961,450	195,370	29,400	280,615	335,884	10,490	520
Buckingham	1,751	1,734	268,697	104,010	863,810	452,820	70,850	248,109	586,839	53,560	35,940
Campbell	1,992	1,949	271,135	126,999	1,604,330	616,160	121,420	376,843	935,262	68,870	47,780
Caroline	2,492	2,456	301,475	153,922	1,408,600	615,240	118,290	412,213	691,661	68,010	26,710
Carroll	3,030	2,968	268,299	150,694	2,025,450	538,130	96,820	576,463	789,437	31,130	18,690
Charles City	439	434	97,726	35,285	596,170	200,830	31,870	98,191	172,086	28,050	3,690
Charlotte	1,763	1,734	255,841	103,858	990,420	564,690	73,680	283,432	702,197	88,800	52,020
Chesterfield	1,494	1,486	194,489	70,378	1,919,200	970,750	116,230	307,604	652,741	69,050	11,340
Clarke	526	524	104,011	82,980	2,796,070	696,940	103,230	456,909	614,067	107,990	31,730
Craig	492	487	86,720	38,656	1,079,480	205,500	32,120	247,753	257,472	11,400	2,650
Culpeper	1,301	1,281	217,528	149,184	2,627,870	927,910	136,520	707,087	764,097	127,520	45,000
Cumberland	1,390	1,350	166,274	74,055	766,030	344,450	57,690	180,038	420,544	49,170	32,460
Dickenson	1,229	1,206	162,420	35,637	878,080	212,690	17,540	212,127	240,258	7,610	350
Dinwiddie	2,059	2,017	283,752	102,016	1,276,540	582,500	105,250	296,329	780,964	66,390	40,730
Elizabeth City	276	272	15,074	10,361	668,280	141,430	24,040	79,327	184,406	23,880	5,770
Essex	1,634	1,587	145,033	77,781	873,100	422,910	54,960	244,704	381,876	41,150	10,070
Fairfax	1,831	1,796	188,397	108,182	3,674,240	1,636,860	206,270	530,211	1,036,690	149,560	51,160
Fauquier	2,256	2,219	389,801	291,734	6,082,860	2,052,390	228,780	1,616,010	1,445,113	198,890	90,950
Floyd	2,284	2,235	234,384	149,407	2,286,480	667,840	116,070	556,981	706,700	27,110	11,550
Fluvanna	1,329	1,305	151,052	73,808	753,810	467,470	66,570	254,084	435,523	36,490	17,140
Franklin	3,732	3,641	395,873	169,159	1,995,400	745,070	130,240	616,162	1,173,243	63,960	34,030
Frederick	1,603	1,584	247,636	161,113	3,869,720	1,389,460	197,840	637,601	993,426	105,710	46,210
Giles	1,033	1,020	139,759	75,192	1,668,810	458,010	68,430	467,324	524,211	37,490	4,940
Gloucester	1,926	1,913	105,894	55,918	930,250	687,850	76,820	233,472	404,548	34,920	9,770
Goochland	1,323	1,316	149,556	68,840	1,073,250	434,070	64,480	234,619	366,869	66,210	12,180
Grayson	2,608	2,552	254,248	143,738	2,924,990	728,490	126,110	754,963	795,641	51,710	6,440
Greene	796	792	83,227	52,279	653,470	237,740	35,470	187,784	281,347	20,310	4,540
Greenesville	1,201	1,147	150,052	65,570	678,240	230,370	47,600	143,790	458,986	65,400	16,430
Halifax	4,092	3,899	492,103	239,614	2,322,810	1,106,960	174,180	564,189	1,778,983	197,000	131,790
Hanover	2,506	2,457	262,997	130,450	1,813,520	886,710	136,150	465,133	1,012,985	111,640	40,910
Henrico	1,370	1,333	120,961	67,672	4,068,440	1,526,820	163,770	378,212	1 069,918	198,990	28,900
Henry	1,911	1,875	210,482	72,673	938,840	367,260	58,200	246,363	651,394	37,460	35,450
Highland	718	676	209,044	92,411	2,429,970	351,230	64,480	558,362	449,894	19,810	6,250
Isle of Wight	1,511	1,486	156,867	61,775	882,170	488,060	64,610	219,373	829,696	105,280	53,610
James City	566	554	69,363	22,374	606,090	177,900	33,470	79,593	177,364	28,710	10,980
King and Queen	1,730	1,672	171,009	76,573	681,740	369,910	55,870	233,717	344,048	16,560	8,290
King George	1,125	1,052	103,529	67,039	705,840	254,580	51,290	211,375	346,580	21,130	11,190
King William	1,004	991	131,859	64,076	781,400	322,320	46,010	202,419	303,032	41,980	7,590
Lancaster	1,092	1,069	63,970	32,004	657,670	418,790	55,330	141,887	279,558	33,550	12,830
Lee	2,807	2,690	243,331	135,165	3,163,330	590,780	80,960	732,380	923,227	42,040	2,840
Loudoun	1,948	1,933	318,902	251,874	6,649,690	2,488,870	295,910	1,621,639	1,817,414	292,150	107,490
Louisa	2,550	2,491	270,011	111,889	1,288,930	834,250	97,630	387,710	526,702	40,680	23,720
Lunenburg	1,707	1,680	233,851	85,067	785,850	464,950	66,190	241,355	622,775	65,640	44,430
Madison	1,223	1,213	172,814	107,047	1,604,510	594,850	76,070	397,015	527,692	73,400	17,390
Mathews	1,438	1,410	43 070	25,334	795,120	616,300	50,940	156,164	313,032	24,060	6,430
Mecklenburg	3,138	3,065	383,580	163,270	1,643,320	853,730	120,100	440,028	1,151,791	120,860	72,490
Middlesex	1,352	1,307	68,147	37,131	638,030	432,030	52,070	136,525	273,891	21,690	11,800
Montgomery	1,230	1,215	193,987	111,842	2,816,420	655,050	83,310	480,307	533,263	37,100	14,170
Nansemond	2,129	2,064	179,116	74,074	1,527,170	790,960	101,800	301,987	1,606,981	290,430	210,510
Nelson	1,841	1,791	240,494	113,672	1,667,320	640,980	80,290	334,507	704,593	48,370	15,130
New Kent	714	706	102,719	39,452	442,890	202,440	27,000	104,856	211,573	19,230	5,000
Norfolk	1,447	1,376	128,034	72,434	4,483,630	917,360	145,130	302,815	2,018,545	398,850	308,600
Northampton	975	964	86,991	47,352	1,646,910	755,050	92,050	231,855	894,936	124,280	157,400
Northumberland	1,572	1,545	100,714	52,767	926,640	536,130	79,980	217,988	416,002	41,070	26,010
Nottoway	1,353	1,332	177,058	72,222	955,510	496,170	56,410	189,320	418,946	46,850	26,450
Orange	1,258	1,240	178,021	103,710	1,794,520	812,420	124,460	458,322	539,467	92,220	31,330
Page	980	969	126,244	70,088	1,943,490	592,040	95,200	342,072	583,324	54,090	27,910
Patrick	2,572	2,525	244,587	97,116	1,129,040	353,000	60,180	312,685	648,805	14,900	18,270
Pittsylvania	4,885	4,823	590,810	280,456	3,390,070	1,593,660	193,050	760,365	2,471,212	203,670	189,890
Powhatan	920	910	144,445	56,629	814,650	424,990	54,490	175,421	391,233	36,850	16,940
Prince Edward	1,707	1,665	192,715	81,291	850,110	523,030	65,240	228,706	622,573	79,590	49,060
Prince George	1,134	1,107	152,124	70,225	886,360	401,540	69,180	175,367	528,455	53,690	18,560
Princess Anne	1,432	1,415	118,529	71,029	1,787,950	605,880	100,560	281,260	1,055,293	176,380	79,370
Prince William	1,261	1,231	174,812	97,202	1,674,400	835,670	99,100	424,647	578,361	69,760	35,890
Pulaski	942	930	166,840	91,397	3,301,150	624,990	92,630	562,764	608,458	63,140	16,320
Rappahannock	977	944	173,656	117,552	2,153,690	556,110	84,870	622,199	649,742	81,160	21,870
Richmond	1,101	1,087	96,370	48,524	644,400	331,640	47,450	174,993	286,148	23,900	14,290

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH GROSS INCOME (PRODUCTS OF 1899 NOT FED TO LIVE STOCK) AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Gross income (products of 1899 not fed to live stock).	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Roanoke	1,139	1,107	143,328	82,600	$2,107,870	$704,100	$105,040	$330,993	$604,889	$58,920	$16,370
Rockbridge	1,679	1,652	265,997	160,533	3,447,460	1,064,340	161,290	658,168	1,079,111	83,230	41,590
Rockingham	3,293	3,244	345,856	240,122	8,747,330	3,237,110	436,340	1,377,426	2,273,990	213,740	105,880
Russell	2,289	2,211	292,397	161,395	3,898,070	667,120	73,400	1,043,525	1,005,207	59,140	8,410
Scott	3,435	3,351	297,355	149,672	2,636,200	676,670	69,300	676,923	906,383	25,820	7,180
Shenandoah	2,382	2,364	234,695	140,837	4,659,880	1,865,030	250,520	771,622	1,319,077	113,070	61,870
Smyth	1,650	1,495	216,746	113,465	3,634,860	619,110	104,660	694,252	744,992	78,430	19,100
Southampton	2,683	2,595	331,728	129,817	1,540,140	803,850	116,020	345,482	1,254,292	199,390	87,820
Spottsylvania	1,734	1,689	207,557	87,732	1,240,230	632,510	100,970	356,065	581,647	65,680	26,160
Stafford	1,297	1,286	139,626	67,263	761,080	347,490	56,900	233,684	382,408	24,950	16,960
Surry	1,094	1,003	110,461	43,938	699,820	363,200	53,530	148,535	446,613	55,710	18,210
Sussex	1,391	1,323	227,222	81,376	956,380	359,540	61,380	187,808	542,964	65,650	26,450
Tazewell	1,989	1,920	280,116	165,338	4,879,420	773,840	87,870	1,072,649	874,974	83,970	10,460
Warren	804	783	115,003	72,465	1,592,230	485,440	80,140	419,903	765,966	67,180	22,380
Warwick	150	144	12,705	5,358	372,620	62,010	8,540	29,738	56,340	9,100	1,940
Washington	3,383	3,322	316,175	192,051	4,436,950	1,091,670	157,520	924,554	1,247,814	78,890	34,270
Westmoreland	1,244	1,212	127,585	70,068	898,970	381,490	62,770	210,343	413,980	35,070	20,990
Wise	1,276	1,252	118,270	43,196	1,160,050	215,540	23,000	243,619	318,479	9,180	680
Wythe	1,326	1,289	244,443	137,363	4,495,700	933,360	139,360	749,615	960,514	111,610	35,240
York	1,139	1,094	52,974	24,345	498,680	269,740	36,390	125,402	210,200	16,130	5,820
Alexandria city	11	10	948	743	48,980	11,820	600	6,609	4,506	900	10
Bristol city	9	9	1,543	1,100	50,470	7,510	1,150	4,0[illegible]	6,402	470	140
Buena Vista city	3	3	157	35	1,900	1,700	170	1,171	1,716	250	100
Charlottesville city	13	13	2,842	2,148	74,400	37,950	1,840	4,386	5,839	1,450	340
Danville city	13	12	273	229	26,360	9,550	890	1,400	6,948	600	100
Fredericksburg city	6	6	522	96	15,350	18,000	1,130	833	3,782	550	80
Lynchburg city	11	11	445	386	18,250	7,500	1,100	3,001	16,239	880	50
Manchester city	6	6	105	76	7,200	2,750	260	1,420	2,234	10	....
Newport News city	7	6	693	304	372,800	6,780	580	733	3,998	1,330	140
Norfolk city	18	11	749	675	201,650	19,700	8,770	7,027	29,069	9,410	6,070
Petersburg city	26	26	2,236	1,811	39,550	29,700	2,080	8,609	16,731	2,340	80
Portsmouth city	4	4	55	50	84,200	4,800	200	1,586	4,057	710	10
Radford city	38	32	3,007	2,497	92,530	38,270	2,620	16,301	26,534	1,920	900
Richmond city	8	8	356	271	22,000	7,350	670	1,075	2,389	1,560	110
Roanoke city	7	7	37	37	2,590	1,570	120	3,778	1,366	....	....
Staunton city	4	4	355	310	59,620	7,700	4,040	6,848	7,726	1,750	120
Williamsburg city	7	4	263	166	18,030	1,650	420	1,877	4,710	1,940	80
Winchester city	12	11	250	192	18,900	16,200	1,260	1,049	3,604	200	160

In the last decade the number of farms increased in all counties except Clarke, Montgomery, and Warwick. A decrease in the acreage of farm land is reported in less than one-fourth of the counties, while a smaller number show losses in the acreage of improved land. The decrease reported in improved area is due to a more intensive cultivation of smaller areas of farm land and to the use of a more strict definition of the term "improved land" by the Twelfth than by any preceding census. The average size of farms for the state is 118.6 acres, ranging from 30.0 acres in Mathews county to 325.5 acres in Bath county. The largest farms are found, as a rule, in the western counties, devoted to cereals and stock raising, and the smallest in the southeastern counties.

Between 1890 and 1900 the value of farms increased in three-fourths of the counties. The decreases reported are mainly in the southwestern counties. For the state the average value of farms, including land, improvements, and buildings, is $1,618. Nearly all counties report increases in the value of implements and machinery, and only five counties report decreases in the amounts invested in live stock.

The average amount paid per farm for labor in 1899 varied from less than $10 to more than $100, the former expenditure being reported from counties devoted mainly to dairying, and the latter, from a few western live-stock counties and some eastern counties containing numerous truck farms. The majority of counties, however, showed little variation from the state average. Clarke, Charles City, Rockingham, and Shenandoah counties alone reported a smaller expenditure for fertilizers in 1899 than in 1889.

FARM TENURE.

Table 4 gives a comparative statement of farm tenure for 1880, 1890, and 1900, showing the number and percentage of farms operated by owners and by tenants. Tenants are divided into two groups—"cash tenants," who pay a rental in cash or a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms in 1900 is given by race of farmer, and "farms operated by owners" are subdivided into groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	167,886	116,290	16,649	34,947	69.3	9.9	20.8
1890	127,600	93,311	11,985	22,304	73.1	9.4	17.5
1880	118,517	83,531	13,392	21,594	70.5	11.3	18.2

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	167,886	102,269	10,382	1,504	2,135	16,649	34,947
White	123,052	79,460	6,759	1,370	1,897	9,758	23,808
Colored[1]	44,834	22,809	3,623	134	238	6,891	11,139

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	60.9	6.2	0.9	1.3	9.9	20.8
White	100.0	64.6	5.5	1.1	1.5	7.9	19.4
Colored[1]	100.0	50.9	8.1	0.3	0.5	15.4	24.8

[1] Including 39 Indians.

In the period from 1880 to 1900 the total number of farms increased 41.7 per cent, and in the last decade, 31.6 per cent. Since 1890 the number of farms operated by owners has increased 24.6 per cent; by cash tenants, 38.9 per cent; and by share tenants, 56.7 per cent. The percentages in Table 4 indicate that the number of farms operated by owners has not increased so rapidly during the last ten years as the number of tenant farms.

In 1900, 73.3 per cent of the farms of the state were operated by white farmers and 26.7 per cent by colored farmers. Of the white farmers, 71.2 per cent own all or a part of the farms they operate, and 28.8 per cent operate farms owned by others. The corresponding percentages for colored farmers are 59.3 and 40.7.

In 1890, 35.0 per cent of all tenants were cash tenants, and in 1900, 32.3 per cent. This slight variation shows there has been little change in the relative proportions of the tenant classes.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	167,886	118.6	19,907,883	100.0	$323,515,977	100.0
White	123,052	143.7	17,678,765	88.8	298,986,961	92.4
Colored[1]	44,834	49.7	2,229,118	11.2	24,529,016	7.6
Owners	102,269	121.6	12,438,460	62.5	208,352,925	64.4
Part owners	10,382	107.0	1,111,067	5.6	19,799,511	6.1
Owners and tenants	1,504	178.6	268,668	1.3	4,123,688	1.3
Managers	2,135	369.4	788,638	4.0	18,439,117	5.7
Cash tenants	16,649	104.4	1,738,423	8.7	25,807,231	8.0
Share tenants	34,947	101.9	3,562,627	17.9	46,993,505	14.5

[1] Includes 39 Indians.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,195	$423	$59	$250	$438	22.7
White	1,513	532	73	312	528	21.7
Colored[1]	323	123	21	80	192	35.0
Owners	1,220	477	66	274	451	22.1
Part owners	1,203	376	60	268	440	23.1
Owners and tenants	1,714	578	87	363	633	23.1
Managers	5,756	1,753	190	938	1,273	14.7
Cash tenants	1,046	292	41	171	381	24.6
Share tenants	887	253	37	168	367	27.3

[1] Includes 39 Indians.

The value of the farm property of colored farmers is $24,529,016, more than one-half the total number owning the farms they operate. With the exception of 39 Indians, the colored farmers of the state are negroes.

Farms operated by share tenants have the smallest average area, 101.9 acres, and those conducted by managers the largest, 369.4 acres. A number of the farms operated by managers are adjuncts of public institutions, while others are conducted for wealthy individuals in connection with their summer homes. These farms, as a rule, are favorably located and highly improved, and the average values of their several forms of farm property, shown in Table 7, are much larger than those of any other tenure group. The ratio which their gross income bears to the total value of their farm property is, however, smaller than for any other group. This is due to the high average valuation of the farm property and to the fact that some of these farms are not cultivated for profit. The high percentage of gross income shown for colored farmers is due to the smaller size and consequent more intensive cultivation of their farms, and the low value of their farm property, or capital invested. More than one-fourth of the farmers are colored, but the value of the farm property they operate is only 7.6 per cent of the total value for the state.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	167,886	118.6	19,907,883	100.0	$323,515,977	100.0
Under 3 acres	1,671	1.8	2,999	(1)	880,414	0.3
3 to 9 acres	12,898	5.9	75,504	0.4	5,456,122	1.7
10 to 19 acres	18,334	13.4	245,754	1.2	9,421,688	2.9
20 to 49 acres	35,644	31.6	1,125,988	5.7	25,867,053	8.0
50 to 99 acres	33,948	70.0	2,376,444	11.9	42,349,071	13.1
100 to 174 acres	32,466	126.4	4,102,998	20.6	65,986,691	20.4
175 to 259 acres	15,348	209.4	3,213,708	16.2	49,649,212	15.3
260 to 499 acres	12,377	340.3	4,211,477	21.2	62,426,138	19.3
500 to 999 acres	4,100	638.1	2,616,261	13.1	36,282,926	11.2
1,000 acres and over	1,100	1,760.7	1,936,750	9.7	26,196,662	7.8

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,195	$423	$69	$250	$438	22.7
Under 3 acres	196	270	15	46	108	20.6
3 to 9 acres	182	169	15	57	108	25.5
10 to 19 acres	244	176	21	73	151	29.3
20 to 49 acres	404	190	27	105	228	31.4
50 to 99 acres	744	289	44	170	349	27.9
100 to 174 acres	1,242	454	70	266	510	25.1
175 to 259 acres	2,031	694	103	407	726	22.4
260 to 499 acres	3,242	1,035	140	627	1,010	20.0
500 to 999 acres	5,896	1,626	206	1,121	1,428	16.1
1,000 acres and over	16,363	3,337	388	2,818	2,900	12.7

The group of farms containing from 260 to 499 acres each comprises a larger total acreage than any other group, but the group containing 100 to 174 acres each represents the greatest value in farm property.

Except for farms of less than 3 acres, the average values increase with the size of the farms. For the group of farms of less than 3 acres each the average values are relatively high, as this group includes many of the florists' establishments of the state and also a large number of city dairies. The incomes from these industries depend less upon the acreage of land used than upon the amount of capital invested and the amounts expended for labor and fertilizers.

The average gross income per acre for the various groups classified by area are as follows: Farms under 3 acres, $60.41; 3 to 9 acres, $18.41; 10 to 19 acres, $11.24; 20 to 49 acres, $7.22; 50 to 99 acres, $4.98; 100 to 174 acres, $4.04; 175 to 259 acres, $3.47; 260 to 499 acres, $2.97; 500 to 999 acres, $2.24; and 1,000 acres and over, $1.65. It will be noted that the average gross income per acre decreases as the farms increase in size.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm; if vegetables are the leading crop, constituting 40 per cent of the value of such products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40 per cent of their income from any one class of products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	167,886	118.6	19,907,883	100.0	$323,515,977	100.0
Hay and grain	37,469	134.6	5,043,288	25.3	96,905,538	30.0
Vegetables	9,047	66.1	597,728	3.0	19,300,556	6.0
Fruits	1,851	110.2	203,941	1.0	4,769,134	1.5
Live stock	41,156	134.0	5,513,798	27.7	106,510,584	32.9
Dairy produce	1,624	135.2	219,531	1.1	8,618,313	2.7
Tobacco	19,466	128.8	2,506,848	12.6	21,481,571	6.6
Cotton	916	97.4	89,197	0.5	734,345	0.2
Sugar	6	32.5	195	(1)	2,666	(1)
Flowers and plants	56	7.3	409	(1)	427,913	0.1
Nursery products	45	114.2	5,138	(1)	448,320	0.1
Miscellaneous	56,250	101.8	5,727,810	28.8	64,317,037	19.9

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$1,195	$423	$59	$250	$438	22.7
Hay and grain	1,686	547	76	277	470	18.2
Vegetables	1,413	483	68	169	715	33.5
Fruits	1,693	587	68	229	665	25.8
Live stock	1,607	506	69	406	455	17.6
Dairy produce	3,388	1,168	144	607	996	18.8
Tobacco	620	288	45	151	476	43.2
Cotton	448	190	35	129	323	40.3
Sugar	182	80	16	166	96	21.8
Flowers and plants	2,652	4,578	373	38	3,517	46.0
Nursery products	7,529	2,004	211	219	4,180	42.0
Miscellaneous	657	287	41	158	319	27.9

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $481.64; nursery products, $36.61; vegetables, $10.82; dairy produce, $7.37; fruits, $6.03; tobacco, $3.70; hay and grain, $3.49; live stock, $3.39; cotton, $3.32; miscellaneous, $3.14; and sugar, $2.97. The wide variations shown in the averages and percentages of gross income are due largely to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens, the average expenditures for such items as labor and fertilizers represent a far larger percentage of the gross income than in the case of "hay and grain," "live stock," or "miscellaneous" farms. Were it possible to present the average net incomes, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS. Average.	Total.	Per cent.	VALUE OF FARM PROPERTY. Total.	Per cent.
The State	167,886	118.6	19,907,883	100.0	$323,515,977	100.0
$0	680	63.9	43,428	0.2	641,040	0.2
$1 to $49	9,631	28.8	277,374	1.4	3,240,650	1.0
$50 to $99	18,552	35.6	660,785	3.3	7,717,410	2.4
$100 to $249	52,053	62.2	3,236,159	16.3	38,641,440	12.0
$250 to $499	44,540	113.6	5,061,491	25.4	62,895,747	19.4
$500 to $999	27,617	186.2	5,142,809	25.8	81,263,570	25.1
$1,000 to $2,499	12,566	315.3	3,962,057	19.9	85,863,020	26.5
$2,500 and over	2,247	678.1	1,523,780	7.7	43,253,100	13.4

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$1,195	$423	$59	$250	$438	22.7
$0	650	162	14	117	....	....
$1 to $49	199	93	9	35	29	8.8
$50 to $99	232	110	13	61	72	17.4
$100 to $249	422	181	23	116	166	22.3
$250 to $499	848	337	47	180	355	25.1
$500 to $999	1,800	660	97	386	688	23.4
$1,000 to $2,499	4,334	1,436	204	859	1,456	21.3
$2,500 and over	13,372	3,201	460	2,216	4,539	23.6

The absence of income in the first group is due in part to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The persons in charge of such farms on June 1, 1900, could not always give definite information concerning the products of the preceding year. The same statement is true, also, of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete statement of farm income in 1899. Other farms with small reported incomes are doubtless summer resorts or the country residences of city merchants and professional men who derive their principal incomes from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with previous census reports.

The value of all live stock on farms, June 1, 1900, was $42,026,737. Of this amount, 36.5 per cent represents the value of horses; 24.2 per cent, that of neat cattle other than dairy cows; 15.8 per cent, that of dairy cows; 7.0 per cent, that of mules; 6.1 per cent, that of swine; 5.0 per cent, that of sheep; 4.5 per cent, that of poultry; and 0.9 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, the value of domestic animals not on farms would be $2,486,687, and the value of all live stock in the state, exclusive of poultry and bees not on farms, was approximately $44,513,424.

Table 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	162,053	$1,273,728	$7.86	4,556
Steers	1 and under 2.	91,579	1,541,054	16.83	810
Steers	2 and under 3.	87,026	2,349,944	27.00	448
Steers	3 and over	79,203	2,899,662	36.61	895
Bulls	1 and over	11,088	294,980	26.60	117
Heifers	1 and under 2.	71,952	1,029,057	14.30	956
Cows kept for milk	2 and over	281,876	6,641,677	23.56	20,029
Cows and heifers not kept for milk.	2 and over	40,735	808,745	19.85	580
Colts	Under 1	19,257	441,858	22.95	405
Horses	1 and under 2.	20,291	780,009	38.44	399
Horses	2 and over	258,974	14,104,537	54.46	27,290
Mule colts	Under 1	2,879	83,918	29.15	66
Mules	1 and under 2.	4,196	192,701	45.92	61
Mules	2 and over	40,399	2,665,146	65.97	2,975
Asses and burros	All ages	412	52,231	126.77	209
Lambs	Under 1	300,804	817,781	2.72	928
Sheep (ewes)	1 and over	353,549	1,135,069	3.21	1,436
Sheep (rams and wethers).	1 and over	38,576	136,929	3.55	321
Swine	All ages	946,443	2,572,524	2.72	52,829
Goats	All ages	5,305	10,002	1.89	1,010
Fowls:[1]					
Chickens[2]		4,590,311	1,886,768		
Turkeys		207,675			
Geese		125,495			
Ducks		117,989			
Bees (swarms of)		139,064	308,417	2.22	
Value of all live stock.			42,026,737		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the numbers of the most important domestic animals.

Table 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	281,876	543,636	298,522	47,886	392,125	946,443
1890	273,634	473,700	242,512	37,533	495,313	796,691
1880	243,061	443,123	218,838	33,598	497,289	956,451
1870	188,471	323,272	152,899	26,903	370,145	674,670
1860[2]	330,713	713,754	287,579	41,015	1,043,269	1,599,919
1850[2]	317,619	758,650	272,403	21,483	1,310,004	1,829,843

[1] Lambs not included.
[2] Including the territory now embraced in West Virginia.

Continuous gains are shown for horses and mules since 1870, but not until 1900 did they regain the numbers reported prior to the Civil War. Changes in the character of agricultural industries of the state since the war have caused less attention to be given the production of meat and wool, so that all neat cattle, sheep, and swine are reported in smaller numbers than in 1850. The numbers of dairy cows and other neat cattle have increased regularly but moderately since 1870. The number of sheep has decreased steadily since 1880, with a decline of 20.8 per cent in the last decade. Swine have fluctuated in number from decade to decade, the ten years succeeding 1890 showing an increase of 18.8 per cent. Other classes show increases in numbers for the last decade as follows: Dairy cows, 3.0 per cent; other neat cattle, 14.8 per cent; horses, 23.1 per cent; mules and asses, 27.6 per cent.

In 1900, the enumerators were instructed to report no fowls under three months old, a limitation not made in previous enumerations. This probably accounts, in part, for the following apparent decreases in the numbers of all classes of domestic fowls in the last decade: Ducks, 60.6 per cent; turkeys, 56.5 per cent; geese, 41.9 per cent; chickens, 30.2 per cent.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of animal products for 1899.

Table 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS, IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	2,020,735	$409,602
Mohair and goat hair	Pounds	343	113
Milk	Gallons	[1] 105,068,428	[2] 6,999,994
Butter	Pounds	19,905,830	
Cheese	Pounds	31,697	
Eggs	Dozens	25,550,460	2,836,899
Poultry			3,744,654
Honey	Pounds	1,708,320	195,886
Wax	Pounds	60,110	
Animals sold			7,800,124
Animals slaughtered			5,859,531
Total			27,846,803

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of all milk sold or consumed and of butter and cheese made.

The value of the animal products of 1899 was $27,846,803. Of this amount, 49.1 per cent represents the value of animals sold and animals slaughtered; 25.1 per cent, that of dairy produce; 23.6 per cent, that of poultry products; 1.5 per cent, that of wool, mohair, and goat hair; and 0.7 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms was $13,659,655, or 15.8 per cent of all farm products, and 18.6 per cent of the gross income. Of the farmers in the state reporting live stock, 138,538, or 88.5 per cent, report animals slaughtered, the average value per farm being $42.30. Sales were reported by 70,706 farmers, or 42.1 per cent of all in the state, the average receipts per farm being $110.32. In obtaining these reports the enumerators were instructed to secure from each farm operator a statement of the amount received from the sale of live animals in 1899, less the amount expended for animals purchased during the same year.

DAIRY PRODUCE.

In 1899, 126,784 farmers, or 75.5 per cent of all in the state, reported dairy products. Of the $6,999,994 given in Table 16 as the value of dairy products, $5,151,473, or 73.6 per cent, represents the value of dairy products consumed on farms, and $1,848,521, or 26.4 per cent, the amounts received from sales of such products. Of the latter amount, $944,496 was received from the sale of 6,889,183 gallons of milk, $869,314, from 5,238,202 pounds of butter; $32,323, from 59,838 gallons of cream; and $2,388, from 24,310 pounds of cheese.

The production of milk in 1899 was 26,924,969 gallons greater than in 1889, a gain of 34.5 per cent. The amount of butter made on farms increased 10.9 per cent, and that of cheese made on farms decreased 71.0 per cent in the same time.

POULTRY AND EGGS.

The value of poultry products in 1889 was $6,581,553, of which 56.9 per cent represents the value of poultry raised, and 43.1 per cent that of eggs produced. The number of eggs produced was 11,992,889 dozens greater in 1899 than in 1889, a gain of 88.5 per cent. Rockingham and Shenandoah counties were first in the production of eggs, each reporting more than a million dozens.

WOOL.

In 1899 more wool was reported than by any census since 1860. The gain since 1889 was 39.4 per cent. This increase is, however, more apparent than real, owing to the fact that the fleeces of 139,572 sheep were omitted from the table in 1890, but included in a general estimate of wool shorn after the census enumeration.

HONEY AND WAX.

The production of honey in 1899 was 11.6 per cent, and that of wax 36.3 per cent greater than in 1889. Pittsylvania, Bedford, and Franklin counties were first in apiarian products.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals for each group, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	123,347	298,522	2.4	126,792	281,876	2.2
White farmers	96,552	259,558	2.7	104,562	253,373	2.4
Colored farmers	26,795	38,964	1.5	22,230	28,503	1.3
Owners[1]	88,364	221,127	2.5	91,402	211,944	2.3
Managers	1,726	8,208	4.8	1,635	8,048	4.9
Cash tenants	11,142	21,982	2.0	9,846	19,400	2.0
Share tenants	22,115	47,205	2.1	23,909	42,484	1.8
Under 20 acres	15,634	20,616	1.3	16,452	20,263	1.2
20 to 99 acres	49,952	86,875	1.7	51,575	84,505	1.6
100 to 174 acres	27,605	69,334	2.5	28,325	65,963	2.3
175 to 259 acres	13,783	44,710	3.2	14,049	42,349	3.0
260 acres and over	16,373	76,987	4.7	16,391	68,796	4.2
Hay and grain	26,615	78,566	3.0	26,803	68,748	2.6
Vegetable	6,884	13,953	2.0	4,815	8,175	1.7
Fruit	1,305	3,276	2.5	1,277	2,558	2.0
Live stock	33,189	94,006	2.8	36,548	97,348	2.7
Dairy	1,400	6,935	5.0	1,624	15,093	9.3
Tobacco	14,161	27,638	2.0	13,300	18,322	1.4
Cotton	578	869	1.5	559	772	1.4
Miscellaneous[2]	39,215	73,279	1.9	41,866	70,860	1.7

[1] Including "part owners" and "owners and tenants."
[2] Including sugar farms, florists' establishments, and nurseries.

CROPS.

The following table gives the statistics of the principal crops grown in 1899:

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	1,910,085	Bushels	36,748,410	$16,233,756
Wheat	927,266	Bushels	8,907,510	6,161,000
Oats	275,394	Bushels	3,269,430	1,103,616
Barley	2,768	Bushels	53,346	25,007
Rye	31,534	Bushels	246,834	124,1[illegible]5
Buckwheat	19,251	Bushels	244,321	111,731
Broom corn	1,762	Pounds	663,390	34,558
Rice	25	Pounds	4,374	94
Kafir corn	9	Bushels	170	80
Flaxseed	10	Bushels	50	52
Clover seed		Bushels	4,144	19,503
Grass seed		Bushels	20,960	21,097
Hay and forage	612,962	Tons	943,079	7,670,082
Cottonseed		Tons	[1]3,390	34,948
Cotton	25,724	Bales	10,789	346,600
Tobacco	184,334	Pounds	122,884,900	7,210,195
Hops	(2)	Pounds	165	17
Peanuts	116,914	Bushels	3,713,347	2,261,148
Dry beans	6,411	Bushels	56,189	66,066
Dry pease	22,206	Bushels	219,142	218,477
Potatoes	51,021	Bushels	4,409,672	2,494,627
Sweet potatoes	40,681	Bushels	4,470,602	1,720,188
Onions	1,717	Bushels	205,869	143,299
Miscellaneous vegetables	97,285			4,725,160
Maple sugar		Pounds	19,310	1,816
Maple sirup		Gallons	1,677	1,534
Sorghum cane	8,039	Tons	[3]2,320	6,012
Sorghum sirup		Gallons	555,321	190,903
Small fruits	8,796			765,097
Grapes	[4]1,663	Centals	36,089	[5]87,737
Orchard fruits	[4]206,362			[6]2,662,483
Tropical fruits				158
Nuts				5,109
Forest products				3,797,116
Flowers and plants	143			238,712
Seeds	22			3,384
Nursery products	1,200			214,988
Miscellaneous				1,197
Total	4,553,584			58,701,742

[1] Exclusive of 1,779 tons, valued at $18,344, sold in seed cotton and included with the cotton.
[2] Less than 1 acre.
[3] Sold as cane.
[4] Estimated from number of vines or trees.
[5] Including value of raisins, wine, etc.
[6] Including value of cider, vinegar, etc.

Of the total value of crops, cereals contributed 40.5 per cent; hay and forage, 13.1 per cent; tobacco, 12.3 per cent; miscellaneous vegetables, 8.0 per cent; forest products, 6.5 per cent; orchard fruits, 4.5 per cent; potatoes, 4.2 per cent; peanuts, 3.9 per cent; sweet potatoes, 2.9 per cent; small fruits, 1.3 per cent; and all other products, 2.8 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $1,669; nursery products, $179; small fruits, $87; potatoes, $49; sweet potatoes, $42; tobacco, $39; sorghum cane and sorghum sirup, $24; broom corn, $20; peanuts, $19; cotton and cottonseed, $15; orchard fruits, $13; hay and forage, $13; dry beans, $10; dry pease, $10; and cereals, $8.

The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production required a relatively great amount of labor and large expenditures for fertilizers.

CEREALS.

The following table is an exhibit of the changes in cereal production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	2,768	19,251	1,910,085	275,394	31,534	927,266
1889	2,051	5,170	1,600,690	495,508	52,063	737,510
1879	859	16,463	1,768,127	563,443	48,746	901,177

PART 2.—BUSHELS PRODUCED.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	53,340	244,321	36,748,410	3,269,430	246,834	8,907,510
1889	40,982	41,199	27,172,493	5,695,100	397,394	7,904,092
1879	14,223	136,004	29,119,761	5,333,181	324,431	7,826,174
1869	7,259	45,075	17,649,304	6,857,555	582,264	7,398,787
1859[2]	68,846	478,090	38,319,999	10,186,720	944,330	13,130,977
1849[2]	25,437	214,898	35,254,319	10,179,144	458,930	11,212,616

[1] No statistics of acreage were secured prior to 1879.
[2] Including the territory now embraced in West Virginia.

Of the total land surface of the state, 12.3 per cent was devoted to cereals in 1899. The total area in cereals was 2,892,992 acres in 1889, and 3,166,298 acres in 1899, an increase of 9.4 per cent. During the last ten years the area in corn has increased 19.3 per cent; wheat, 25.7 per cent; buckwheat, 272.4 per cent; and barley, 35.0 per cent; while that in oats decreased 44.4 per cent, and that in rye, 39.4 per cent.

In 1899, 60.3 per cent of the total acreage in cereals was devoted to corn; 29.3 per cent, to wheat; 8.7 per cent, to oats; 1.0 per cent, to rye; and 0.7 per cent, to buckwheat, barley, rice, and Kafir corn. Corn is the most important, being reported by 156,703 farmers, or 93.3 per cent of the total number in the state. Pittsylvania, Fauquier, Loudoun, Halifax, Caroline, and Accomac counties, in the eastern part, report nearly one-seventh of the total acreage in corn. Augusta and Rockingham, in the north, contain more than one-eighth of the wheat acreage and three-fifths of the barley acreage, while the southern counties of Bedford, Franklin, Halifax, and Pittsylvania report one-fifth of the acreage devoted to oats. Frederick and Carroll counties lead in the production of rye, and Carroll, Floyd, Grayson, and Smith counties, in the production of buckwheat.

HAY AND FORAGE.

In 1900, 115,910 farmers, or 69.0 per cent of the total number, reported hay and forage crops, from which, exclusive of cornstalks and corn strippings, they obtained an average yield of 1.0 tons per acre. The total area in hay and forage in 1899 was 612,962 acres, or 1.3 per cent greater than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 2,696 acres and 2,922 tons; millet and Hungarian grasses, 13,315 acres and 15,294 tons; alfalfa or lucern, 349 acres and 521 tons; clover, 104,124 acres and 105,640 tons; other tame and cultivated grasses, 442,070 acres and 437,436 tons; grains cut green for hay, 40,531 acres and 44,329 tons; crops grown for forage, 9,877 acres and 21,837 tons; and cornstalks and corn strippings, 623,174 acres and 315,100 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is included under "corn," as the forage secured was an incidental product of the corn crop.

TOBACCO.

According to the census of 1850, 56,803,227 pounds of tobacco were produced in Virginia in 1849. In all subsequent decades the crop has undergone great fluctuations. The census of 1860 showed a gain over that of 1850 of 67,165,085 pounds, or 118.2 per cent, but the next census showed a decline of 86,881,948 pounds, or 70.1 per cent. Between 1870 and 1880 there was a gain of 42,902,504 pounds, or 115.7 per cent, while the decade between 1880 and 1890 was marked by another decline, the loss being 31,466,213 pounds, or 39.3 per cent.

The present census shows that in 1899 tobacco was grown in Virginia by 44,872 farmers, who obtained from 184,334 acres a yield of 122,884,900 pounds. This was a gain of 73,755 acres, or 66.7 per cent, over the crop area of 1889, and an increase in production of 74,362,245 pounds, or 153.3 per cent, in the last ten years. The total value of the crop was $7,210,195, an average of $160.68 for each farm reporting. The average yield per acre in 1899 was 667 pounds, against 439 pounds in 1889, and 568 pounds in 1879. The average area for each farm on which tobacco was grown was 4.1 acres.

The tobacco crop of 1899 was distributed over 88 counties of the state, the leading county being Pittsylvania, with an area of 29,806 acres. The next in rank was Halifax, and the third Mecklenburg. These three counties together contributed 34.7 per cent of the total acreage and 30.5 per cent of the total production. The counties next in order were Bedford, Charlotte, Campbell, Henry, Amherst, Warren, Prince Edward, Lunenburg, Franklin, and Appomattox. These 13 counties together furnished 72.4 per cent of the acreage and 70.3 per cent of the entire production of the state.

COTTON.

The following table is a statement of the changes in cotton production since 1859.

Table 20.—ACREAGE AND PRODUCTION OF COTTON: 1859 TO 1899.

YEAR.[1]	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	25,724	[1]34.4	10,789	5,166,630	101.5
1889	39,213	[1]12.9	5,375	2,563,875	[2]71.1
1879	45,040		19,595	8,876,535	11,076.4
1869[3]				79,422	[2]98.6
1859[3]				5,663,515	

[1] No statistics of acreage were secured prior to 1880.
[2] Decrease.
[3] Including the territory now embraced in West Virginia.

In 1879, Virginia produced the largest crop of cotton reported for that state by any census. The decrease shown for 1869 was the direct result of the effects of the Civil War. The decade ending in 1889 witnessed another decrease in the production of cotton amounting to 71.1 per cent.

In 1899, 4,761 farmers devoted an area of 25,724 acres, or 0.3 per cent of the total improved farm land of the state to cotton, an average of 5.4 acres per farm. From this land was produced 5,166,630 pounds of cotton, an average of 201 pounds per acre. The total value of this crop, including the value of the cotton seed, was $381,548, an average of $80.14 per farm and $14.83 per acre. This value constituted 0.5 per cent of the gross farm income.

Of the 118 counties in the state, only 24 report cotton. Those devoting the greatest area to this crop were Brunswick, Greenesville, Southampton, Mecklenburg, and Sussex, ranking in the order named and reporting 91.1 per cent of the total acreage. They are located in the south central and southeastern parts of the state.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table:

Table 21.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	8,190,025	4,253,364	9,835,982	8,391,425
Apricots	2,950	1,793	678	1,024
Cherries	269,690	132,631	188,693	100,217
Peaches	1,939,113	1,218,219	357,339	1,052,000
Pears	291,288	122,917	88,400	51,553
Plums and prunes	118,193	16,022	21,167	2,886

The total number of fruit trees in 1890 was 5,744,946, while in 1900 there were 10,828,777, showing an increase of 5,083,831, or 88.5 per cent. The rates of increase for the several varieties are as follows: Plums and prunes, more than sixfold; pears, 136.9 per cent; cherries, 103.3 per cent; apples, 92.6 per cent; apricots, 64.5 per cent; and peaches, 59.2 per cent.

Of the total number of trees reported in 1900, 75.6 per cent were apple trees; 17.9 per cent, peach trees; 2.7 per cent, pear trees; 2.5 per cent, cherry trees; and 1.3 per cent, apricot, plum and prune, and unclassified trees, the last class, which is not included in the table, numbering 17,518 trees, and yielding 5,142 bushels of fruit.

The value of orchard products, given in Table 18, includes the value of 43,995 barrels of cider, 16,414 barrels of vinegar, and 2,302,480 pounds of dried and evaporated fruits.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 by the 11,147 farmers reporting them was 8,796 acres, an average of 0.8 acres per farm. Of the total, 7,821 acres, or 88.9 per cent, were devoted to strawberries, which yielded 12,270,300 quarts. Of this fruit, 72.4 per cent of the acreage and 73.1 per cent of the yield were reported by Norfolk, Princess Anne, and Accomac, three extreme eastern counties bordering on Chesapeake Bay. The acreages and productions of the other berries were as follows: Blackberries and dewberries, 444 acres and 532,830 quarts; raspberries and Logan berries, 365 acres and 424,110 quarts; gooseberries, 66 acres and 75,140 quarts; currants, 39 acres and 42,060 quarts; and other small fruits, 61 acres and 79,480 quarts.

VEGETABLES.

The total value of vegetables grown in 1899, including potatoes, sweet potatoes, and onions, was $9,083,274, of which 27.5 per cent represents the value of potatoes; 18.9 per cent, that of sweet potatoes; 1.6 per cent, that of onions, and 52.0 per cent, that of miscellaneous vegetables.

Potatoes were grown in 1899 by 83,780 farmers, or 49.9 per cent of the total number in the state. The area devoted to this crop in 1889 was 36,412 acres, and that in 1899, 51,021 acres, a gain of 40.1 per cent.

In the growing of miscellaneous vegetables, 97,285 acres were used. Of this area, the products of 55,561 acres were not reported in detail. Of the remaining 41,724 acres, 10,105 acres were devoted to cabbages; 9,815 acres, to tomatoes; 9,297 acres, to watermelons; 3,028 acres, to muskmelons; 2,015 acres, to sweet corn; 1,861 acres, to spinach; 1,603 acres, to cucumbers; 1,222 acres, to beans; 1,131 acres, to pease; and 1,647 acres, to other vegetables.

PEANUTS.

Peanuts were grown in 1899 by 11,572 farmers, or 6.9 per cent of the total number in the state. The area devoted to their cultivation was 116,914 acres, and the product secured therefrom 3,713,347 bushels. Increases of 98.3 per cent in acreage and 216.9 per cent in production are shown for the last decade. The average yield per acre was 19.9 bushels in 1889 and 31.8 in 1899.

The leading counties are Southampton, Nansemond, Isle of Wight, Sussex, and Prince George, ranking in the order named, and reporting, in the aggregate, 76.3 per cent of the total acreage.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was grown by 19,304 farmers on 8,039 acres, an average of 0.4 acres for each farm reporting. From this area they sold 2,320 tons of cane for $6,012, and from the remaining product manufactured 555,321 gallons of sirup, valued at $190,903. This was a decrease in acreage from that of 1889 of 16.1 per cent. The total value of sorghum-cane products of 1899 was $196,915, an average of $10.20 for each farm reporting, and of $24.50 per acre.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 143 acres, and the value of the products sold therefrom was $238,712. These flowers and plants were grown by 134 farmers and florists, of whom 56 made commercial floriculture their principal business. These 56 proprietors had invested in land, buildings, implements, and live stock $427,913, of which $256,375 represents the value of buildings. Their sales of flowers and plants amounted to $191,845, and they obtained other products valued at $5,145. They expended for labor $44,350, and for fertilizers $4,295. The average annual income for each farm reporting, including products fed to live stock, was $3,521.

In addition to the 56 principal florists' establishments, 3,028 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 2,887,643 square feet, making, with the 596,617 square feet belonging to the florists' establishments, a total of 3,484,260 square feet of land under glass.

NURSERIES.

The total value of the nursery products sold in 1899 was $214,988, reported by the operators of 89 farms. Of this number 45 derived their principal income from the nursery business. They had 5,138 acres of land, valued at $338,790; buildings worth $90,175; implements and machinery worth $9,480; and live stock worth $9,875. The value of their products in 1899, exclusive of products fed to live stock, was $188,116, of which $178,016 represents the value of nursery products and $10,100 that of other products. The expenditure for labor was $41,155, and for fertilizers, $4,609. The average income for each farm reporting, including the value of products fed to live stock, was $4,281.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $7,790,720, an average of $46 per farm. The average expenditure was $915 for nurseries, $792 for florists' establishments, $134 for dairy farms, $112 for vegetable farms, $78 for fruit farms, $53 for hay and grain farms, $44 for live-stock farms, and $43 for tobacco farms. "Managers" expended on an average $275; "owners," $48; "cash tenants," $43; and "share tenants," $29. White farmers expended $60 per farm and colored farmers, $10.

Fertilizers purchased in 1899 cost $3,681,790, an average of $22 per farm and an increase since 1890 of 58.7 per cent. The average expenditure was $102 for nurseries, $90 for vegetable farms, $77 for florists' establishments, $34 for tobacco farms, $31 for dairy farms, $30 for fruit farms, $21 for hay and grain farms, and $14 for live-stock farms.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 224. WASHINGTON, D. C. July 3, 1902.

AGRICULTURE.

MISSOURI.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

Sir: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Missouri, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It also includes the house in which the farmer resides and all other buildings used by him in connection with his farming operations.

The farms of Missouri, June 1, 1900, numbered 284,886 and were valued at \$843,979,213, of which amount \$148,508,490, or 17.6 per cent, represents the value of buildings, and \$695,470,723, or 82.4 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was \$28,602,680, and of live stock, \$160,540,004. These values added to that of farms give \$1,033,121,897, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was \$219,296,970, of which amount \$97,841,944, or 44.6 per cent, represents the value of animal products, and \$121,455,026, or 55.4 per cent, the value of crops including forest products cut or produced on farms. The total value of farm products for 1899 exceeds that for 1889 by \$109,545,946, an increase of 99.8 per cent, but a part of this gain is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was \$57,952,360, leaving \$161,344,610 as the gross farm income. The ratio which this latter amount bears to the "total value of farm property" is referred to as the "percentage of gross income upon investment." For Missouri, in 1899, it was 15.6 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Missouri.

Very respectfully,

L. G. Powers.
Chief Statistician for Agriculture.

AGRICULTURE IN MISSOURI.

GENERAL STATISTICS.

Missouri has a total land area of 68,735 square miles, or 43,990,400 acres, of which 33,997,873 acres, or 77.3 per cent, are included in farms.

The surface of Missouri is divided into two unequal portions by the Missouri River, which takes a zigzag course from west to east across the state. That part lying south of the river includes about two-thirds the area of the state and is of a varied nature. Its eastern portion is low and swampy and subject to frequent overflows by the Mississippi River and its tributaries. Above the swamps are limestone bluffs which extend westward, but are less precipitous as they approach the Osage River. In the south and west are the Ozark Mountains, rendering this region broken and hilly, the isolated peaks varying in height from 500 to 1,000 feet, and inclosing many fertile valleys. The northern part of the state is generally rolling prairie.

The immediate valley of the Missouri has a rich alluvial soil of great fertility, while other portions have soils, which are very productive, practically without fertilization.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades, since 1850, the number of farms, the total and average acreage, and the per cent of farm land improved:

Table 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	284,886	33,997,873	22,900,043	11,097,830	119.3	67.4
1890	238,043	30,780,290	19,792,313	10,987,977	129.3	64.3
1880	215,575	27,879,276	16,745,031	11,134,245	129.3	60.1
1870	148,328	21,707,220	9,130,615	12,576,605	146.3	42.1
1860	92,792	19,984,810	6,246,871	13,737,939	215.4	31.3
1850	54,458	9,732,670	2,938,425	6,794,245	178.7	30.2

The number of farms reported, June 1, 1900, was more than five times as great as that reported in 1850, and 19.7 per cent greater than in 1890. The total acreage of farm land, also, has rapidly increased, the gain for the last decade being 10.5 per cent. Since 1860 the number of farms has gained faster than the total acreage, involving a decrease in the average size of farms and indicating a progressive division of farm holdings. A steady increase is shown in the acreage and per cent of improved land.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

Table 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$1,033,121,897	$843,979,213	$28,602,680	$160,540,004	$219,296,970
1890	786,390,253	625,858,361	21,830,719	138,701,173	109,751,024
1880	489,521,663	375,633,307	18,103,074	95,785,282	95,912,660
1870[2]	492,789,746	392,908,047	15,596,426	84,285,273	[3]103,035,759
1860	293,037,307	230,632,126	8,711,508	53,693,673	....
1850	87,094,648	63,225,543	3,981,525	19,887,580	....

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

Since 1850 the total value of farm property has increased $946,027,249, and in the last decade $246,731,644, or 31.4 per cent. For the same decade the gain in the value of land, improvements, and buildings was $218,120,852, or 34.9 per cent; in that of implements and machinery, $6,771,961, or 31.0 per cent; and in that of live stock, $21,838,831, or 15.7 per cent. The value of the farm products of 1899 was nearly twice that of 1889. A portion of this increase, and of that shown for implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous census years.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH GROSS INCOME (PRODUCTS OF 1899 NOT FED TO LIVE STOCK), AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Gross income (products of 1899 not fed to live stock).	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	284,886	275,634	33,997,873	22,900,043	$695,470,723	$148,508,490	$28,602,680	$160,540,004	$161,344,610	$9,803,610	$370,630
Adair	2,696	2,616	319,132	240,892	6,275,060	1,167,360	240,580	1,685,966	1,299,620	43,810	1,100
Andrew	2,562	2,505	267,752	222,664	10,056,550	2,164,460	359,580	2,443,977	2,176,975	115,230	560
Atchison	2,149	2,035	336,591	302,117	14,095,800	1,928,510	397,920	3,435,939	3,047,080	303,660	8,500
Audrain	2,770	2,713	415,248	372,861	9,300,370	2,148,840	316,970	2,330,374	1,818,251	104,410	920
Barry	3,709	3,607	339,337	202,178	3,905,280	872,400	241,140	970,054	1,287,112	69,880	940
Barton	2,590	2,484	347,553	311,024	6,956,760	1,191,860	278,610	1,586,996	1,370,958	46,520	680
Bates	4,070	3,861	513,842	444,528	11,413,780	2,111,630	435,910	2,753,030	2,526,970	129,070	3,140
Benton	2,575	2,533	367,747	190,928	3,835,910	1,034,520	209,370	1,289,251	1,045,950	39,760	1,160
Bollinger	2,298	2,259	274,282	129,470	1,693,050	541,540	164,570	667,639	753,025	23,700	10,500
Boone	3,540	3,425	408,336	301,732	8,226,060	2,045,760	314,560	2,260,535	2,060,652	130,780	1,070
Buchanan	2,584	2,459	233,372	177,312	11,345,780	1,876,930	330,290	1,754,086	2,006,522	146,510	4,210
Butler	1,577	1,546	154,127	55,664	1,009,030	289,010	80,610	407,591	471,128	30,760	760
Caldwell	2,329	2,205	276,827	246,077	8,459,630	1,736,740	269,660	2,115,736	1,893,398	90,870	1,260
Callaway	3,585	3,501	483,905	340,989	7,069,828	1,899,730	305,840	2,278,811	2,117,039	109,920	3,630
Camden	2,069	2,006	284,292	82,857	1,525,800	354,270	94,660	625,402	619,447	23,110	20
Cape Girardeau	2,576	2,514	348,957	211,544	6,124,490	1,664,590	383,110	999,291	1,409,527	92,670	6,720
Carroll	3,692	3,531	419,245	371,073	12,130,480	2,154,640	422,030	2,486,775	2,519,153	144,000	3,950
Carter	554	526	64,084	22,873	388,730	100,300	29,440	187,036	198,508	9,250	530
Cass	3,225	3,096	411,754	363,474	11,172,190	2,271,300	391,580	2 441,262	2,488,520	129,770	3,300
Cedar	2,765	2,727	279,184	185,840	3,724,830	819,630	202,540	1,055,549	1,011,639	43,750	1,110
Chariton	3,805	3,690	450,367	350,567	11,016,820	2,251,700	435,380	2,541,637	2,257,662	103,730	3,420
Christian	2,648	2,570	258,208	149,140	3,060,550	710,550	189,090	782,577	994,448	49,260	1,360
Clark	2,514	2,381	307,491	224,651	7,318,290	1,424,830	281,580	1,555,014	1,405,111	83,180	1,950
Clay	2,203	2,115	235,734	197,550	8,494,180	1,662,880	229,430	2,085,593	1,788,656	116,100	2,960
Clinton	2,024	1,940	273,704	251,250	8,120,050	1,738,600	283,000	2,707,170	2,009,790	164,860	1,170
Cole	1,700	1,655	224,754	119,476	3,420,970	1,042,110	240,290	671,483	962,301	41,100	2,070
Cooper	2,664	2,620	338,441	264,760	9,174,080	2,048,820	374,670	1,903,745	2,054,969	146,270	3,600
Crawford	1,914	1,884	266,243	100,045	2,591,610	524,670	122,410	592,201	600,611	33,320	1,380
Dade	2,732	2,649	294,434	207,587	4,676,280	814,410	212,640	1,181,211	1,218,612	39,510	6,530
Dallas	2,397	2,335	257,765	125,231	1,816,980	522,270	119,220	680,318	618,175	25,170	1,110
Daviess	3,308	3,134	353,670	279,050	9,950,520	2,013,640	367,180	2,525,595	2,126,973	98,070	1,700
Dekalb	2,377	2,298	261,394	222,284	8,339,060	1,665,180	250,150	2,075,752	1,750,893	72,630	1,750
Dent	1,748	1,735	274,747	101,513	1,585,830	376,290	111,990	545,391	616,232	33,770	1,110
Douglas	2,738	2,714	348,101	126,885	1,614,540	423,900	103,130	552,530	587,468	18,840	620
Dunklin	2,542	2,427	143,640	101,173	2,193,520	596,120	133,150.	681,774	1,593,546	73,100	960
Franklin	3,853	3,795	466,598	263,711	8,216,490	2,640,780	511,440	1,447,273	2,245,167	262,150	2,350
Gasconade	1,799	1,764	294,972	109,491	2,913,040	1,150,670	272,800	680,502	848,630	76,500	470
Gentry	2,699	2,608	300,589	227,449	8,412,970	1,519,770	320,790	2,362,186	1,987,074	73,790	3,180
Greene	4,320	4,120	369,021	278,721	8,143,910	1,913,190	396,960	1,537,252	2,124,590	132,440	7,680
Grundy	2,298	2,206	272,601	197,384	6,928,710	1,276,390	232,420	1,751,710	1,493,275	76,660	1,700
Harrison	3,836	3,705	448,941	328,598	10,878,440	1,951,620	436,690	3,145,983	2,267,862	67,110	4,630
Henry	3,447	3,325	437,720	370,976	9,309,020	1,854,500	344,330	2,008,658	2,005,257	132,820	4,200
Hickory	1,768	1,700	217,947	101,897	2,053,710	442,620	99,370	629,039	545,875	16,510	360
Holt	2,256	2,175	265,920	224,996	9,918,610	1,646,710	330,660	2,047,982	1,955,506	117,260	150
Howard	2,037	1,981	285,521	213,894	6,523,120	1,779,880	285,530	1,594,836	1,658,606	164,080	1,640
Howell	3,065	3,030	417,170	153,701	3,821,160	910,850	201,360	729,028	904,782	98,600	1,550
Iron	880	843	102,284	41,784	716,060	272,220	47,770	307,276	302,724	12,270	730
Jackson	3,681	3,546	358,904	284,122	20,806,360	4,623,760	419,150	2,818,278	3,532,744	279,510	5,230
Jasper	3,054	2,892	342,191	270,236	9,581,900	1,609,800	354,570	1,396,978	1,968,272	154,270	21,620
Jefferson	2,596	2,576	344,176	156,055	4,945,650	1,804,810	298,540	963,181	1,434,679	109,430	4,800
Johnson	3,869	3,701	488,131	411,544	10,431,130	2,158,150	415,610	2,367,798	2,294,902	133,190	2,180
Knox	2,133	2,037	309,244	252,685	6,767,650	1,423,880	302,710	1,868,980	1,449,634	60,370	1,500
Laclede	2,614	2,563	289,936	131,942	2,228,160	600,130	139,320	737,944	812,225	31,280	1,070
Lafayette	3,043	2,975	367,526	326,718	13,597,200	2,953,000	480,490	2,589,762	2,694,706	235,430	2,650
Lawrence	3,414	3,271	352,120	264,343	7,262,110	1,392,030	323,580	1,228,361	1,699,616	84,190	8,060
Lewis	2,277	2,181	309,821	235,437	6,779,670	1,463,220	235,270	1,511,894	1,248,094	57,090	1,200
Lincoln	2,763	2,692	256,643	252,984	5,936,250	1,476,550	289,750	1,438,071	1,605,242	73,640	11,870
Linn	2,925	2,754	393,454	304,720	9,297,810	1,922,730	338,510	2,534,203	1,939,038	97,600	4,890
Livingston	2,752	2,613	321,068	246,638	9,544,440	1,702,390	310,600	1,898,748	1,708,486	91,020	960
McDonald	2,066	1,958	186,532	87,712	1,770,370	430,340	128,210	597,275	726,173	31,200	1,850
Macon	4,233	4,095	486,180	364,444	8,990,560	2,132,340	400,110	2,471,227	1,944,626	76,310	2,750
Madison	1,163	1,150	147,711	67,225	1,152,110	345,810	101,650	385,448	499,195	19,140	6,860
Maries	1,619	1,609	248,466	92,440	1,527,450	364,810	94,790	481,426	515,647	23,850	110
Marion	2,022	1,929	267,621	199,145	6,175,720	1,550,300	238,520	1,322,291	1,462,121	93,160	1,810
Mercer	2,507	2,413	291,917	235,774	5,597,270	1,140,510	260,580	1,997,038	1,627,199	59,230	970
Miller	2,251	2,196	277,554	116,683	2,230,390	579,360	133,180	690,522	710,086	32,290	290
Mississippi	1,150	1,100	139,891	97,453	5,271,210	382,950	137,490	582,147	721,868	94,200	1,100
Moniteau	2,144	2,069	255,533	183,348	5,058,945	1,233,500	271,300	1,108,168	1,219,889	52,280	1,140
Monroe	3,217	3,049	405,467	331,911	8,523,970	1,951,430	316,730	2,514,088	2,050,964	64,910	2,810
Montgomery	2,264	2,196	302,932	207,008	5,134,040	1,302,120	229,800	1,296,986	1,186,844	67,280	3,120
Morgan	2,013	1,929	267,457	139,649	3,104,410	951,010	180,020	1,028,980	927,731	31,180	770
New Madrid	1,063	1,026	121,805	90,635	2,517,610	348,920	103,330	544,269	692,659	72,960	4,270
Newton	3,043	2,967	280,406	193,560	5,365,300	893,720	275,940	861,467	1,329,324	79,140	6,560
Nodaway	4,490	4,323	556,122	486,462	20,792,940	3,573,190	718,640	5,037,408	4,467,336	228,160	2,540
Oregon	1,880	1,838	224,877	86,426	1,491,630	392,220	105,260	473,671	575,298	32,810	110
Osage	2,022	1,922	341,103	137,186	3,550,380	1,033,350	247,000	728,888	946,236	119,180	690
Ozark	2,029	1,954	275,293	79,085	886,470	264,040	68,310	490,878	431,341	13,180	200
Pemiscot	1,201	1,102	85,844	47,361	1,185,130	228,290	63,320	446,610	570,329	38,920	100
Perry	1,936	1,916	259,259	139,945	4,022,610	952,450	252,230	651,690	1,074,430	61,670	1,900
Pettis	2,935	2,824	408,515	344,869	10,256,860	2,170,850	316,640	2,127,882	2,237,849	143,480	4,790

TABLE 3.—NUMBER AND ACREAGE OF FARMS AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH GROSS INCOME (PRODUCTS OF 1899 NOT FED TO LIVE STOCK), AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Gross income (products of 1899 not fed to live stock).	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Phelps	2,013	1,963	254,286	106,241	$2,016,140	$497,000	$124,170	$573,686	$627,215	$21,990	$660
Pike	2,873	2,807	397,274	294,947	8,091,890	2,017,650	311,980	1,891,047	1,945,630	139,830	2,420
Platte	2,042	1,963	261,435	182,567	9,019,870	1,711,430	326,960	1,710,380	1,845,315	137,040	2,520
Polk	3,673	3,589	360,871	234,426	4,766,860	1,128,020	254,460	1,350,729	1,266,691	30,590	1,830
Pulaski	1,512	1,447	195,117	75,660	1,338,670	324,530	82,910	480,687	505,131	23,030	380
Putnam	2,596	2,492	326,747	246,194	6,362,010	1,084,460	245,880	1,905,026	1,257,031	59,240	2,510
Ralls	1,996	1,914	287,995	230,819	5,856,220	1,283,170	229,550	1,461,202	1,347,589	82,290	2,290
Randolph	2,460	2,382	287,491	224,515	6,072,770	1,619,090	263,150	1,633,529	1,222,136	67,610	1,790
Ray	3,321	3,172	340,866	288,627	10,299,790	1,833,320	381,720	2,521,971	2,375,463	119,170	3,500
Reynolds	1,165	1,145	120,374	50,271	689,950	231,830	64,870	460,219	388,645	13,830	350
Ripley	1,740	1,686	159,723	63,496	725,380	234,530	72,790	372,258	404,126	12,850	570
St. Charles	2,297	2,228	300,171	220,491	8,308,590	1,967,310	371,310	1,107,798	1,800,226	214,750	8,540
St. Clair	2,851	2,770	347,511	219,404	4,495,640	1,020,840	230,710	1,278,211	1,206,036	55,060	4,790
Ste. Genevieve	1,364	1,329	230,494	94,600	2,138,160	722,070	143,860	469,070	682,213	30,410	4,600
St. Francois	1,277	1,259	207,685	97,765	2,857,400	754,100	138,020	571,629	691,825	60,990	11,610
St. Louis	3,908	3,840	253,065	197,558	25,449,140	4,783,890	701,360	1,163,438	3,173,535	421,130	30,550
St. Louis city	826	805	11,561	9,305	6,405,260	1,294,420	164,430	363,681	1,622,169	209,860	15,660
Saline	3,638	3,521	438,976	384,236	15,403,040	2,845,060	452,350	3,140,827	3,023,368	266,230	14,050
Schuyler	1,654	1,595	198,530	162,867	4,222,590	867,350	191,240	1,208,585	913,861	25,170	590
Scotland	2,118	2,077	277,789	222,498	6,813,910	1,332,250	260,240	1,711,759	1,293,079	37,540	1,290
Scott	1,341	1,293	181,897	125,094	3,847,200	633,450	221,730	630,434	942,152	102,650	2,820
Shannon	1,311	1,293	158,024	50,665	899,890	245,960	62,140	343,645	357,140	24,400	670
Shelby	2,475	2,385	307,514	245,638	6,366,540	1,552,220	296,220	1,872,036	1,533,439	55,240	2,770
Stoddard	2,873	2,761	227,417	142,759	2,742,440	617,880	151,230	859,963	1,140,155	65,830	1,590
Stone	1,627	1,584	170,582	73,127	1,399,360	316,090	103,840	547,825	584,760	21,990	290
Sullivan	3,101	3,002	402,871	323,868	8,458,950	1,562,570	278,980	2,731,171	1,777,578	79,270	1,040
Taney	1,671	1,633	241,408	66,988	1,138,060	299,550	67,610	535,245	458,650	13,060	20
Texas	3,729	3,639	505,288	185,681	2,528,410	774,000	168,290	798,888	851,414	42,100	3,330
Vernon	3,988	3,855	484,744	408,694	9,304,010	1,992,160	377,560	2,098,994	2,056,509	123,530	3,030
Warren	1,358	1,342	217,684	116,770	3,324,140	1,062,660	227,560	681,068	831,036	70,250	2,020
Washington	1,724	1,705	213,130	93,743	2,124,920	607,510	140,560	608,752	677,756	39,230	11,470
Wayne	1,733	1,681	197,413	83,022	1,277,910	420,890	97,710	596,343	633,100	27,970	530
Webster	2,500	2,452	263,286	143,960	2,696,760	718,000	152,320	741,523	823,329	32,920	3,240
Worth	1,549	1,462	164,829	119,169	4,287,820	703,420	164,540	1,235,657	1,069,430	40,130	80
Wright	2,726	2,649	326,582	139,272	2,039,400	549,160	126,880	591,160	665,326	38,350	2,070

All counties report increases in the number of farms in the last decade. Only five counties, Dunklin, Iron, Lincoln, Madison, and Washington, report decreases in farm area. It is probable that the decrease in improved acreage reported by a few counties is due to the use of a more strict definition of the term "improved" by the Twelfth than by any preceding census. The smallest farms are in the cotton counties, and in those where there are numerous vegetable farms and florists' establishments, and the largest, where cereals and live-stock raising are the chief agricultural pursuits. The average size of farms for the state is 119.3 acres, and varies from 14.0 acres in St. Louis city to 169.0 acres in Ste. Genevieve county.

Except Cole and Dallas counties, all report an increased total value of farms in the last ten years. The average value of farms for the state is $2,963. Most counties show increases in the value of implements and machinery, the average per farm being $100. The value of live stock increased in nearly all counties, only eight reporting a smaller value in 1900 than in 1890.

FARM TENURE.

Table 4 gives a comparative exhibit of farm tenure for 1880, 1890, and 1900. The farms operated by tenants are divided into groups designated as farms operated by "cash tenants," who pay a cash rental or a stated amount of labor or farm produce, and farms operated by "share tenants," who pay as rental a share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer. "Farms operated by owners" are subdivided into four groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	284,886	197,989	31,230	55,667	69.5	11.0	19.5
1890	238,043	174,285	23,525	40,233	73.2	9.9	16.9
1880	215,575	156,703	19,843	39,029	72.7	9.2	18.1

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State.	284,886	159,223	31,747	5,188	1,831	31,230	55,667
White	279,933	157,322	31,040	5,136	1,794	30,399	54,242
Colored[1]	4,953	1,901	707	52	37	831	1,425

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State.	100 0	55.9	11.2	1.8	0.6	11.0	19.5
White	100.0	56.2	11.1	1.8	0.6	10.9	19.4
Colored[1]	100.0	38.4	14.3	1.0	0.7	16.8	28.8

[1] Comprising 3 Indians and 4,950 negroes.

Between 1890 and 1900 the number of farms operated by owners increased 23,704, or 13.6 per cent; cash tenant farms increased 7,705, or 32.8 per cent; and share tenant farms, 15,434, or 38.4 per cent. In 1890, 63.1 per cent of all tenants were share tenants, and in 1900, 64.1 per cent.

Of the farmers of the state, 98.3 per cent are white and 1.7 per cent, colored. Of the white farmers, 69.1 per cent own all or a part of the farms they operate; 30.9 per cent operate farms owned by others. For colored farmers the corresponding percentages are 53.7 and 46.3.

The number of cash tenants exceeds that of share tenants in a number of counties where the farms are more intensively cultivated and more valuable than elsewhere. They are chiefly situated near the principal cities and are generally north of the Missouri River.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	284,886	119.3	33,997,873	100.0	$1,033,121,897	100.0
White	279,933	120.5	33,726,480	99.2	1,025,151,594	99.2
Colored[1]	4,953	54.8	271,393	0.8	7,970,303	0.8
Owners	159,223	127.4	20,281,378	59.7	596,225,314	57.7
Part owners	31,747	135.0	4,284,841	12.6	136,140,257	13.2
Owners and tenants	5,188	163.2	846,931	2.5	25,047,302	2.4
Managers	1,831	354.2	648,597	1.9	23,094,383	2.2
Cash tenants	31,230	93.1	2,908,443	8.5	117,554,213	11.4
Share tenants	55,667	90.3	5,027,683	14.8	135,060,428	13.1

[1] Comprising 3 Indians and 4,950 negroes.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,441	$521	$100	$564	$566	15.6
White	2,464	527	101	570	571	15.6
Colored[1]	1,182	174	45	208	282	17.5
Owners	2,417	601	108	619	591	15.8
Part owners	2,916	552	118	702	678	15.8
Owners and tenants	3,254	646	137	791	686	14.2
Managers	8,895	1,460	201	2,057	1,608	12.8
Cash tenants	2,804	426	88	446	562	14.9
Share tenants	1,750	287	69	320	389	16.0

[1] Comprising 3 Indians and 4,950 negroes.

The value of farm property of the colored farmers is $7,970,303, an average value of $1,609 per farm, or about one-half the average value of farms operated by white farmers, $3,662. The higher percentage of gross income for the farms of colored farmers does not indicate superior farm management, but is due to the smaller average area and consequent more intensive cultivation of these farms, and to the smaller value of farms or capital invested. For farms of the same area white farmers obtain slightly larger percentage of gross income, though for every form of farm property their farms show average values.

Farms operated by share tenants have the lowest average area, 90.3 acres, while those operated by managers have the highest, 354.2 acres. As a rule the latter are favorably located, highly improved, and sometimes not primarily cultivated for profit when adjuncts of public institutions or when conducted by wealthy individuals in connection with their summer homes. This should account for the comparatively low percentage of gross income for this group.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	284,886	119.3	33,997,873	100.0	$1,033,121,897	100.0
Under 3 acres	1,469	1.8	2,682	(1)	2,670,825	0.3
3 to 9 acres	6,333	6.3	40,179	0.1	8,092,619	0.8
10 to 19 acres	11,286	13.8	155,332	0.5	13,863,223	1.3
20 to 49 acres	56,931	35.6	2,028,673	6.0	75,355,286	7.3
50 to 99 acres	78,933	74.5	5,885,823	17.3	182,619,027	17.7
100 to 174 acres	78.941	133.9	10,573,397	31.1	296,589,385	28.7
175 to 259 acres	29,014	210.2	6,097,961	17.9	183,200,387	17.7
260 to 499 acres	18,117	334.0	6,051,799	17.8	182,400,410	17.7
500 to 999 acres	3,268	639.7	2,090,466	6.1	63,525,369	6.1
1,000 acres and over	594	1,804.0	1,071,561	3.2	24,805,366	2.4

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,441	$521	$100	$564	$566	15.6
Under 3 acres	750	803	54	211	725	39.8
3 to 9 acres	706	413	39	120	233	18.2
10 to 19 acres	770	279	40	139	207	16.9
20 to 49 acres	836	237	60	201	265	20.0
50 to 99 acres	1,526	367	80	341	411	17.8
100 to 174 acres	2,526	567	112	553	596	16.9
175 to 259 acres	4,340	832	161	981	911	14.4
260 to 499 acres	6,952	1,202	214	1,700	1,344	13.3
500 to 999 acres	13,660	1,958	294	3,627	2,470	12.7
1,000 acres and over	29,762	3,409	517	8,072	5,099	12.2

The group of farms containing from 100 to 174 acres each, comprises the largest percentage of the total farm acreage, and also the largest percentage of the total value of farm property. In this group the average values of the various forms of farm property approach nearest to the averages for the state. Except for farms under 3 acres, the average values of the several forms of farm property generally advance with the size of the farm. For farms of less than 3 acres the average value of buildings exceeds that of land and improvements, as this class includes most of the florists' establishments and many city dairies.

The average gross incomes per acre for the various groups are as follows: Farms under 3 acres, $396.76; 3 to 9 acres, $36.73; 10 to 19 acres, $15.04; 20 to 49 acres, $7.43; 50 to 99 acres, $5.51; 100 to 174 acres, $4.45; 179 to 259 acres, $4.34; 260 to 499 acres, $4.02; 500 to 999 acres, $3.86; and 1,000 acres and over, $2.83. The relatively high gross income per acre for farms of less than 3 acres is due to the fact that the incomes of the florists' establishments and city dairies, of which this group is largely composed, do not depend so much upon the acreage of land used as upon the amount of capital invested in buildings, implements, and live stock, and the amounts expended for labor and fertilizers.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

In Tables 10 and 11 farms are classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes at least 40 per cent of the total value of the products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40 per cent of the value of the products not fed to live stock, the farm is designated as a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40.0 per cent of their income from any one class of farm products. Farms reporting no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	284,886	119.3	33,997,873	100.0	$1,033,121,897	100.0
Hay and grain	76,733	118.8	9,118,904	26.8	280,269,603	27.1
Vegetables	4,267	36.1	153,868	0.5	16,254,188	1.6
Fruit	2,592	80.9	209,666	0.6	8,421,362	0.8
Live stock	151,451	133.0	20,148,833	59.3	618,720,308	59.9
Dairy produce	6,021	95.9	577,575	1.7	27,660,208	2.7
Tobacco	264	74.6	19,696	0.1	596,140	(1)
Cotton	2,236	50.4	112,676	0.3	2,904,796	0.3
Sugar	118	71.2	8,405	(1)	197,575	(1)
Flowers and plants	183	3.4	618	(1)	1,088,436	0.1
Nursery products	116	83.2	9,650	(1)	872,140	0.1
Miscellaneous	40,905	88.9	3,637,982	10.7	76,137,141	7.4

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900.					Per cent of gross income on total investment in farm property.
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	
The State	$2,441	$521	$100	$564	$566	15.6
Hay and grain	2,663	469	104	417	563	15.4
Vegetables	3,013	537	91	168	522	13.7
Fruit	2,323	616	88	222	510	15.7
Live stock	2,635	599	110	741	640	15.7
Dairy produce	3,151	680	102	661	644	14.0
Tobacco	1,475	360	63	360	478	21.2
Cotton	833	189	45	232	485	37.3
Sugar	1,115	247	77	235	384	22.9
Flowers and plants	3,053	2,689	160	45	2,285	38.4
Nursery products	5,687	1,441	204	186	3,141	41.8
Miscellaneous	1,238	309	62	252	286	15.4

For the several classes of farms the average value per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $676.74; nursery products, $37.76; vegetables, $14.48; cotton, $9.62; tobacco, $6.40; fruit, $6.30; sugar, $5.39; live stock, $4.81; hay and grain, $4.74; and miscellaneous products, $3.22.

The wide variations shown in the averages and percentages of gross income are largely due to the fact that in computing gross income no deductions are made for expenses involved in operations. For florists' establishments, nurseries, and market gardens, the average expenditure for such items as labor and fertilizers, represents a far greater percentage of gross income than for "hay and grain," "live-stock," or "miscellaneous" farms. If it were possible to present the average net incomes, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	284,886	119.3	33,997,873	100.0	$1,033,121,897	100.0
$0	1,448	95.3	138,025	0.4	3,163,580	0.3
$1 to $49	7,093	54.3	384,938	1.1	5,721,880	0.5
$50 to $99	15,290	56.3	861,561	2.5	13,194,240	1.3
$100 to $249	64,540	71.3	4,604,733	13.6	85,583,280	8.3
$250 to $499	86,461	96.9	8,374,040	24.6	208,514,680	20.2
$500 to $999	72,495	139.2	10,092,572	29.7	324,525,650	31.4
$1,000 to $2,499	32,417	225.1	7,296,719	21.5	288,263,777	27.9
$2,500 and over	5,142	436.7	2,245,285	6.6	104,154,810	10.1

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900.					Per cent of gross income on total investment in farm property.
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	
The State	$2,441	$521	$100	$564	$566	15.6
$0	1,538	187	33	427	....	....
$1 to $49	558	122	23	104	31	3.8
$50 to $99	573	143	28	119	70	8.2
$100 to $249	854	219	43	210	170	12.8
$250 to $499	1,585	379	79	369	358	14.8
$500 to $999	3,024	662	133	658	688	15.4
$1,000 to $2,499	6,131	1,194	213	1,354	1,417	15.9
$2,500 and over	13,694	2,257	355	3,950	4,338	21.4

The absence of income in the first group is due, in part, to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The persons in charge of such farms, on June 1, 1900, could not always give definite information concerning the products of the preceding year. The same statement is true, also, of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete exhibit of farm income in 1899. Some of the farms with small reported incomes are doubtless the suburban or summer homes of city merchants and professional men who derive their principal income from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	633,317	$6,943,267	$10.96	13,410
Steers	1 and under 2	386,809	8,713,534	22.53	2,320
Steers	2 and under 3	363,775	12,451,823	34.23	3,388
Steers	3 and over	148,965	6,818,862	45.77	10,624
Bulls	1 and over	43,390	1,921,821	44.29	978
Heifers	1 and under 2	312,749	6,040,589	19.31	2,922
Cows kept for milk	2 and over	765,386	23,514,794	30.72	49,192
Cows and heifers not kept for milk.	2 and over	324,198	9,252,117	28.54	1,436
Colts	Under 1	58,177	1,277,129	21.95	1,299
Horses	1 and under 2	63,214	2,070,506	32.75	1,109
Horses	2 and over	845,646	38,747,179	45.82	127,105
Mule colts	Under 1	41,424	1,140,502	27.53	262
Mules	1 and under 2	47,111	1,939,879	41.18	415
Mules	2 and over	194,984	12,401,901	63.60	12,065
Asses and burros	All ages	8,777	1,111,893	126.68	658
Lambs	Under 1	423,510	999,349	2.36	805
Sheep (ewes)	1 and over	587,757	2,060,859	3.51	7,210
Sheep (rams and wethers).	1 and over	75,946	290,638	3.83	692
Swine	All ages	4,524,664	16,533,935	3.65	109,678
Goats	All ages	24,487	64,786	2.65	988
Fowls:[1]					
Chickens[2]		14,903,601	5,720,359		
Turkeys		466,665			
Geese		428,307			
Ducks		278,140			
Bees (swarms of)		205,110	508,217	2.48	
Unclassified			16,065		
Value of all live stock.			160,540,004		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The value of all live stock on farms, June 1, 1900, was $160,540,004. Of this amount, 32.5 per cent represents the value of neat cattle other than dairy cows; 26.2 per cent, that of horses; 14.6 per cent, that of dairy cows; 10.3 per cent, that of swine; 9.6 per cent, that of mules; 3.6 per cent, that of poultry; 2.1 per cent, that of sheep; 0.7 per cent, that of asses and burros; and 0.4 per cent, the value of all other live stock.

No reports were received of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of live stock not on farms was $9,649,952. Exclusive of poultry and bees not on farms, the total value of live stock in the state was $170,189,956.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the numbers of the most important domestic animals:

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	765,386	2,213,203	967,037	292,296	663,703	4,524,664
1890	851,076	2,118,640	946,401	251,714	950,562	4,987,432
1880	661,405	1,419,527	667,776	192,027	1,411,298	4,553,123
1870	398,515	755,180	493,969	111,502	1,352,001	2,306,430
1860	345,243	823,741	361,874	80,941	937,445	2,354,425
1850	230,169	561,341	225,319	41,667	762,511	1,702,625

[1] Lambs not included.

For the fifty years following 1850 every class of live stock, except sheep, shows a great increase in numbers. Between 1850 and 1880 the number of sheep increased, decade by decade, but since that time each succeeding decade shows a larger decrease.

In 1900 dairy cows, sheep, and swine were reported in smaller numbers than in 1890, and other classes of live stock show but small increases, owing to the excellent market for all classes of live stock just previous to the time of enumeration, and the high prices at that time. (See Table 14.) For the year 1899, 55.2 per cent of the value of all animal products for the state was derived from the sale of live animals, greatly reducing the flocks and herds.

Compared with the census of 1890, that of 1900 shows the following increases: Mules and asses, 16.1 per cent; neat cattle other than dairy cows, 4.5 per cent; horses, 2.2 per cent. Sheep decreased 30.2 per cent; dairy cows, 10.1 per cent; and swine, 9.3 per cent.

In 1900 the enumerators were instructed to report no fowls under 3 months old, which limitation was not made in previous census reports. This probably accounts for the apparent decreases in the numbers of all domestic fowls. Compared with the figures for 1890, the census of 1900 shows decreases in numbers of fowls as follows: Ducks, 55.7 per cent; turkeys, 49.8 per cent; geese, 49.6 per cent; and chickens, 34.6 per cent. The increased production of eggs indicates that there have been increases in the numbers of most kinds of fowls.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the products of the animal industry in 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS, IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	4,145,137	$822,871
Mohair and goat hair	Pounds	10,203	2,798
Milk	Gallons	[1]258,207,755	[2]15,042,360
Butter	Pounds	45,509,110	
Cheese	Pounds	323,439	
Eggs	Dozens	85,203,290	8,315,371
Poultry			9,525,252
Honey	Pounds	3,018,929	348,604
Wax	Pounds	69,258	
Animals sold			54,018,809
Animals slaughtered			9,765,879
Total			97,841,944

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of all milk sold or consumed and of butter and cheese made.

The value of animal products for the year 1899 was $97,841,944, of which amount 65.2 per cent represents the value of animals sold and animals slaughtered on farms; 18.2 per cent, that of poultry and eggs; 15.4 per cent, that of dairy produce; 0.8 per cent, that of wool, mohair, and goat hair; and 0.4 per cent, the value of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms for the year 1899 was $63,784,688, or 39.5 per cent of the gross farm income. Atchison county is first in amount of sales, reporting $1,407,838 received by 1,610 farmers from the sale of live animals, and seven other counties of the state report sales amounting to more than a million dollars each. Of all farmers reporting live stock, 228,531, or 82.3 per cent, reported animals slaughtered, the average value per farm being $42.73; and 199,935, or 72.0 per cent, reported sales, the average receipts per farm being $270.18. In securing the reports of animals sold on farms, the enumerators were instructed to obtain from each farmer a statement of the amount received from the sale of live animals less the amount paid in 1899 for such animals purchased during the same year.

DAIRY PRODUCE.

Of the total value of dairy produce given in Table 16, 65.1 per cent represents the value of such produce consumed on farms, and 34.9 per cent the receipts from sales. Of the latter amount, $2,985,872 was received from the sale of 25,954,163 gallons of milk; $2,123,750, from 14,298,011 pounds of butter; $129,159, from 248,542 gallons of cream; and $17,459, from 245,092 pounds of cheese. The amount of milk produced in 1899 was 64,276,652 gallons greater than in 1889, a gain of 33.1 per cent. The amounts of cheese and butter made on farms increased, respectively, 12.1 per cent and 5.6 per cent in the same time.

POULTRY AND EGGS.

The total value of the products of the poultry industry in 1899 was $17,840,623. Of this amount, 53.4 per cent represents the value of poultry raised, and 46.6 per cent, that of eggs produced. There were 85,203,290 dozens of eggs reported in 1900, 60.3 per cent more than ten years before. Twenty-seven counties reported more than a million dozens of eggs each, Franklin county making the largest report.

WOOL.

The largest report of wool for the state was made in 1880. Between 1880 and 1890 there was a considerable decrease, but the census of 1900 indicates an increase of 2.6 per cent since 1890. This increase is probably more apparent than real, owing to the fact that in 1890 the fleeces of at least 277,627 sheep were omitted from the table but included in a general estimate of the wool shorn after the census enumeration. The average weight of fleeces increased, in that time, from 6.0 pounds to 6.1 pounds.

HONEY AND WAX.

In 1899 there were 3,018,929 pounds of honey and 69,258 pounds of wax reported, a decrease since 1890 of 32.8 per cent in honey and 8.5 per cent in wax.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	255,522	967,037	3.8	240,140	765,386	3.2
White farmers	251,395	956,291	3.8	237,411	760,227	3.2
Colored farmers	4,127	10,746	2.6	2,729	5,159	1.9
Owners[1]	178,659	711,618	4.0	175,912	601,914	3.4
Managers	1,551	11,095	7.2	1,413	7,282	5.2
Cash tenants	27,333	96,769	3.5	23,628	68,316	2.9
Share tenants	47,979	147,555	3.1	39,187	87,874	2.2
Under 20 acres	13,749	26,640	1.9	10,560	23,938	2.3
20 to 99 acres	119,198	354,446	3.0	108,514	244,957	2.3
100 to 174 acres	73,570	278,451	3.8	72,414	243,256	3.4
175 to 259 acres	27,774	146,543	5.3	27,622	127,971	4.6
260 acres and over	21,231	160,957	7.6	21,030	125,264	6.0
Hay and grain	65,659	226,838	3.5	56,763	149,719	2.6
Vegetable	3,487	15,821	4.5	2,249	3,727	1.7
Fruit	2,003	5,021	2.5	1,709	3,266	1.9
Live stock	142,380	603,028	4.2	139,512	487,592	3.5
Dairy	5,474	19,882	3.6	6,021	47,748	7.9
Tobacco	209	766	3.7	149	380	2.6
Cotton	1,535	3,295	2.1	1,420	3,107	2.2
Sugar	102	292	2.9	76	140	1.8
Flower and plant	77	133	1.7	25	32	1.3
Nursery	56	144	2.6	52	104	2.0
Miscellaneous	34,540	91,817	2.7	32,164	69,571	2.2

[1] Including "part owners" and "owners and tenants"

CROPS.

The following table gives the statistics of the principal crops grown in 1899:

TABLE 18.—ACREAGE, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	7,423,683	Bushels	208,844,870	$61,246,306
Wheat	2,056,219	Bushels	23,072,768	13,520,012
Oats	916,178	Bushels	20,545,350	4,669,185
Barley	1,727	Bushels	28,969	11,232
Rye	21,233	Bushels	220,338	103,192
Buckwheat	2,715	Bushels	21,480	12,079
Kafir corn	1,990	Bushels	38,497	12,836
Flax seed	100,952	Bushels	611,888	519,929
Clover seed		Bushels	58,737	220,759
Grass seed		Bushels	219,760	202,636
Hay and forage	3,481,506	Tons	4,326,896	20,467,501
Cotton	45,596	Bales	26,676	849,199
Cottonseed		Tons	[1] 5,593	65,059
Tobacco	4,361	Pounds	3,041,996	218,991
Hemp	10	Pounds	2,000	100
Hops	(2)	Pounds	383	57
Broom corn	10,219	Pounds	3,693,370	159,988
Peanuts	271	Bushels	6,679	6,407
Dry beans	4,376	Bushels	45,647	73,850
Dry pease	5,319	Bushels	54,763	66,701
Potatoes	93,915	Bushels	7,786,623	2,756,695
Sweet potatoes	9,844	Bushels	743,377	424,470
Onions	1,383	Bushels	259,272	155,877
Castor beans	5,622	Bushels	31,966	31,177
Miscellaneous vegetables	114,853			6,388,460
Maple sirup		Gallons	5,474	5,271
Maple sugar		Pounds	12,056	1,288
Sorghum cane	30,997	Tons	22,166	62,967
Sorghum sirup		Gallons	1,990,987	597,667
Small fruits	14,860			1,050,811
Orchard fruits	[3] 471,349	Bushels		[4] 2,944,175
Grapes	[3] 4,938	Centals	137,837	[5] 314,807
Figs		Pounds	550	20
Nuts				19,838
Forest products				4,442,131
Flowers and plants	181			409,890
Seeds	156			15,416
Nursery products	2,972			349,449
Miscellaneous	195			68,609
Total	14,827,620			121,455,026

[1] Exclusive of 7,760 tons, valued at $76,258, sold in seed cotton and included with the cotton.
[2] Less than 1 acre.
[3] Estimated from number of trees or vines.
[4] Including value of cider and vinegar.
[5] Including value of raisins, wine, etc.

Of the total value of crops, cereals, including Kafir corn, contributed 65.5 per cent; hay and forage, 16.8 per cent; vegetables, including potatoes, sweet potatoes, and onions, 7.2 per cent; fruits and nuts, 3.6 per cent; forest products, 3.7 per cent; and all other products, 3.2 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $2,265; nursery products, $118; small fruits, $69; tobacco, $50; miscellaneous vegetables, $47; sweet potatoes, $43; potatoes, $29; sorghum cane and sirup, $21; cotton, $20; broom corn, $16; dry beans and pease, $14; hay and forage, $6; castor beans, $6; and flaxseed, $5. The crops yielding the highest average returns per acre were grown upon highly improved land. Their production required a relatively great amount of labor and large expenditures for fertilizers.

CEREALS.

The following table is a statement of the changes in cereal production since 1849:

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	1,727	2,715	7,423,683	916,178	21,233	2,056,219
1889	1,504	2,802	6,072,121	1,676,706	24,283	1,946,785
1879	6,472	5,463	5,588,266	968,473	46,484	2,074,394

PART 2.—BUSHELS PRODUCED.

YEAR.	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	28,969	21,480	208,844,870	20,545,350	220,338	23,072,768
1889	34,863	28,440	196,999,016	39,820,149	308,807	30,113,821
1879	123,031	67,640	202,414,413	20,670,958	535,426	24,966,627
1869	269,240	36,252	66,034,075	16,578,313	559,532	14,315,926
1859	228,502	182,292	72,892,157	3,680,870	293,262	4,227,586
1849	9,631	23,641	36,214,637	5,278,079	44,268	2,981,652

[1] No statistics of acreage were secured prior to 1879.

The total area devoted to cereals in 1879 was 8,689,551 acres; in 1889, 9,724,201 acres; and in 1899, 10,421,755 acres. This was a gain in the last decade of 7.2 per cent. The increases in area devoted to cereals in the past decade were: Corn, 22.3 per cent; barley, 14.8 per cent; and wheat, 5.6 per cent. The decreases were: Oats, 45.4 per cent; rye, 12.6 per cent; and buckwheat, 3.1 per cent. The total number of bushels produced in 1899 was 252,733,775, or nearly six times the number produced in 1849, which was 44,551,808.

Of the total area in cereals in 1899, 71.2 per cent was devoted to corn; 19.7 per cent, to wheat; 8.8 per cent, to oats; 0.2 per cent, to rye; and 0.1 per cent, to buckwheat and barley.

The operators of 259,420 farms, or 91.1 per cent of the total number in the state, reported corn; 89,941, or 31.6 per cent, reported wheat; and 83,411, or 29.3 per cent, reported oats. Nodaway county leads in the acreage and production of corn, oats, and barley. Franklin county produced the most wheat, and Clark county the most buckwheat and rye.

HAY AND FORAGE.

In 1900, 176,893 farmers, or 62.1 per cent of the total number in the state, reported hay or forage crops. Exclusive of cornstalks and corn strippings, they obtained an average yield of 1.17 tons per acre. The total area in hay and forage for 1899 was 3,481,506 acres, or 21.3 per cent greater than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 167,959 acres and 196,288 tons; millet and Hungarian grasses, 166,709 acres and 230,995 tons; alfalfa or lucern, 2,239 acres aud 5,409 tons; clover, 377,228 acres and 493,364 tons; other tame and cultivated grasses, 2,563,365 acres and 2,829,485 tons; grains cut green for hay, 124,515 acres and 151,967 tons; crops grown for forage, 79,491 acres and 154,691 tons; cornstalks and corn strippings, 258,552 acres and 264,697 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage" but the acreage is a part of that given for "corn," as the forage secured was only an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 may be seen in the following table:

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	20,040,399	8,150,442	6,496,436	8,698,170
Apricots	16,190	6,250	583	1,035
Cherries	679,985	381,185	62,708	88,444
Peaches	4,557,365	1,999,474	61,006	1,667,789
Pears	548,702	84,741	58,449	58,683
Plums and prunes	745,187	152,686	111,603	40,338

Of the farmers of the state, 119,605, or 42.0 per cent, report orchard fruits in 1900. Since 1890 there has been a large general increase throughout the state in the number of fruit trees. Apple trees increased 145.9 per cent; peach trees, 127.9 per cent; apricot trees, 159.0 per cent; and cherry trees, 78.4 per cent. There are more than six times the number of pear trees reported in 1890, and nearly five times as many plum and prune trees. The largest gains in the numbers of apple and peach trees have been in the southern part of the state.

Of all fruit trees in 1900, 75.2 per cent were apple trees; 17.1 per cent, peach trees; 2.8 per cent, plum and prune trees; 2.1 per cent, pear trees; 2.5 per cent, cherry trees; 0.3 per cent, apricot and unclassified fruit trees. The latter class, which is not included in the table, numbered 69,973, and yielded 14,716 bushels of fruit.

The value of orchard products, given in Table 18, includes the value of 29,545 barrels of cider, 10,050 barrels of vinegar, and 1,327,660 pounds of dried and evaporated fruits. Comparisons of yields or of their values, when made by decades only, are of little significance, as the yield of any given year is largely dependent upon the nature of the season.

All counties of the state reported fruit trees, and a majority show marked increases since 1890. The southern counties reported the largest numbers of apple and peach trees.

COTTON.

The following table is a statement of the changes in cotton production since 1859:

TABLE 21.—ACREAGE AND PRODUCTION OF COTTON: 1859 TO 1899.

YEAR.	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	45,596	[1]20.4	25,576	12,865,944	70.1
1889	57,260	78.3	15,856	7,563,312	[1]17.8
1879	32,116	....	20,318	9,204,054	1,602.0
1869	....	....	....	540,764	[1]97.0
1859	....	....	....	18,328,660	....

[1] Decrease.

In 1899, 4,691 farmers devoted an area of 45,596 acres to the production of cotton, an average of 9.7 acres per farm. From this land was obtained 12,865,944 pounds of cotton, an average of 2,743 pounds per farm and 282 pounds per acre. The total value of this crop, including the value of the cottonseed, was $904,258, an average of $192.76 per farm, and $19.83 per acre.

The counties which devoted the largest area to cotton are Dunklin, Pemiscot, Stoddard, New Madrid, and Ozark, ranking in the order named, and reporting 91.2 per cent of the total acreage. Dunklin alone reported 56.3 per cent of the total acreage. With the exception of Ozark, these counties adjoin, and are located in the extreme southeastern corner of the state.

VEGETABLES.

The value of all vegetables grown in the state in 1899, including potatoes, sweet potatoes, and onions, was $8,725,502. Aside from the land devoted to potatoes, sweet potatoes, and onions, 114,853 acres were used in the growing of miscellaneous vegetables. Of this area the products of 74,663 acres were not reported in detail. Of the remaining 40,190 acres, concerning which detailed reports were received, 14,487 acres were devoted to watermelons; 10,277, to tomatoes; 5,963, to cabbages; 4,733, to sweet corn; 2,113, to muskmelons; 1,293, to cucumbers; 278, to pumpkins; 187, to beans; 129, to lettuce; 127, to pease; 106, to spinach; and 497, to other vegetables.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 14,860 acres, distributed among 48,517 farms. The value of the fruits grown was $1,050,811, an average of $22 per farm. The acreages and productions of the various berries were as follows: Strawberries, 7,498 acres and 13,018,460 quarts; blackberries and dewberries, 4,441 acres and 5,121,860 quarts; raspberries and Logan berries, 1,660 acres and 1,940,850 quarts; gooseberries, 731 acres and 865,870 quarts; currants, 194 acres and 223,730 quarts; and other berries, 336 acres and 314,150 quarts.

TOBACCO.

According to the census of 1850 Missouri produced 17,113,784 pounds of tobacco. The census of 1860 shows a gain of 7,972,412 pounds, or 46.6 per cent. In every decade since 1860 there has been a greater or less decrease in the crop in the state. Between 1860 and 1870 there was a decrease of 12,765,713 pounds, or 50.9 per cent. Between 1870 and 1880 there was a decline of 2.5 per cent, and between 1880 and 1890, a decline of 2,590,834 pounds, or 21.6 per cent.

The present census shows that in 1899 tobacco was grown in Missouri by 10,475 farmers, who obtained from 4,361 acres a yield of 3,041,996 pounds, valued at $218,991. This was a decrease in area for the last decade of 6,989 acres, or 61.6 per cent, and in production, of 6,382,827 pounds, or 67.7 per cent. The average area for each farm on which tobacco was grown was a little over two-fifths of an acre. Tobacco was grown in 114 counties of the state, the area ranging from 1 acre in New Madrid county to 751 acres in Chariton county.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was raised by 48,951 farmers on 30,977 acres of land, an average of 0.6 acre for each farm reporting. From this area they sold 22,166 tons of cane for $62,967, and from the remaining product manufactured 1,990,987 gallons of sirup, valued at $597,657. There was a decrease in acreage in ten years of 14.6 per cent. The crop reached its highest point in 1879, when a production of 4,129,595 gallons of sirup was reported.

FLAX.

Flax was grown in 1899 by 5,730 farmers, or 2.0 per cent of the total number in the state. Since 1889 the area devoted to this crop has increased from 56,421 to 100,952 acres, or 78.9 per cent, and the yield, in bushels of seed, from 450,831 to 611,888, or 35.7 per cent. The total value of the crop was $519,929. The average yield per acre was 8.0 bushels of seed in 1889, and 6.1 in 1899. The average acreage per farm devoted to this crop was 17.6, and the average value of crop per farm, $90.74.

Almost the entire crop was grown near the western border south of the Missouri River. The leading counties in both acreage and production are Bates, Cass, Barton, Vernon, Johnson, and Henry, ranking in the order named.

CASTOR BEANS.

Castor beans were grown in 1899 by 495 farmers, who devoted to their cultivation 5,622 acres and secured therefrom a product of 31,966 bushels, an average of 5.7 bushels per acre, and valued at $31,177. Of the total acreage, 97.2 per cent was reported from the southwestern counties of Vernon, Barton, and Cedar, ranking in the order named.

BROOM CORN.

In 1899, 10,219 acres, reported by 1,978 farmers, produced 3,693,370 pounds of broom corn, valued at $159,988. This is a gain in product, since 1890, of 2,642,231 pounds, or 251.4 per cent, and an increase of 290.3 per cent in acreage. More than half of the total product was grown in the four west central counties of Henry, Bates, Benton, and St. Clair.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 181 acres, and the value of products sold therefrom was $409,890. These flowers and plants were grown by 270 farmers and florists. Of this number, 183 made commercial floriculture their principal business. These 183 proprietors had invested, in the aggregate, $1,088,436, of which $558,775 represents the value of land and improvements other than buildings; $492,200, the value of buildings; $29,240, that of implements and machinery; and $8,221, that of live stock. Their sales of flowers and plants amounted to $400,136, and they secured other products valued at $18,088. They expended for labor $86,720, and for fertilizers, $4,181.

In addition to the 183 principal florists' establishments, 1,088 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 1,988,860 square feet, making, with the 1,137,540 square feet belonging to the florists' establishments, a total of 3,126,400 square feet of land under glass.

NURSERIES.

The total value of nursery products sold in 1899 was $349,449, reported by the operators of 259 farms and nurseries. Of this number, 116 derived their principal income from the nursery business. They had 9,650 acres of land, valued at $659,770; buildings worth $167,125; implements and machinery, $23,640; and live stock, $21,605. Their total income, exclusive of products fed to live stock, was $364,356, of which $333,366 represents the value of nursery stock, and $30,990, that of other products. The expenditure for labor was $91,348, and for fertilizers, $2,715.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899 was $9,803,610, an average of $34 per farm. The average expenditure was $787 for nurseries, $474 for florists' establishments, $70 for fruit farms, $63 for vegetable farms, $54 for dairy farms, $38 for live-stock farms, $31 for hay and grain farms, $24 for cotton farms, $22 for tobacco farms, and $14 for sugar farms. "Managers" expended on an average, $266; "owners," $37; "cash tenants," $34; and "share tenants," $16. White farmers expended $35 per farm, and colored farmers, $13.

Fertilizers purchased in 1899 cost $370,630, an average of $1.30 per farm, and more than five times the amount expended in 1890. The average expenditure was $23 for nurseries and florists' establishments, $6 for vegetable farms, $4 for fruit farms, and $1 for hay and grain, live-stock, dairy, tobacco, and sugar farms.

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AGRICULTURE.

MISSISSIPPI.

Hon. William R. Merriam,
Director of the Census.

Sir: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Mississippi, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides and all other buildings used by him in connection with his farming operations.

The farms of Mississippi, June 1, 1900, numbered 220,803, and were valued at $152,007,000. Of this amount, $37,150,340, or 24.4 per cent, represents the value of buildings, and $114,856,660, or 75.6 per cent, the value of land and improvements other than buildings. On the same date the value of farm implements and machinery was $9,556,805, and of live stock, $42,657,222. These values, added to that of farms, give $204,221,027, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $102,492,283, of which amount $17,608,507, or 17.2 per cent, represents the value of animal products, and $84,883,776, or 82.8 per cent, the value of crops, including forest products. The total value of farm products for 1899 exceeds that for 1889 by $29,149,288, or 39.7 per cent.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $11,748,625, leaving $90,743,658 as the gross farm income. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Mississippi in 1899 it was 44.4 per cent.

As no reports of expenditure for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Mississippi.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN MISSISSIPPI.

GENERAL STATISTICS.

Mississippi has a total land area of 46,340 square miles, or 29,657,600 acres, of which 18,240,736 acres, or 61.5 per cent, are included in farms.

From the northeast corner of Mississippi, where the land is slightly rugged, the surface gradually slopes, with many undulations, west to the Mississippi River and south to the Gulf of Mexico. The broad, low ridge thus formed extends nearly north and south through the state, and divides the waters which flow into the Mississippi from the affluents of the Tombigbee, Pearl, and Pascagoula rivers. On this ridge are large tracts of arable land, much of which is under cultivation, while other portions are covered by forests. To the west is doubtless the most desirable farm land of the state, extending from Vicksburg to the north state line, and including all that portion between the Mississippi and Yazoo rivers. To the east are broad, gently rolling prairie lands, exceedingly fertile, yielding large crops of corn and cotton.

The state has several varieties of soil, most of which are fertile and productive. Among these are the brown loam of the central table-land; the rich, black, calcareous soil of the prairie region; the sandy loam with a clayey or sandy subsoil, south of the central ridge; and the yellow loam of the northeast. All of these except the last two are unusually rich, and may easily be kept in a high state of cultivation without the use of fertilizers.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the per cent of farm land improved.

Table 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	220,803	18,240,736	7,594,428	10,646,308	82.6	41.6
1890	144,318	17,572,547	6,849,390	10,723,157	121.8	39.0
1880	101,772	15,855,462	5,216,937	10,638,525	155.8	32.9
1870	68,023	13,121,113	4,209,146	8,911,967	192.9	32.0
1860	42,840	15,839,684	5,065,755	10,773,929	369.7	32.0
1850	33,960	10,490,419	3,444,358	7,046,061	308.9	32.8

The number of farms reported, June 1, 1900, was more than six times as great as the number reported in 1850 and 53.0 per cent greater than in 1890. The total acreage, however, has gained only 73.9 per cent since 1850, and 3.8 per cent since 1890, showing that the number of farms has increased faster than the total acreage, involving a general decrease in the average size of farms. The percentage of farm land improved is somewhat greater than ten years ago, but little change being shown for any decade before 1880.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

Table 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY AND OF PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$204,221,027	$152,007,000	$9,556,805	$42,657,222	$102,492,283
1890	167,328,457	127,423,157	5,968,865	33,936,435	73,342,995
1880	122,016,268	92,844,915	4,885,636	24,285,717	63,701,844
1870[2]	116,113,447	81,716,576	4,456,633	29,940,238	[3] 73,137,953
1860	241,478,571	190,760,367	8,826,512	41,891,692	....
1850	79,905,223	54,738,634	5,762,927	19,403,662	....

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

The remarkable growth of agriculture in the decade from 1850 to 1860, the disastrous effects of the Civil War, and the subsequent partial recovery of the state, are interesting facts shown in the above table. The total value of farm property is even now less than it was in 1860, but the value of implements and machinery and of live stock has reached the highest point in the history of the state.

The gain in the last decade in the total value of farm property was $36,892,570, or 22.0 per cent. The value of land, improvements, and buildings increased $24,583,843, or 19.3 per cent; that of implements and machinery, $3,587,940, or 60.1 per cent; and that of live stock, $8,720,787, or 25.7 per cent. The value of the farm products of 1899 was 39.7 per cent greater than the value reported for 1889. A portion of this increase and of that shown for implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous years.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH GROSS INCOME (PRODUCTS OF 1899 NOT FED TO LIVE STOCK), AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	220,803	211,299	18,240,736	7,594,428	$114,856,660	$37,150,340	$9,556,805	$42,657,222	$90,743,658	$3,917,256	$932,098
Adams	2,583	2,525	141,222	73,756	1,114,520	461,580	112,890	464,572	1,280,026	89,930	4,070
Alcorn	1,944	1,871	198,371	71,203	822,240	292,980	85,730	396,964	672,448	11,690	9,320
Amite	3,280	3,116	325,269	122,868	1,327,780	597,500	149,935	580,110	1,405,225	54,340	41,310
Attala	4,381	4,167	385,003	150,341	1,543,880	553,450	156,735	679,127	1,484,558	34,102	9,006
Benton	1,867	1,782	216,101	64,844	638,710	280,070	61,480	345,528	634,641	1,370	920
Bolivar	5,515	5,245	246,143	185,746	5,892,190	1,189,260	312,860	1,159,902	3,269,798	331,830	25,080
Calhoun	3,097	2,875	307,537	92,168	1,147,480	416,410	109,620	628,197	996,600	12,210	710
Carroll	3,424	3,270	312,698	128,561	1,730,660	527,980	165,780	668,276	1,352,176	54,570	1,810
Chickasaw	2,894	2,512	256,839	124,490	1,584,060	482,430	133,500	605,517	1,134,497	29,980	1,580
Choctaw	2,189	2,087	217,591	70,290	696,070	326,890	83,410	408,692	744,388	22,370	7,500
Claiborne	2,970	2,879	222,490	116,624	1,393,790	490,000	140,610	553,126	1,111,750	38,120	2,830
Clarke	2,308	2,266	232,888	73,488	775,850	421,720	85,830	412,059	820,542	33,850	27,180
Clay	2,815	2,686	198,812	111,929	1,595,120	419,040	127,070	567,652	1,125,082	18,950	620
Coahoma	4,055	3,945	195,494	121,905	4,337,050	873,120	218,745	830,688	2,365,867	192,790	8,190
Copiah	4,500	4,187	392,514	176,814	2,008,880	969,690	255,410	883,628	1,973,137	54,274	59,594
Covington	1,966	1,946	252,427	59,664	794,470	455,870	88,650	384,465	748,350	24,030	30,230
De Soto	3,726	3,645	257,771	151,066	2,262,390	780,860	166,910	736,242	1,667,155	59,150	2,030
Franklin	1,903	1,856	243,107	66,096	846,060	316,350	76,540	403,653	843,772	21,990	10,230
Greene	733	731	139,945	16,709	301,060	170,100	33,350	232,593	176,436	3,530	15,510
Grenada	1,948	1,884	216,224	87,175	1,025,670	303,140	74,460	403,188	764,995	41,710	660
Hancock	530	521	75,855	6,014	199,910	131,940	26,980	241,829	170,339	5,390	5,580
Harrison	713	711	88,898	9,353	337,900	209,270	31,810	266,307	269,311	13,430	15,440
Hinds	6,607	6,140	394,046	251,369	3,000,080	1,069,500	288,750	1,258,124	2,743,643	63,470	11,850
Holmes	5,145	5,080	359,859	203,480	2,902,600	880,120	212,325	904,285	2,287,731	56,782	8,936
Issaquena	1,646	1,593	90,676	55,052	1,456,110	413,870	110,085	334,035	887,071	34,702	786
Itawamba	2,259	2,193	272,395	80,228	691,300	264,530	87,780	451,626	747,445	10,280	8,210
Jackson	544	540	126,370	8,239	352,130	185,450	31,130	221,653	192,249	10,120	11,210
Jasper	2,254	2,199	294,657	82,259	775,660	360,790	72,130	469,234	864,435	29,270	29,580
Jefferson	3,575	3,469	219,018	112,110	1,296,080	580,940	140,590	642,117	1,558,058	144,580	4,640
Jones	1,561	1,527	218,314	44,078	646,830	326,130	7[illegible],370	348,454	666,410	18,060	42,970
Kemper	3,314	3,148	312,641	122,562	1,205,500	531,520	119,990	621,930	1,247,194	48,080	31,970
Lafayette	3,871	3,655	346,743	127,915	1,880,120	53,310	171,260	696,649	1,419,478	31,690	970
Lauderdale	3,358	3,215	315,542	130,159	1,616,880	675,930	135,620	623,959	1,388,146	66,130	46,230
Lawrence	2,510	2,446	276,683	92,662	810,010	386,610	93,830	461,692	974,052	39,310	30,900
Leake	2,756	2,667	302,264	102,736	886,180	394,860	101,720	468,227	966,529	35,620	16,710
Lee	3,501	3,323	238,491	134,379	1,585,950	510,440	137,480	710,790	1,356,017	29,630	1,160
Leflore	4,266	3,978	192,108	117,013	3,430,180	658,020	189,870	622,761	2,032,187	108,592	3,056
Lincoln	2,316	2,196	221,388	87,007	883,050	520,990	144,455	498,584	961,807	18,212	38,116
Lowndes	3,467	3,419	242,942	150,057	2,280,260	703,940	196,830	687,598	1,486,173	63,070	12,370
Madison	4,717	4,565	341,388	218,172	2,600,660	882,420	180,060	878,489	1,860,708	117,190	8,790
Marion	1,781	1,754	236,333	54,156	634,450	293,710	83,570	399,339	612,585	18,690	22,110
Marshall	4,516	4,322	379,098	82,581	1,733,630	813,720	181,610	803,901	1,751,664	37,760	2,520
Monroe	4,854	4,615	372,738	187,404	3,013,680	848,950	245,290	877,675	2,009,066	71,100	11,810
Montgomery	2,394	2,277	215,967	91,375	933,650	380,710	94,850	478,328	860,035	30,990	4,210
Neshoba	2,256	2,126	266,491	74,470	702,680	353,120	78,030	439,445	817,228	29,450	20,550
Newton	3,277	3,225	299,641	114,928	1,135,760	543,230	109,860	605,696	1,165,741	48,770	41,710
Noxubee	4,412	4,289	318,005	193,390	2,265,590	735,720	175,090	893,056	1,581,046	39,920	4,220
Oktibbeha	3,163	3,034	207,895	119,809	1,505,580	474,130	124,370	618,648	1,075,212	35,550	990
Panola	4,744	4,582	333,015	187,182	2,244,980	744,170	192,890	955,150	1,794,735	28,500	690
Pearl River	491	481	81,793	9,241	192,260	106,010	23,370	213,380	160,182	3,480	5,670
Perry	1,148	1,108	195,034	24,872	557,390	298,020	72,120	367,169	420,195	4,490	18,530
Pike	2,550	2,365	276,739	96,570	985,630	573,220	130,210	514,273	1,130,446	40,810	47,160
Pontotoc	3,368	3,265	240,326	85,333	1,172,560	407,530	102,620	573,898	1,097,450	18,730	300
Prentiss	2,591	2,435	222,236	74,436	929,970	321,270	104,510	477,040	863,305	18,090	6,920
Quitman	1,031	1,004	66,813	23,363	703,290	125,360	56,480	190,900	536,930	29,040	150
Rankin	3,398	3,229	330,501	310,356	1,252,800	466,750	134,960	669,996	1,106,997	38,424	26,112
Scott	2,083	1,983	236,061	70,943	599,310	330,910	72,025	376,662	687,820	25,922	19,756
Sharkey	2,043	2,019	80,362	61,115	2,222,100	463,300	125,510	416,466	1,356,880	81,260	1,690
Simpson	2,161	2,024	222,949	74,281	770,750	301,320	63,440	369,313	698,362	25,840	22,420
Smith	2,400	2,205	270,831	75,602	749,490	335,620	73,430	421,041	751,774	19,310	25,610
Sunflower	2,705	2,639	122,965	73,696	2,435,210	477,530	108,610	650,913	1,078,430	79,510	260
Tallahatchie	3,289	3,193	179,426	95,611	2,157,490	531,410	117,560	624,651	1,508,418	12,204	240
Tate	3,704	3,557	218,840	120,504	1,722,810	563,630	136,710	665,292	1,404,020	16,020	480
Tippah	2,288	2,154	238,980	72,576	885,230	302,750	72,560	392,147	733,201	9,710	2,250
Tishomingo	1,625	1,487	208,907	46,114	416,980	168,190	41,870	258,890	433,103	4,560	4,980
Tunica	2,902	2,853	144,968	93,438	2,973,140	455,930	122,060	520,470	1,846,019	205,900	460
Union	2,895	2,634	218,437	82,641	1,051,830	359,400	119,265	546,722	946,446	12,470	890
Warren	4,058	3,649	221,851	116,942	2,176,090	627,210	182,500	706,681	1,794,695	144,370	1,960
Washington	6,853	6,668	265,138	197,896	6,767,530	1,657,240	396,870	1,372,594	3,944,632	306,802	2,400
Wayne	1,790	1,753	207,212	40,266	471,900	287,410	60,130	322,677	464,661	19,130	18,426
Webster	2,262	2,133	240,567	80,511	711,220	313,430	73,220	438,782	756,504	28,210	3,850
Wilkinson	2,687	2,600	268,548	109,247	1,337,840	484,730	134,815	578,595	1,196,863	82,280	6,060
Winston	2,592	2,414	294,870	98,319	800,900	351,890	97,360	425,348	909,761	26,490	16,220
Yalobusha	2,743	2,619	251,330	96,581	1,218,360	432,880	125,240	521,320	1,111,704	19,280	1,530
Yazoo	6,741	6,549	428,145	238,098	4,749,260	1,261,420	346,720	1,323,842	3,493,122	239,850	7,320

Increases in the number of farms in the last decade are reported for all counties except Issaquena. The total acreage of farm land increased in two-thirds of the counties, while the remaining counties show decreases. The decrease in improved acreage reported for nearly one-fifth of the counties is due to a more intensive cultivation of smaller areas of farm land, and to the use of a more strict definition of the term "improved" by the Twelfth than by any preceding census. The average size of farms for the state is 82.6 acres, ranging from 38.7 acres in Washington county to 232.3 acres in Jackson county. The average size of farms is, as a rule, largest in the southern counties, and smallest in the northern counties having the greatest acreages in cotton.

Between 1890 and 1900 the total value of farms decreased in nearly one-sixth of the counties, these, with one exception, being in the northern part of the state. For the state, the average value of farms was $688.43. Issaquena alone reported a decrease in the value of implements and machinery, and every county but De Soto, Issaquena, and Monroe reported a gain in the value of live stock.

Very few counties reported large average expenditures per farm for labor in 1899. The amount varied from less than $1 per farm in Benton county to over $70 per farm in Tunica county. In the counties reporting low averages, cultivation was not intensive and farmers exchanged labor or paid in produce. One-third of the counties, usually those reporting large expenditures in 1889, showed a decrease in the total expenditures for fertilizers in 1899.

FARM TENURE.

Table 4 is an exhibit of farm tenure for 1880, 1890, and 1900, showing the number and per cent of farms operated by owners and by tenants. Tenants are divided into two groups: "Cash tenants," who pay a rental in cash or in a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms in 1900 is given by race of farmer, and "farms operated by owners" are subdivided into groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it and the other, or others, owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

Table 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	220,803	82,951	70,699	67,153	37.6	32.0	30.4
1890	144,318	68,058	30,366	45,894	47.2	21.0	31.8
1880	101,772	57,214	17,440	27,118	56.2	17.1	26.7

[1] Including "part owners," "owners and tenants," and "managers."

Table 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	220,803	75,981	5,431	609	930	70,699	67,153
White	92,124	57,613	2,972	463	823	13,505	16,748
Colored	128,679	18,368	2,459	146	107	57,194	50,405
Indian	328	102	2	....	....	50	174
Negro	128,351	18,266	2,457	146	107	57,144	50,231

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	34.4	2.5	0.3	0.4	32.0	30.4
White	100.0	62.5	3.2	0.5	0.9	14.7	18.2
Colored	100.0	14.3	1.9	0.1	0.1	44.4	39.2

In the period from 1880 to 1900 the total number of farms increased 117.0 per cent, and in the last decade, 53.0 per cent. Since 1890, the number of farms operated by owners has increased 21.9 per cent; by cash tenants, 132.8 per cent; and by share tenants, 46.3 per cent. The percentages shown in Table 4 indicate that the number of farms operated by owners has not increased so rapidly since 1880 as the number operated by tenants.

In 1900, 41.7 per cent of the farms of the state were operated by white farmers and 58.3 per cent by colored farmers. Of the white farmers, 66.2 per cent owned all or a part of the farms they operated and 33.8 per cent operated farms owned by others. The corresponding percentages for colored farmers are 16.3 and 83.7, respectively.

In 1890, 39.8 per cent of all tenants were cash tenants, and in 1900, 51.3 per cent. Generally in the counties where most of the farmers are white, share tenants outnumber cash tenants; but in those counties where colored farmers predominate, the proportion of cash tenants is greater.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	220,803	82.6	18,240,736	100.0	$204,221,027	100.0
White	92,124	133.9	12,337,537	67.6	117,733,593	57.7
Negro	128,351	45.9	5,886,075	32.3	86,390,974	42.3
Indian	328	52.2	17,124	0.1	96,460	(1)
Owners	75,981	148.3	11,265,023	61.8	100,196,000	49.1
Part owners	5,431	111.0	602,674	3.3	5,808,863	2.8
Owners and tenants	609	148.0	90,130	0.5	694,683	0.3
Managers	930	555.0	516,176	2.8	8,756,607	4.3
Cash tenants	70,699	50.1	3,541,828	19.4	53,739,987	26.3
Share tenants	67,153	33.1	2,224,905	12.2	35,024,887	17.2

(1) Less than one-tenth of 1 per cent.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900.					Per cent of gross income on total investment in farm property.
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	
The State	$520	$168	$44	$193	$411	44.4
White	649	277	68	284	469	36.7
Negro	429	91	26	128	370	54.9
Indian	164	50	12	68	182	61.8
Owners	658	291	71	299	486	36.8
Part owners	563	207	53	247	418	39.0
Owners and tenants	560	224	55	302	455	39.8
Managers	6,048	1,582	522	1,264	1,640	17.4
Cash tenants	470	104	31	155	403	52.9
Share tenants	337	74	17	94	318	60.9

In 1900, 32.4 per cent of the total acreage was operated by colored farmers, while about one-tenth was actually owned by them. The value of the farms operated by colored farmers was 42.3 per cent of the total, although the value of farms owned by them was only about one-twelfth. The large per cent of gross income shown for colored farmers in Table 7 is due to the smaller size and consequent more intensive cultivation of their farms and to the lower value of their farm property, or capital invested. It is due also to the systems of tenure widely used in Southern states, under which the most fertile areas of the large plantations are rented in small tracts to negroes and appear as the farms of colored tenants, while the large unimproved areas, on which few products are raised and which contain the valuable buildings of the plantation, are retained by the proprietor and appear as the farms of white owners.

Farms conducted by share tenants have the smallest average area, 33.1 acres, and those of managers, the largest, 555.0 acres. These latter farms, as a rule, are favorably located and highly improved, many being large cotton plantations, and the average values of the various forms of farm property, shown in Table 7, are much larger for this class than for any other group classified by tenure. The ratio which the gross income of these farms bears to the total value of farm property is, however, smaller than for the other groups, due to the high average valuation of farm property or capital invested.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	220,803	82.6	18,240,736	100.0	$204,221,027	100.0
Under 3 acres	499	2.2	1,085	(1)	370,227	0.2
3 to 9 acres	6,242	6.9	43,018	0.2	2,299,814	1.1
10 to 19 acres	35,529	15.0	532,517	2.9	15,016,084	7.4
20 to 49 acres	85,934	31.0	2,667,004	14.6	51,540,352	25.2
50 to 99 acres	39,469	71.1	2,806,402	15.4	33,696,365	16.5
100 to 174 acres	31,380	136.6	4,287,219	23.5	35,154,413	17.2
175 to 259 acres	10,331	210.2	2,171,850	11.9	17,480,208	8.6
260 to 499 acres	8,099	337.6	2,734,103	15.0	21,027,518	10.3
500 to 999 acres	2,461	636.4	1,566,195	8.6	13,983,622	6.8
1,000 acres and over	859	1,666.3	1,431,343	7.9	13,652,424	6.7

(1) Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUE PER FARM OF— Farm property, June 1, 1900.					Per cent of gross income on total investment in farm property.
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	
The State	$520	$168	$44	$193	$411	44.4
Under 3 acres	145	382	22	193	177	23.8
3 to 9 acres	159	120	15	74	135	36.6
10 to 19 acres	250	73	15	85	246	58.3
20 to 49 acres	361	90	25	124	361	60.2
50 to 99 acres	461	150	42	201	453	53.1
100 to 174 acres	570	226	56	268	477	42.6
175 to 259 acres	869	362	90	371	573	33.9
260 to 499 acres	1,382	552	136	526	724	27.9
500 to 999 acres	3,409	1,072	305	896	1,190	20.9
1,000 acres and over	10,813	2,347	698	2,035	2,911	18.3

The total acreage is greatest for the group of farms containing 100 to 174 acres, but the group containing from 20 to 49 acres reports the greatest value of farm property.

For the group of farms of less than 3 acres, the average values given in Table 9 are relatively high, as this group contains many of the florists' establishments of the state, and a number of city dairies. It should be borne in mind that the income from these industries depends less upon the acreage of land used, than upon the amount of capital invested in buildings, implements, and live stock, and the expenditures for labor and fertilizers.

The average gross incomes per acre for the various groups classified by area are as follows: Farms under 3 acres, $81.36; 3 to 9 acres, $19.57; 10 to 19 acres, $16.44; 20 to 49 acres, $11.62; 50 to 99 acres, $6.37; 100 to 174 acres, $3.49; 175 to 259 acres, $2.73; 260 to 499 acres, $2.14; 500 to 999 acres, $1.87; 1,000 acres and over, $1.75.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm; if vegetables are the leading crop, constituting 40.0 per cent of the value of products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40.0 per cent of their income from any one class of products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	220,803	82.6	18,240,736	100.0	$204,221,027	100.0
Hay and grain	6,757	106.0	715,939	3.9	9,981,418	4.9
Vegetables	2,473	62.8	155,351	0.9	2,237,985	1.1
Fruits	301	137.0	41,239	0.2	539,619	0.3
Live stock	9,117	170.6	1,555,120	8.5	16,216,290	8.0
Dairy produce	2,965	121.1	359,048	2.0	4,599,781	2.3
Tobacco	59	70.7	4,172	(1)	50,375	(1)
Cotton	163,234	65.7	10,725,601	58.8	133,019,349	65.1
Rice	19	148.3	2,817	(1)	29,489	(1)
Sugar	49	146.6	7,185	0.1	55,126	(1)
Flowers and plants	11	2.7	30	(1)	25,427	(1)
Nursery products	14	125.1	1,761	(1)	66,460	(1)
Miscellaneous	35,804	130.5	4,672,483	25.6	37,399,708	18.3

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$520	$168	$44	$193	$411	44.4
Hay and grain	872	329	74	202	313	21.2
Vegetables	452	230	46	177	367	40.5
Fruits	926	496	78	293	806	45.0
Live stock	810	411	101	457	402	22.6
Dairy produce	698	415	69	369	304	19.6
Tobacco	517	142	45	150	467	54.7
Cotton	489	127	36	163	425	52.2
Rice	906	279	74	293	480	30.9
Sugar	597	196	118	214	431	38.3
Flowers and plants	655	1,514	72	71	1,059	45.8
Nursery products	3,326	1,090	108	223	1,941	40.9
Miscellaneous	507	236	56	246	375	36.0

The importance of cotton growing in this state is shown by the fact that cotton plantations comprise 58.8 per cent of the total area in farms and 65.1 per cent of the total value of farm property.

For the several classes of farms the average values per acre of the products not fed to live stock are as follows: Farms deriving their principal income from flowers and plants, $388.47; nursery products, $15.52; tobacco, $6.60; cotton, $6.47; fruits, $5.88; vegetables, $5.83; rice, $3.23; hay and grain, $2.95; sugar, $2.94; miscellaneous, $2.88; dairy produce, $2.51; and live stock, $2.36.

The wide variations shown in the averages and in the percentages of gross income are largely due to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens the average expenditures for such items as labor and fertilizers represent a far larger percentage of the gross income than in the case of "hay and grain," "live-stock," or "miscellaneous" farms. Were it possible to present the average net incomes the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	220,803	82.6	18,240,736	100.0	$204,221,027	100.0
$0	2,766	32.6	90,078	0.5	1,325,010	0.7
$1 to $49	6,089	35.6	216,826	1.2	2,220,460	1.1
$50 to $99	9,727	43.1	419,504	2.3	3,971,270	1.9
$100 to $249	60,394	52.3	3,157,039	17.3	29,650,870	14.5
$250 to $499	89,539	74.2	6,647,933	36.5	69,224,530	33.9
$500 to $999	43,030	121.0	5,205,842	28.5	60,371,427	29.6
$1,000 to $2,499	8,063	220.3	1,776,341	9.7	24,532,490	12.0
$2,500 and over	1,195	608.5	727,173	4.0	12,924,970	6.3

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$520	$168	$44	$193	$411	44.4
$0	318	75	15	71	....	....
$1 to $49	215	72	13	65	26	7.0
$50 to $99	226	86	17	79	75	18.3
$100 to $249	268	94	21	108	189	38.5
$250 to $499	423	143	34	173	379	48.9
$500 to $999	795	242	66	300	687	48.9
$1,000 to $2,499	1,731	569	164	579	1,251	41.1
$2,500 and over	6,903	1,802	618	1,493	4,146	38.3

The absence of income in the first group is due in part to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The persons in charge of such farms on June 1, 1900, could not always give definite information concerning the products of the preceding year. The same statement is true, also, of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete statement of farm income in 1899. Other farms with small reported incomes are doubtless the country homes of city merchants and professional men, who derive their principal incomes from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping of neat cattle was determined by their present and prospective relation to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—NUMBER AND VALUE OF DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	238,601	$1,157,630	$4.85	9,935
Steers	1 and under 2	63,962	525,015	8.21	2,189
Steers	2 and under 3	35,111	404,282	11.51	1,245
Steers	3 and over	43,149	1,040,517	24.11	3,404
Bulls	1 and over	17,601	288,883	16.41	486
Heifers	1 and under 2	89,985	899,800	10.00	2,515
Cows kept for milk	2 and over	299,318	6,408,246	21.41	16,899
Cows and heifers not kept for milk.	2 and over	85,629	1,346,548	15.73	1,346
Colts	Under 1	17,089	367,069	21.48	401
Horses	1 and under 2	14,489	495,714	34.21	372
Horses	2 and over	197,733	10,020,068	50.67	14,960
Mule colts	Under 1	7,581	220,146	29.04	76
Mules	1 and under 2	12,286	606,409	49.36	154
Mules	2 and over	194,392	13,302,252	68.43	4,132
Asses and burros	All ages	1,773	216,609	122.17	244
Lambs	Under 1	76,162	107,166	1.41	759
Sheep (ewes)	1 and over	162,188	289,401	1.78	1,598
Sheep (rams and wethers).	1 and over	74,282	138,378	1.86	762
Swine	All ages	1,290,498	2,963,573	2.30	23,126
Goats	All ages	55,388	45,594	0.82	1,895
Fowls:[1]					
Chickens[2]	....	5,194,856	1,655,319	....	....
Turkeys	....	189,698			
Geese	....	357,963			
Ducks	....	95,668			
Bees (swarms of)	....	95,257	158,603	1.66	....
Value of all live stock.	....	....	42,657,222	....	....

[1] The number reported is of fowls over three months old. The value is for all, old and young.
[2] Including Guinea fowls.

The total value of live stock on farms, June 1, 1900, was $42,657,222, of which amount 33.1 per cent represents the value of mules; 25.5 per cent, that of horses; 15.0 per cent, that of dairy cows; 13.3 per cent, that of other neat cattle; 6.9 per cent, that of swine; 3.9 per cent, that of poultry; 1.3 per cent, that of sheep; and 1.0 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of the domestic animals not on farms is $1,740,471. Exclusive of poultry and bees not on farms, the total value of the live stock in the state is approximately $44,397,693.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the change since 1850 in the number of the most important domestic animals:

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	299,318	574,038	229,311	216,032	236,470	1,290,498
1890	310,159	604,619	155,050	156,755	451,779	1,163,141
1880	268,178	449,157	112,309	129,778	287,694	1,151,818
1870	173,899	327,176	90,221	85,886	232,732	814,381
1860	207,646	522,263	117,571	110,723	352,632	1,532,768
1850	214,231	519,739	115,460	54,547	304,929	1,582,734

[1] Lambs not included.

The census of 1900 shows an increase in the number of dairy cows of 39.7 per cent since 1850, but a decrease of 3.5 per cent in the last decade. The apparent decrease was due to the restriction in 1900 of the term "dairy cows" to those "kept for milk" exclusively, while many cows which were milked at some time in the year were included among the 85,629 "cows and heifers not kept for milk." The increase in all dairy products confirms this statement.

"Other neat cattle" show an increase in number of 10.4 per cent since 1850, and a decrease of 5.1 per cent since 1890. The number of horses has increased 98.6 per cent in the last half century, and that of mules, nearly four times. Sheep have decreased 22.4 per cent, and swine, 18.5 per cent. In the last decade the number of horses has increased 47.9 per cent; mules, 37.8 per cent; and swine, 10.9 per cent; while sheep have decreased 47.7 per cent in the same time.

In comparing the poultry report of 1900 (see Table 14) it should be borne in mind that in 1900 the enumerators were instructed to report no fowls under three months old, while in 1890 no such restriction was made. Compared with the figures for 1890, the present census shows an increase of 50.1 per cent in the number of ducks reported, and decreases in the number of other fowls as follows: Geese, 24.6 per cent; chickens, 7.8 per cent; and turkeys, 2.4 per cent.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the animal products of 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS, IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	779,310	$144,758
Mohair and goat hair	Pounds	268	84
Milk	Gallons	[1] 97,030,385	
Butter	Pounds	18,881,236	[2] 6,064,513
Cheese	Pounds	28,572	
Eggs	Dozens	18,942,070	1,871,765
Poultry			2,387,484
Honey	Pounds	1,048,490	113,021
Wax	Pounds	49,170	
Animals sold			2,208,466
Animals slaughtered			4,818,416
Total			17,608,507

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of all milk sold or consumed and of butter and cheese made.

The value of the animal products of the state in 1899 was $17,608,507, of which amount 39.9 per cent represents the value of animals sold and animals slaughtered on farms; 34.4 per cent, that of dairy products; 24.2 per cent, that of poultry and eggs; 0.8 per cent, that of wool, mohair, and goat hair; and 0.7 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms, $7,026,882, was 7.7 per cent of the gross farm income. Of all farmers reporting domestic animals, 138,390, or 65.9 per cent, reported animals slaughtered, the average value per farm being $34.82; and 52,189, or 24.8 per cent, reported sales of live animals, the average receipts per farm being $42.32.

DAIRY PRODUCE.

In 1899 the proprietors of 2,965 farms, or 1.3 per cent of the farms of the state, derived their principal income from the sale of dairy produce. The production of milk in 1899 was 46,227,014 gallons greater than in 1889, the gain being 91.0 per cent. The quantity of butter made on farms increased 45.4 per cent in the same time, and that of cheese nearly six times.

Of the $6,064,513 given in Table 16 as the value of dairy produce, $5,334,225, or 88.0 per cent, represents the value of such produce consumed on farms, and $730,288, or 12.0 per cent, the receipts from sales. Of the latter amount, $443,956 was received from the sale of 2,654,703 pounds of butter; $279,968, from 2,041,443 gallons of milk; $4,864, from 8,191 gallons of cream; and $1,500, from 11,192 pounds of cheese.

POULTRY AND EGGS.

Of the $4,259,249 given as the value of poultry products, $2,387,484, or 56.1 per cent, represents the value of poultry raised, and $1,871,765, or 43.9 per cent, the value of eggs produced. There were 18,942,070 dozen eggs produced in 1899, a gain of 66.3 per cent since 1889. This tends to confirm the statement made in the discussion of Table 15, that the apparent decrease in the numbers of fowls is due to a difference in methods of enumeration.

WOOL.

Perry county leads in the production of wool, with Pearl River second. The production of wool increased in the forty years preceding 1890, with the exception of the decade 1860 to 1870, but in 1900 both sheep and wool showed marked decreases, that of wool for the last decade being 24.9 per cent. This decrease was probably more marked than the percentage indicates, as the fleeces of at least 76,843 sheep were omitted from the tables in 1900, but included in a general estimate of wool shorn after the census enumeration. The average weight of fleeces increased from 2.8 pounds in 1889 to 3.1 pounds in 1900.

HONEY AND WAX.

In 1890, 822,673 pounds of honey and 21,962 pounds of wax were reported, while in 1900 there were 1,048,490 pounds of honey and 49,170 pounds of wax. Yazoo, Attala, Copiah, Bolivar, and Lauderdale counties, ranking in the order named, lead in apiarian products.

HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses, mules, and dairy cows, and the average number of these animals per farm. In computing the averages presented, only those farms which report the kind of live stock under consideration are included.

TABLE 17.—HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.		MULES.		DAIRY COWS.	
	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.
Total	127,033	1.8	119,983	1.8	139,307	2.1
White farmers	67,816	2.0	47,280	2.4	76,821	2.6
Colored farmers	59,217	1.5	72,703	1.4	62,486	1.6
Owners[1]	63,601	2.1	45,429	2.2	70,853	2.6
Managers	736	3.9	779	11.1	708	5.0
Cash tenants	39,793	1.6	42,978	1.5	39,448	1.7
Share tenants	22,903	1.4	30,797	1.3	28,298	1.5
Under 20 acres	15,647	1.3	17,714	1.1	14,390	1.6
20 to 99 acres	68,450	1.6	68,008	1.5	76,917	1.7
100 to 174 acres	24,398	2.0	18,481	1.9	27,754	2.4
175 to 259 acres	8,532	2.3	7,087	2.4	9,603	3.0
260 acres and over	10,006	3.2	8,693	4.6	10,643	4.4
Hay and grain	3,296	1.9	2,632	2.6	2,924	2.3
Vegetable	1,610	1.7	981	1.6	1,314	2.3
Fruit	226	2.1	145	2.1	234	2.6
Live stock	7,271	2.5	4,614	3.4	7,912	3.1
Dairy	2,306	2.2	1,001	2.4	2,965	4.9
Cotton	85,996	1.7	94,402	1.7	93,061	1.9
Miscellaneous[2]	26,328	1.9	16,208	1.9	30,897	2.4

[1] Including "part owners" and "owners and tenants."
[2] Including tobacco farms, rice farms, sugar farms, florists' establishments, and nurseries.

In Mississippi, as in all states where much of the farm labor is performed by negroes, and where cotton is a staple crop, large numbers of mules are used as work animals. If the numbers of horses and mules be combined, the average number of work animals per farm compares favorably with the corresponding figures for the more intensively cultivated farms of New England.

CROPS.

The following table gives the statistics of the principal crops grown in 1899:

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	2,276,313	Bushels	38,789,920	$18,873,934
Wheat	6,447	Bushels	37,257	30,743
Oats	87,066	Bushels	862,805	383,633
Barley	32	Bushels	330	203
Rye	103	Bushels	963	755
Broom corn	214	Pounds	143,750	6,950
Rice	2,095	Pounds	739,222	28,564
Kafir corn	9	Bushels	277	136
Clover seed		Bushels	130	432
Grass seed		Bushels	379	600
Hay and forage	99,261	Tons	164,650	1,459,879
Cottonseed		Tons	[1] 634,083	6,692,027
Cotton	2,897,920	Bales	1,313,798	47,340,314
Tobacco	203	Pounds	62,760	9,225
Hops	(2)	Pounds	15	2
Peanuts	5,853	Bushels	95,738	89,350
Dry beans	1,149	Bushels	11,162	11,672
Dry pease	69,490	Bushels	590,537	567,279
Potatoes	6,370	Bushels	398,272	245,777
Sweet potatoes	38,169	Bushels	2,817,386	1,458,490
Onions	233	Bushels	26,243	24,058
Miscellaneous vegetables	50,356			2,807,652
Sugar cane	11,552	Tons	122,384	
(a) Cane sold		Tons	[3] 5,914	23,918
(b) Cane kept for seed		Tons	45,809	161,084
(c) Sugar made		Pounds	18,930	893
(d) Sirup and molasses made.		Gallons	1,413,219	618,975
Sorghum cane	15,734	Tons	[3] 3,366	10,052
Sorghum sirup		Gallons	1,162,269	313,365
Small fruits	1,549			141,009
Grapes	[4] 426	Centals	10,706	[5] 39,277
Orchard fruits	[4] 40,304			[6] 440,118
Tropical fruits				1,226
Nuts				17,158
Forest products				3,023,626
Flowers and plants	62			26,907
Seeds	4			153
Nursery products	181			31,305
Miscellaneous	19			3,035
Total	5,611,114			84,883,776

[1] Exclusive of 14,137 tons, valued at $149,145, sold in seed cotton, and included with the cotton.
[2] Less than one acre.
[3] Sold as cane.
[4] Estimated from number of vines or trees.
[5] Including value of raisins, wine, etc.
[6] Including value of cider and vinegar.

Of the total value of crops, cotton, including seed, contributed 63.6 per cent; cereals, including Kafir corn and rice, 22.8 per cent; forest products, 3.6 per cent; miscellaneous vegetables, 3.3 per cent; hay and forage, 1.7 per cent; sweet potatoes, 1.7 per cent; and all other products, 3.3 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $434; nursery products, $173; onions, $103; miscellaneous vegetables, $56; tobacco, $45; potatoes, $39; sweet potatoes, $38; broom corn, $32; cotton, $16; hay and forage, $15; peanuts, $15; orchard fruits, $11; dry beans, $10; and cereals, $8. The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production requires a relatively great amount of labor and large expenditures for fertilizers.

COTTON.

The following table is an exhibit of the changes in cotton production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF COTTON: 1849 TO 1899.

YEAR.	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	2,897,920	0.5	1,313,798	643,339,470	16.8
1889	2,883,278	36.9	1,154,725	550,803,825	26.2
1879	2,106,215		963,111	436,289,283	77.9
1869			564,938	245,183,092	[1]54.2
1869			1,202,507	535,115,615	176.2
1849			484,292	193,716,800	

[1] Decrease.

In 1859 the amount of cotton produced was nearly three times that of 1849. The Civil War, occurring during the next decade affected all industries, and the quantity of cotton grown decreased 54.2 per cent. From 1869 to 1889 it increased rapidly, and although only a slightly increased acreage was shown for 1899, the production showed a gain of 16.8 per cent for the last decade. Decreases in acreage are noted for many of the counties located in the southern and western parts of the state.

In 1899, 186,999 farmers devoted to cotton an area of 2,897,920 acres, and 38.2 per cent of the improved farm land of the state, an average of 15.5 acres per farm. From this land was produced 643,339,470 pounds of cotton, an average of 222 pounds per acre, 13,883 pounds per square mile of land surface of the state, and 415 pounds per capita. The total value of the product, including the value of the seed, was $54,032,341, an average of $288.94 per farm, and $18.65 per acre. This value constituted 59.5 per cent of the gross farm income.

All the counties in the state are reported as raising cotton, those devoting the greatest number of acres to this product being Yazoo, Washington, Hinds, Bolivar, Noxubee, Holmes, Monroe, and Panola, ranking in the order named and reporting 25.1 per cent of the total acreage.

CEREALS.

Table 20 presents an exhibit of the changes in cereal production since 1849.

TABLE 20.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	32	2,276,313	87,066	2,095	103	6,447
1889	80	1,706,352	133,361	1,543	406	2,519
1879	44	1,570,550	198,497	3,501	806	43,524

[1] No statistics of acreage were secured prior to 1879.

TABLE 20.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899—Continued.

PART 2.—BUSHELS PRODUCED.[1]

YEAR.[2]	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	330	38,789,920	862,805	739,222	963	37,257
1889	875	26,148,144	1,362,290	676,746	3,544	16,570
1879	348	21,340,800	1,959,620	1,718,951	5,134	218,890
1869	3,973	15,637,316	414,586	374,627	14,852	274,479
1859	1,875	29,057,682	221,235	809,082	39,474	587,925
1849	228	22,446,552	1,503,288	2,719,856	9,606	137,990

[1] Rice reported in pounds.
[2] No statistics of acreage were secured prior to 1879.

The total area devoted to cereals in 1879 was 1,816,922 acres; in 1889, 1,844,261 acres; and in 1899, 2,372,065 acres; an increase for the twenty years of 30.6 per cent. The acreage given for 1899 includes 9 acres devoted to Kafir corn. The increases in the areas devoted to the various cereals in the decade 1889 to 1899 were: Wheat, 155.9 per cent; rice, 35.8 per cent; and corn, 33.4 per cent. The decreases were: Rye, 74.6 per cent; barley, 60.0 per cent; and oats, 34.7 per cent.

Exclusive of rice the total number of bushels reported in 1849 was 24,097,664; and for 1899, 39,691,275; an increase of 64.7 per cent in the half century. The production of rice shows a decrease in the same time of 72.8 per cent.

Of the total area under cereals in 1899, 95.9 per cent was devoted to corn; 3.7 per cent, to oats; and 0.4 per cent, to wheat, rice, rye, barley, and Kafir corn.

Corn, wheat, oats, and rye were reported from nearly all parts of the state. Kafir corn was grown in the 3 counties of Benton, Copiah, and Tippah. Rice was grown in 48 counties, of which the 6 counties of Copiah, Lawrence, Lincoln, Marion, Rankin, and Simpson furnished 60.5 per cent of the entire acreage.

HAY AND FORAGE.

In 1900, 43,012 farmers, or 19.5 per cent of the total number, reported hay or forage crops. Excluding cornstalks and corn strippings, they obtained an average yield of 1.3 tons per acre. The total acreage in hay and forage for 1899 was 99,261, or 50.0 per cent greater than ten years before. Of this acreage 49.2 per cent, or 48,848 acres, produced 65,138 tons of grains cut green for hay.

In 1899 the acreages and yields of the various other kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 6,753 acres and 7,965 tons; millet and Hungarian grasses, 1,397 acres and 2,369 tons; alfalfa or lucerne, 99 acres and 201 tons; clover, 2,940 acres and 3,500 tons; other tame and cultivated grasses, 34,157 acres and 42,638 tons; crops grown for forage, 5,067 acres and 7,521 tons; and cornstalks and corn strippings, 146,709 acres and 35,318 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is part of that given for "corn," as the forage secured was only an incidental product of the crop.

SUGAR CANE.

Table 21 presents a comparative exhibit of the acreage of sugar cane, and the production of sugar and sirup: 1849 to 1899.

TABLE 21.—ACREAGE OF SUGAR CANE AND PRODUCTION OF SUGAR AND SIRUP: 1849 TO 1899.

YEAR.[1]	Acreage in cane.	SUGAR.		SIRUP.	
		Production in pounds.	Average yield per acre in pounds.	Production in gallons.	Average yield per acre in gallons.
1899	11,552	18,930	1.6	1,413,219	122.3
1889	12,694	67,860	5.3	1,524,024	120.1
1879	4,555	21,600	4.7	536,625	117.8
1869		58,800		152,164	
1859		607,200		10,016	
1849		465,600			

[1] No statistics of acreage were secured prior to 1879.

The present census shows that in 1899 sugar cane was grown by 26,300 farmers on 11,552 acres, an average of 0.44 acre for each farm reporting. From this area they sold 5,914 tons of cane for $23,918, and from the remaining product manufactured 18,930 pounds of sugar, valued at $893, and 1,413,219 gallons of sirup and molasses valued at $618,975. This was a decrease in acreage since 1889 of 8.9 per cent. The total value of sugar-cane products was $643,786, an average of $24.48 for each farm reporting, and of $55.73 per acre. The value of sugar was 4.7 cents per pound, and of sirup and molasses 43.8 cents per gallon.

In addition to the above it is estimated that 45,809 tons of cane, valued at $161,084, were kept for seed.

SORGHUM CANE.

Sorghum cane was grown in 1899 by 25,183 farmers on 15,734 acres, an average of 0.62 acre for each farm reporting. From this area they sold 3,366 tons of cane for $10,052, and from the remaining product manufactured 1,162,269 gallons of sirup, valued at $313,365. The total value of sorghum-cane products was $323,417, an average of $12.84 for each farm reporting, and of $20.56 per acre.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 may be seen in the following table:

TABLE 22.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	705,796	357,309	249,035	605,368
Apricots	5,109	961	772	781
Cherries	30,186	7,579	2,352	3,861
Peaches	1,856,748	878,569	252,305	1,324,354
Pears	177,824	27,107	36,923	18,531
Plums and prunes	689,053	501,392	66,793	107,502

In 1890 the total number of fruit trees was 1,772,917; in 1900 there were 3,499,818, showing an increase for the decade of 1,726,901, or 97.4 per cent. There were more than six times as many pear trees, more than five times as many apricot trees, and nearly four times as many cherry trees reported in 1900 as in 1890. Peach trees increased 111.3 per cent; apple trees, 97.5 per cent; and plum and prune trees, 37.4 per cent, in the last decade.

Of the total number of fruit trees in 1900, 53.0 per cent were peach trees; 20.2 per cent, apple trees; 19.7 per cent, plum and prune trees; 7.1 per cent, pear, cherry, apricot, and unclassified fruit trees. The latter class, which is not included in the table, numbered 35,102 trees and yielded 2,747 bushels of fruit.

The value of orchard fruits, given in Table 18, includes the value of 480 barrels of cider, 388 barrels of vinegar, and 19,290 pounds of dried and evaporated fruits. Comparisons of the yields of orchard fruits, or of their values, are of little importance, as the yield of any given year depends largely upon the nature of the season.

The northern half of the state reports the largest number of the various kinds of fruit trees and shows large increases since 1890. The southern half of the state is better adapted to the cultivation of the tropical fruits. Peach trees, however, are reported from every county, the increase being quite general throughout the state. The six counties which rank above the others in the number of these trees and report 23.3 per cent of the total number, are Madison, Lee, Hinds, Prentiss, Tippah, and Copiah counties.

TROPICAL FRUITS.

The Twelfth Census reports 12,739 fig, 2 lemon, 3,696 orange, and 4 pomelo trees. Two hundred and sixty farms reported fig trees, with a yield of 61,600 pounds, valued at $1,226. For the other tropical fruit trees no products were reported.

SMALL FRUITS.

The total area devoted to small fruits in 1899 was 1,549 acres, distributed among 2,292 farms, an average of 0.7 acre per farm. Of the total area 1,383 acres, or 89.3 per cent, were devoted to strawberries yielding 1,546,570 quarts. The acreages and productions of the other berries were as follows: Blackberries and dewberries, 84 acres and 97,030 quarts; raspberries and Logan berries, 49 acres and 56,020 quarts; currants, 3 acres and 2,830 quarts; gooseberries, 1 acre and 590 quarts; and other small fruits, 29 acres and 32,440 quarts.

VEGETABLES.

The total value of vegetables grown in 1899, including potatoes, sweet potatoes, and onions, was $4,535,977, of which 32.2 per cent represents the value of sweet potatoes; 5.4 per cent, that of potatoes; 0.5 per cent, that of onions; and 61.9 per cent, that of miscellaneous vegetables.

Sweet potatoes were grown in 1899 by 67,490 farmers, or 30.6 per cent of the total number in the state. The area devoted to this crop in 1889 was 44,188 acres, and in 1899, 38,169 acres, a decrease of 13.6 per cent. They were grown most extensively in the southern part of the state.

In the growing of miscellaneous vegetables 50,356 acres were used. Of this area the products of 38,357 acres were not reported in detail. Of the remaining 11,999 acres, 6,253 acres were devoted to watermelons; 2,587 acres, to tomatoes; 1,614 acres, to cabbages; 622 acres, to muskmelons; 244 acres, to cucumbers; 224 acres, to beans; and 455 acres, to other vegetables.

PEANUTS.

Peanuts were grown in 1899 by 8,417 farmers, who devoted to their cultivation 5,853 acres, and secured therefrom a product of 95,738 bushels, an average of 16.4 bushels per acre. Increases of 198.6 per cent in acreage and 132.5 per cent in production are shown for the last decade. All counties of the state reported peanuts; Clarke, Monroe, Marion, and Lauderdale leading. The average acreage per farm was 0.7, and in but few counties exceeded 1 acre.

TOBACCO.

The tobacco crop of Mississippi, like that of many other states, has been subject to great fluctuation. The state produced in 1849, 49,960 pounds of tobacco. The census of 1860 showed a gain over this amount of 109,181 pounds, or 218.5 per cent. The census of 1870 showed a falling off from this of 98,129 pounds, or 61.7 per cent. Between 1870 and 1880 the production increased from 61,012 to 414,663 pounds, a gain of 353,651 pounds, while between 1880 and 1890 there was a decrease of about the same number of pounds, or 85.0 per cent.

The present census shows that in 1899 tobacco was grown in Mississippi by 1,119 farmers, who obtained from 203 acres a yield of 62,760 pounds. This was a gain of 649 pounds, or 1.0 per cent over the crop of 1889, from an area 31 acres less than that of 1889. The total value of the crop was $9,225, or an average of $8.24 for each farm reporting.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 42 acres, and the value of the products sold therefrom was $26,907. These flowers and plants were grown by 53 farmers and florists. Of this number, 11 made commercial floriculture their principal business. They had invested in the aggregate $25,427, of which $7,200 represents the value of the land and improvements other than buildings; $16,650, the value of buildings; $790, that of implements and machinery; and $787, that of live stock. Their sales of flowers and plants amounted to $10,669, and they reported other products valued at $985. They expended for labor $2,985 and for fertilizers $90. The average gross income for each farm reporting was $1,059.

In addition to 10 of the 11 principal florists' establishments, 276 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 61,290 square feet, making, with the 58,890 square feet belonging to the florists' establishments, a total of 120,180 square feet.

NURSERIES.

The total value of nursery stock sold in 1899 was $31,305, reported by the operators of 53 farms and nurseries. Of this number, 14 derived their principal income from the nursery business. They had 1,751 acres of land, valued at $46,560; buildings worth $15,265; implements and machinery, $1,510; and live stock, $3,125. Their total income, inclusive of products fed to live stock, was $28,458, of which $21,978 represents the value of nursery stock, and $6,480 that of other products. The expenditure for labor was $6,800, and for fertilizers, $895. The average income for each farm reporting, including products fed to live stock, was $2,033.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $3,917,256, an average of $18 per farm. The average expenditure was highest on the most intensively cultivated farms, being $486 for nurseries, $271 for florists' establishments, $88 for fruit farms, $35 for hay and grain farms, $30 for live-stock farms, $23 for vegetable farms, $20 for dairy farms, $19 for tobacco farms, $17 for cotton farms, $14 for sugar farms, and $7 for rice farms "Managers" expended on an average, $331; "owners," $27; "cash tenants," $15; and "share tenants," $6. White farmers expended $28 per farm, and colored farmers, $10.

Fertilizers purchased in 1899 cost $932,098, an average of $4 per farm, and an increase since 1890 of 18.1 per cent. The average expenditure was $64 for nurseries, $15 for sugar farms, $13 for vegetable farms, $12 for fruit and rice farms, $8 for florists' establishments, $6 for live-stock and dairy farms, $5 for tobacco farms, $4 for hay and grain farms, and $3 for cotton farms.

IRRIGATION STATISTICS.

Irrigation does not occupy an important place in the agriculture of Mississippi. In 1899, on three farms, 40 acres were irrigated—30 acres in rice and 10 acres in truck and small fruits. The irrigating systems cost $2,825. The most extensive plant is reported from Lauderdale county, and consists of a reservoir capable of irrigating 150 acres, which was made by damming a ravine. A large spring in the hill by the plantation furnishes the supply, which is stored in the reservoir, and thence directed by means of pipes and ditches to the land to be irrigated. This irrigating system complete cost $2,500. On this farm 4 acres in cabbage produced 30,000 heads; 1 acre in asparagus, 2,000 bunches; 1 acre in celery, 2,000 bunches; 2 acres in strawberries, 10,000 quarts; and 1 acre in rice, 4,000 pounds. The value of the irrigated crops on 10 acres was approximately $1,800, or $180 per acre.

The alluvial lands of the state are undoubtedly adapted to the cultivation of rice, but this industry occupies the attention of the agriculturist only to a limited extent. The introduction of modern systems of irrigation would tend greatly to promote the extension of the areas in this crop, and would increase the average yield per acre, which is now only 352 pounds for the state.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 226. WASHINGTON, D. C. JULY 3, 1902.

AGRICULTURE.

TENNESSEE.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Tennessee, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, together with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Tennessee, June 1, 1900, numbered 224,623, and were valued at $265,150,750. Of this amount $63,136,960, or 23.8 per cent, represents the value of buildings, and $202,013,790, or 76.2 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $15,232,670, and of live stock, $60,818,605. These values, added to that of farms, give $341,202,025, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $106,166,440, of which amount $35,421,198, or 33.4 per cent, represents the value of animal products, and $70,745,242, or 66.6 per cent, the value of crops, including forest products cut or produced on farms. The "total value of farm products" for 1899 is approximately twice that for 1889, but a part of this increase is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting the value of the products fed to live stock on the farms of the producers from the total value of farm products. In 1899 the reported value of products fed was $18,430,310, leaving $87,736,130 as the gross farm income for that year. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Tennessee in 1899 it was 25.7 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture for the United States. The present publication is designed to present a summarized advance statement for Tennessee.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN TENNESSEE.

GENERAL STATISTICS.

The total land area of Tennessee is 41,750 square miles, or 26,720,000 acres, of which 20,342,058 acres, or 76.1 per cent, are included in farms.

Tennessee is divided into three sections—east, middle, and west. East Tennessee extends from the bordering mountains of the Appalachian system to the crest of the Cumberland Plateau, and contains some of the highest ridges of the mountain system, and a valley region of about 100 miles in width, the valley being broken by many minor elevations and depressions.

The middle section is formed by extensions of the Cumberland Plateau at the north and south, reaching as far west as the northern course of the Tennessee River. This extension, known as the Highland Rim, incloses a depression 5,450 square miles in area, resembling the bed of a drained lake and called the Central Basin.

The western division extends from the West Tennessee River to the Mississippi. The eastern part of this section contains ridges and bluffs, and the western is composed of the alluvial bottom lands of the Mississippi, interspersed with numerous lakes and swamps.

The soil in the west is sandy, mellow, and generally fertile, while the black loams of the Mississippi bottom lands are the richest in the state. The greatest diversity of soil is found in east Tennessee, only the valleys and river bottoms having high fertility. The soil of the Cumberland Plateau is sandy, porous, and not very productive, but the rich limestone soils of the Central Basin produce abundantly.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the per cent of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	224,623	20,342,058	10,245,950	10,096,108	90.6	50.4
1890	174,412	20,161,583	9,362,555	10,799,028	115.6	46.4
1880	165,650	20,666,915	8,496,556	12,170,359	124.8	41.1
1870	118,141	19,581,214	6,843,278	12,737,936	165.7	34.9
1860	82,368	20,669,165	6,795,337	13,873,828	250.9	32.9
1850	72,735	18,984,022	5,175,173	13,808,849	261.0	27.3

The total number of farms reported in 1900 was over three times as great as in 1850 and 28.8 per cent greater than in 1890. The total acreage has not increased rapidly, the gain since 1850 being but 7.2 per cent, and in the last decade but 0.9 per cent. These changes have resulted in a continuous decrease in the average size of farms, indicating a progressive division of farm holdings and a more complete utilization of the soil. The area of improved land has increased continuously since 1870 and at a more rapid rate than the total farm acreage, the per cent of farm land improved being greater in 1900 than in any previous census year.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$341,202,025	$265,150,750	$15,232,670	$60,818,605	$106,166,440
1890	312,891,650	242,700,540	9,936,880	60,254,230	55,194,181
1880	259,456,170	206,749,837	9,054,863	43,651,470	62,076,311
1870[2]	282,027,309	218,743,747	8,199,487	55,084,075	[3]86,472,847
1860	340,036,202	271,358,985	8,465,792	60,211,425	....
1850	133,189,438	97,851,212	5,360,210	29,978,016	....

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

The above table shows the remarkable growth of agriculture in the half century from 1850 to 1900. The increase in the total value of farm property since 1890 was $28,310,375, or 9.0 per cent. The increase in the value of land, improvements, and buildings was $22,450,210, or 9.3 per cent; in that of implements and machinery, $5,295,790, or 53.3 per cent; and in that of live stock, $564,375, or 0.9 per cent. The value of farm products in 1899 was 92.4 per cent greater than the value reported for 1889. A part of this increase, and of that shown for implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous years.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	224,623	216,550	20,342,058	10,245,950	$202,013,790	$63,136,960	$15,232,670	$60,818,605	$87,736,130	$4,730,370	$898,070
Anderson	1,595	1,584	180,291	70,295	1,381,210	386,100	85,620	378,428	491,557	26,260	2,070
Bedford	2,887	2,831	287,612	190,144	5,187,330	1,441,930	345,010	1,263,968	1,637,465	97,100	8,970
Benton	1,916	1,762	204,047	70,420	876,720	294,930	77,710	444,690	600,840	10,510	830
Bledsoe	984	946	140,101	50,493	1,102,790	235,040	57,730	321,440	392,626	18,900	6,580
Blount	2,161	2,125	277,982	131,944	2,447,620	633,750	184,070	612,447	912,556	42,660	22,900
Bradley	1,728	1,636	192,081	93,040	1,405,600	476,850	133,210	393,091	624,636	17,830	16,310
Campbell	1,834	1,789	167,969	68,392	1,031,660	328,170	67,010	384,623	477,608	18,710	4,380
Cannon	1,950	1,852	155,225	74,363	1,395,270	416,080	110,340	648,196	713,424	34,590	3,500
Carroll	3,785	3,637	320,326	173,287	1,977,500	738,340	227,620	907,579	1,278,611	32,940	1,740
Carter	2,027	1,980	134,838	55,637	1,598,660	606,770	79,760	311,614	544,014	29,870	13,150
Cheatham	1,562	1,477	143,093	60,842	1,276,860	456,930	112,050	361,139	660,276	32,100	13,690
Chester	1,603	1,472	152,418	55,270	676,500	251,360	88,790	371,713	532,162	11,650	180
Claiborne	2,809	2,689	222,536	113,634	1,438,580	493,220	89,240	662,313	768,080	22,210	3,830
Clay	1,350	1,277	143,013	57,803	718,040	168,980	56,130	283,616	371,668	13,620	2,180
Cocke	2,534	2,471	216,048	107,441	1,873,810	444,000	109,570	618,116	737,800	32,760	7,990
Coffee	1,956	1,900	193,788	97,420	1,675,760	463,730	146,140	634,835	735,124	34,710	20,060
Crockett	2,667	2,448	161,499	97,184	1,465,680	648,600	202,070	754,131	1,009,796	35,810	6,810
Cumberland	1,036	1,026	152,417	24,288	463,300	182,000	44,630	246,828	247,941	9,600	2,320
Davidson	3,316	3,223	302,844	177,337	9,663,080	3,059,980	470,550	1,486,389	2,083,062	272,860	9,160
Decatur	1,819	1,626	180,467	57,091	918,970	245,040	76,450	376,280	601,808	16,810	670
Dekalb	2,446	2,359	193,331	96,212	1,655,140	436,910	121,130	672,621	919,880	20,630	3,610
Dickson	2,209	2,164	237,881	88,676	1,263,410	519,060	141,360	570,269	709,613	30,160	7,920
Dyer	2,861	2,731	212,214	125,676	3,108,670	864,810	249,170	1,063,128	1,340,453	60,290	2,160
Fayette	4,886	4,663	380,121	205,741	2,476,680	821,110	237,690	1,036,648	1,816,226	59,120	830
Fentress	972	942	177,022	37,607	507,440	140,680	45,230	211,847	236,145	11,040	1,660
Franklin	2,342	2,273	254,441	128,983	2,274,680	717,990	218,130	631,732	1,062,856	60,820	42,950
Gibson	6,486	5,168	354,011	234,310	4,233,760	1,504,500	439,810	1,483,954	2,319,961	86,760	6,620
Giles	4,276	4,116	340,702	224,783	4,445,400	1,438,850	329,370	1,263,235	1,784,432	82,630	4,400
Grainger	2,069	2,033	177,829	103,479	1,319,860	620,800	104,360	430,556	639,648	34,420	15,560
Greene	4,188	4,069	365,948	229,823	3,830,430	1,266,850	270,460	1,016,556	1,396,985	65,260	40,670
Grundy	534	522	69,406	19,297	366,090	126,920	40,500	145,395	198,168	9,600	2,990
Hamblen	1,207	1,166	107,071	76,183	1,385,170	464,130	101,660	338,828	624,582	34,520	20,250
Hamilton	1,665	1,620	138,182	67,794	2,231,480	568,680	131,880	408,449	696,166	81,460	10,420
Hancock	1,623	1,582	124,519	65,133	1,051,130	285,660	60,770	324,485	470,001	15,410	2,140
Hardeman	3,296	3,176	348,521	130,694	1,566,240	641,410	176,390	768,653	1,289,556	40,440	3,280
Hardin	3,024	2,796	258,720	102,635	1,601,180	455,890	142,880	714,644	950,366	17,030	1,720
Hawkins	3,263	3,165	281,924	150,298	2,589,680	876,630	149,390	773,068	1,094,155	68,620	18,480
Haywood	3,653	3,523	259,160	155,649	2,157,470	791,470	222,430	941,602	1,412,473	42,640	2,280
Henderson	3,008	2,859	298,990	109,876	1,138,900	362,370	137,200	629,923	986,203	20,410	1,000
Henry	3,540	3,344	320,498	172,809	2,593,340	892,540	252,220	933,018	1,328,399	42,920	5,530
Hickman	1,883	1,850	242,816	87,673	1,720,250	624,080	140,500	719,719	978,028	42,780	3.930
Houston	693	671	76,410	25,714	363,770	137,490	34,640	174,607	199,120	6,480	410
Humphreys	1,643	1,604	235,369	69.095	1,666,760	392,170	106,610	632,034	694,659	39,040	2,100
Jackson	2,365	2,270	176,842	81,560	1,632,770	349,830	89,020	544,761	768,987	29,800	1,600
James	719	677	86,517	38,236	729,990	154,890	44,590	172,219	276,402	16,320	6,430
Jefferson	2,162	2,081	188,557	125,618	2,681,490	800,080	173,610	696,326	1,014,949	64,040	27,370
Johnson	1,429	1,390	122,670	55,992	1,392,290	404,380	60,680	302,537	418,081	24,930	2,910
Knox	3,862	3,790	290,955	188,771	5,644,870	1,739,620	354,410	957,296	1,776,044	188,710	83,230
Lake	696	518	54,285	42,372	1,301,080	173,170	44,350	290,525	586,828	98,640	....
Lauderdale	3,086	2,790	216,965	119,546	2,340,470	668,030	190,930	823,464	1,461,265	128,720	2,000
Lawrence	1,724	1,693	219,282	63,563	931,640	312,640	99,610	353,199	460,689	12,250	9,470
Lewis	540	505	62,282	15,967	350,600	89,160	31,700	138,196	150,286	3,190	1,310
Lincoln	3,669	3,407	337,277	181,932	4,280,520	1,117,880	284,140	1,094,049	1,486,453	62,700	7,360
Loudon	1,206	1,169	139,819	81,356	1,484,560	429,470	111,990	346,436	514,591	43,160	19,110
McMinn	2,642	2,477	268,704	149,149	1,995,310	661,290	188,640	622,849	982,632	43,390	23,850
McNairy	3,012	2,764	291,422	87,743	1,066,020	379,120	123,670	637,497	941,565	15,470	2,550
Macon	2,132	2,084	176,130	78,384	967,650	368,670	97,930	466,946	590,000	18,920	5,670
Madison	3,672	3,460	298,363	157,657	2,237,040	774,360	162,690	853,925	1,458,539	49,940	2,590
Marion	1,186	1,165	123,181	60,154	1,238,750	350,260	84,790	352,228	461,085	22,110	4,480
Marshall	2,703	2,600	229,482	136,927	3,290,210	1,031,030	238,230	1,026,241	1,100,756	56,030	3,200
Maury	3,945	3,741	368,104	283,671	7,886,920	1,879,660	425,830	1,633,806	2,092,705	152,890	1,680
Meigs	983	972	124,819	64,248	1,212,460	282,580	76,060	304,499	461,926	24,680	4,690
Monroe	2,384	2,314	286,223	120,950	1,912,220	530,750	152,640	570,671	799,632	34,640	21,200
Montgomery	3,494	3,365	321,368	204,103	3,781,660	1,461,170	248,760	982,888	1,631,426	148,230	31,920
Moore	918	844	68,743	43,195	897,300	235,460	69,460	294,049	414,527	13,710	400
Morgan	1,143	1,125	126,113	33,092	510,460	243,060	46,830	248,215	286,960	12,150	2,900
Obion	3,192	3,061	304,879	186,788	5,624,770	1,264,270	424,090	1,315,725	1,943,905	105,090	3,450
Overton	2,214	2,126	235,615	99,414	958,040	318,960	82,640	449,112	674,420	22,500	3,610
Perry	1,319	1,228	194,481	45,065	1,128,010	275,340	71,800	376,461	532,720	20,080	380
Pickett	926	892	88,026	37,680	322,390	116,830	32,870	179,137	246,547	9,540	2,400
Polk	1,130	1,112	131,051	44,022	664,140	205,450	62,200	238,644	369,038	14,420	8,930
Putnam	2,616	2,530	209,388	93,015	1,064,030	414,950	122,280	554,501	749,072	18,950	5,950
Rhea	1,131	1,104	115,993	65,377	1,176,530	304,050	77,650	283,249	432,595	36,240	5,180
Roane	1,883	1,796	198,034	95,005	1,641,590	495,080	111,600	447,394	678,831	36,980	6,010
Robertson	3,290	3,247	278,608	196,142	8,877,860	1,443,260	333,620	847,754	1,646,505	116,760	93,650
Rutherford	4,335	4,197	361,299	214,949	6,360,270	1,700,060	370,830	1,458,283	1,796,662	88,070	10,200
Scott	1,389	1,364	164,743	39,728	545,220	210,880	42,620	273,694	352,410	11,920	2,110
Sequatchie	383	373	67,034	19,850	425,290	99,650	31,480	187,113	167,191	7,470	2,030
Sevier	3,193	3,135	249,233	114,794	1,977,750	536,730	132,770	667,380	947,494	39,060	8,140
Shelby	6,887	6,664	377,689	243,181	6,246,940	2,005,430	432,500	1,549,000	3,294,392	243,160	28,760

Table 3.—NUMBER AND ACREAGE OF FARMS AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Smith	2,665	2,538	203,870	115,240	$2,866,900	$859,750	$167,190	$981,803	$1,133,523	$46,280	$970
Stewart	1,900	1,818	197,694	83,199	1,046,500	453,310	125,480	574,465	757,206	36,170	4,290
Sullivan	2,732	2,655	238,148	150,084	2,715,310	968,390	179,680	658,568	887,667	52,240	28,420
Sumner	3,280	3,217	312,740	187,509	4,179,030	1,529,930	290,570	1,251,684	1,316,486	90,200	11,260
Tipton	4,168	3,875	244,561	155,956	2,752,630	1,011,940	253,190	1,007,163	1,889,057	76,610	2,640
Trousdale	810	796	71,457	42,431	830,670	307,850	54,990	329,209	318,879	13,630	340
Unicoi	678	637	52,551	18,950	422,150	164,010	30,610	110,308	168,087	22,290	1,060
Union	1,952	1,801	152,918	80,654	944,640	312,360	73,880	363,288	535,406	22,340	2,630
Van Buren	482	467	83,401	24,229	306,510	100,080	25,730	134,270	155,137	4,290	1,430
Warren	2,301	2,234	233,466	122,426	1,790,540	711,460	214,270	578,929	967,922	39,710	39,930
Washington	2,457	2,402	186,073	132,789	2,473,060	957,930	186,760	581,785	854,874	79,170	36,310
Wayne	1,717	1,640	231,708	62,488	984,250	282,520	84,550	445,216	495,152	23,260	910
Weakley	5,010	4,821	343,005	214,172	3,889,540	1,454,420	422,670	1,365,647	2,206,326	142,140	6,050
White	1,794	1,763	182,104	97,324	1,248,310	416,990	119,310	478,787	601,804	24,730	10,390
Williamson	3,152	3,083	340,886	182,179	6,046,420	1,610,980	345,200	1,234,082	1,646,293	155,590	3,380
Wilson	3,880	3,756	364,731	202,990	4,861,850	1,577,260	323,140	1,598,047	1,776,404	83,090	3,410

All counties report an increase in the number of farms in the last decade, and nearly two-thirds of the counties report an increase in total farm area. The decrease reported in improved acreage for some of the counties is due to a more intensive cultivation of the soil, and to the use of a more strict definition of the term "improved land" by the Twelfth than by any preceding census. The average size of farms varies in different sections, being 54.8 acres in Shelby county and 182.1 acres in Fentress county. As a rule, the counties reporting large acreage in cotton contain the smallest farms.

Increases in the total value of farms between 1890 and 1900 are reported by over four-fifths of the counties. For the state, the average value of farms in 1900 was $1,180. The increase in the value of implements and machinery was relatively greater and more general than for any other item of farm property. Live stock increased in value in three-fourths of the counties, while the decreases reported for the remaining counties are slight.

FARM TENURE.

Table 4 gives a comparative exhibit of farm tenure in 1880, 1890, and 1900. The farms operated by tenants are divided into two groups designated as farms operated by "cash tenants," who pay a cash rental or a stated amount of labor or farm produce, and farms operated by "share tenants," who pay as rental a share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, the farms operated by owners being subdivided into groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive a fixed salary from the owners for their supervision and other services.

Table 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 to 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	224,623	133,483	28,348	62,792	59.5	12.6	27.9
1890	174,412	120,622	19,762	34,028	69.2	11.3	19.5
1880	165,650	108,454	19,266	37,930	65.5	11.6	22.9

[1] Including "part owners," "owners and tenants," and "managers."

Table 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

Part 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	224,623	114,929	13,652	3,616	1,286	28,348	62,792
White	190,728	107,327	11,962	3,482	1,204	17,439	49,314
Colored	33,895	7,602	1,690	134	82	10,909	13,478
Indian	12	4				1	7
Negro	33,883	7,598	1,690	134	82	10,908	13,471

Part 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	51.2	6.1	1.6	0.6	12.6	27.9
White	100.0	56.3	6.3	1.8	0.6	9.1	25.9
Colored	100.0	22.4	5.0	0.4	0.2	32.2	39.8

Since 1880 the total number of farms has increased 58,973, or 35.6 per cent. Since 1890 the number of owners has increased 12,861, or 10.7 per cent; that of cash tenants, 8,586, or 43.4 per cent; and that of share tenants, 28,764, or 84.5 per cent. The percentages in Table 4 show that the number of farms operated by share tenants has increased at a greater rate than those operated by owners and cash tenants.

Of the farms of the state, 84.9 per cent are operated by white farmers, and 15.1 per cent by colored farmers. Of the white farmers, 64.4 per cent own all or part of the farms they operate, and 35.6 per cent operate farms owned by others. For colored farmers the corresponding percentages are 27.8 and 72.2. Of the colored farmers, 12 are Indians and the remainder negroes. The Indians own 4 of their farms and rent 7 of them as share tenants.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	224,623	90.6	20,342,058	100.0	$341,202,025	100.0
White farmers	190,728	98.5	18,791,962	92.4	314,459,889	92.2
Colored farmers[1]	33,895	45.7	1,550,096	7.6	26,742,136	7.8
Owners	114,929	111.3	12,786,547	62.9	205,994,435	60.4
Part owners	13,652	90.1	1,229,892	6.0	21,866,948	6.4
Owners and tenants	3,616	140.4	507,536	2.5	8,288,974	2.4
Managers	1,286	298.4	383,754	1.9	7,927,543	2.3
Cash tenants	28,348	66.5	1,884,992	9.3	35,747,086	10.5
Share tenants	62,792	56.5	3,549,337	17.4	61,377,039	18.0

[1] Including 12 Indians.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The state	$899	$281	$68	$271	$391	25.7
White farmers	970	312	73	294	409	24.8
Colored farmers[1]	500	107	38	144	285	36.2
Owners	1,012	367	83	330	438	24.4
Part owners	966	280	76	280	413	25.8
Owners and tenants	1,331	439	109	413	522	22.8
Managers	4,053	1,139	192	780	1,237	20.1
Cash tenants	801	188	51	221	376	29.8
Share tenants	634	139	40	164	281	28.8

[1] Including 12 Indians.

Colored farmers controlled 7.6 per cent of the total acreage and 7.8 per cent of the total value of farm property. The average values of all forms of farm property are less for colored than for white farmers. The high per cent of gross income for colored farmers is a result of the smaller average area of their farms and the more intensive cultivation which is generally given to smaller farms. It is due in some degree, also, to the lower values of the farm property for this group, as the total value of farms, or capital invested, is used as a base in the computation.

Farms operated by managers have the highest average values of all forms of farm property, for many of this class are large cotton plantations, while some are farms connected with state institutions. The ratio which the gross income bears to the total value of farm property is, however, smaller than for any other group. This is due to the high average valuation of these farms and the fact that some of them are not cultivated for profit.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	224,623	90.6	20,342,058	100.0	$341,202,025	100.0
Under 3 acres	1,123	2.2	2,498	(1)	623,399	0.2
3 to 9 acres	9,902	6.4	62,917	0.3	4,546,506	1.3
10 to 19 acres	25,517	14.3	364,695	1.8	12,150,603	3.6
20 to 49 acres	61,442	31.5	1,937,942	9.5	45,173,189	13.2
50 to 99 acres	57,265	68.7	3,935,990	19.4	72,485,325	21.3
100 to 174 acres	42,476	126.5	5,371,931	26.4	85,278,279	25.0
175 to 259 acres	15,108	207.5	3,134,766	15.4	48,416,248	14.2
260 to 499 acres	9,166	336.2	3,081,484	15.2	46,692,634	13.7
500 to 999 acres	2,058	624.6	1,285,379	6.3	15,819,883	4.6
1,000 acres and over	566	2,057.3	1,164,456	5.7	10,015,959	2.9

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$899	$281	$68	$271	$391	25.7
Under 3 acres	165	277	20	93	166	29.9
3 to 9 acres	197	161	20	81	128	27.9
10 to 19 acres	243	102	29	102	167	35.0
20 to 49 acres	408	137	35	155	259	35.2
50 to 99 acres	722	237	62	245	362	28.6
100 to 174 acres	1,175	376	94	363	492	24.5
175 to 259 acres	1,963	574	139	529	696	21.7
260 to 499 acres	3,281	864	189	760	1,000	19.6
500 to 999 acres	5,089	1,234	263	1,101	1,541	20.0
1,000 acres and over	12,648	2,654	372	2,022	2,853	16.1

The group of farms containing from 20 to 49 acres includes a larger number of farms than any other, but the group "100 to 174" acres constitutes the largest part of the total acreage and value.

With a few exceptions, the average values of all forms of farm property increase with the size of the farms. For the group of farms of less than 3 acres each, the average values are comparatively high, as this group includes 10 of the 32 florists' establishments of the state, besides many market gardens, poultry farms, and city dairies. The income from these industries is determined not so much by the area of land used, as by the capital invested and the amounts expended for labor and fertilizers.

The average gross incomes per acre for the various groups, classified by area, are as follows: Farms under 3 acres, \$74.64; 3 to 9 acres, \$20.16; 10 to 19 acres, \$11.66; 20 to 49 acres, \$8.21; 50 to 99 acres, \$5.27; 100 to 174 acres, \$3.89; 175 to 259 acres, \$3.36; 260 to 499 acres, \$2.97; 500 to 999 acres, \$2.47; and 1,000 acres and over, \$1.39.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If for any farm 40 per cent of the products not fed to live stock consists of hay and grain, the farm is designated a "hay and grain" farm. Should 40 per cent of the total value of products consist of vegetables, the farm is designated a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive their principal income from any one class of farm products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	224,623	90.6	20,342,058	100.0	\$341,202,025	100.0
Hay and grain	62,608	97.6	6,107,654	30.0	119,843,688	35.1
Vegetables	2,602	43.9	114,267	0.6	4,694,338	1.4
Fruits	1,396	88.3	123,278	0.6	2,061,448	0.6
Live stock	65,546	100.5	6,585,194	32.4	110,025,387	32.3
Dairy produce	1,850	91.7	169,663	0.8	7,158,200	2.1
Tobacco	6,172	80.5	496,922	2.5	9,539,315	2.8
Cotton	28,007	60.2	1,686,647	8.3	25,895,859	7.6
Sugar	85	53.5	4,646	(1)	80,875	(1)
Flowers and plants	32	10.5	335	(1)	314,935	0.1
Nursery products	57	120.0	6,840	(1)	459,306	0.1
Miscellaneous	56,268	89.7	5,046,712	24.8	61,128,674	17.9

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	\$899	\$281	\$68	\$271	\$391	25.7
Hay and grain	1,234	325	82	273	437	22.8
Vegetables	1,133	426	73	172	385	21.4
Fruits	859	340	77	201	568	38.4
Live stock	924	325	75	355	392	23.4
Dairy produce	2,319	854	126	570	717	18.5
Tobacco	896	333	77	240	509	33.0
Cotton	557	142	42	184	369	39.9
Sugar	645	141	36	129	232	24.4
Flowers and plants	6,078	3,369	256	139	5,242	53.3
Nursery products	5,726	1,805	276	251	8,624	107.0
Miscellaneous	605	215	53	213	309	28.4

For the several classes of farms the average values per acre of products not fed to live stock are: For farms deriving their principal income from flowers and plants, \$500.75; nursery products, \$71.87; vegetables, \$8.77; dairy produce, \$7.81; fruits, \$6.43; tobacco, \$6.33; cotton, \$6.13; hay and grain, \$4.48; sugar, \$4.34; live stock, \$3.91; and miscellaneous, \$3.44.

The wide variations shown in the averages and percentages of gross income are due largely to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens, the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than in the case of "hay and grain," "live-stock," or "miscellaneous" farms. Were it possible to present the average net incomes, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	224,623	90.6	20,342,058	100.0	\$341,202,025	100.0
\$0	1,124	56.0	62,937	0.3	778,260	0.2
\$1 to \$49	7,217	32.1	231,488	1.1	2,641,470	0.8
\$50 to \$99	16,732	36.9	617,852	3.0	7,435,910	2.2
\$100 to \$249	73,621	55.4	4,082,017	20.1	51,039,208	15.0
\$250 to \$499	76,016	86.4	6,565,313	32.3	95,959,082	28.1
\$500 to \$999	37,401	139.8	5,227,039	25.7	94,962,480	27.8
\$1,000 to \$2,499	11,046	248.0	2,738,923	13.5	64,996,970	19.0
\$2,500 and over	1,466	557.0	816,489	4.0	23,388,645	6.9

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$899	$281	$68	$271	$391	25.7
$0	528	80	14	70	....	....
$1 to $49	225	72	13	56	28	7.6
$50 to $99	259	88	17	80	72	16.2
$100 to $249	386	134	29	144	176	25.3
$250 to $499	709	236	61	256	348	27.6
$500 to $999	1,504	474	123	438	667	26.3
$1,000 to $2,499	3,752	1,040	241	851	1,402	23.8
$2,500 and over	10,520	2,771	495	2,168	4,451	28.0

There were 1,124 farms reporting no income in 1899. Some of these farms are summer or suburban homes, some are farms partially abandoned in 1899, while others had changed owners or tenants, and the persons in charge June 1, 1900, were unable to give definite information concerning the products of the preceding year. To this extent the reports fall short of giving a complete statement of farm income in 1899.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—NUMBER OF DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	236,000	$1,606,949	$6.81	12,246
Steers	1 and under 2	110,368	1,432,689	12.98	2,183
Steers	2 and under 3	68,301	1,236,363	18.10	1,168
Steers	3 and over	20,127	490,640	24.38	1,034
Bulls	1 and over	11,927	292,251	24.50	222
Heifers	1 and under 2	94,224	1,243,158	13.19	2,106
Cows kept for milk	2 and over	321,676	8,137,474	26.30	30,273
Cows and heifers not kept for milk	2 and over	49,560	961,527	19.40	1,139
Colts	Under 1	23,853	663,620	27.82	799
Horses	1 and under 2	23,109	993,396	42.99	643
Horses	2 and over	305,426	18,024,601	59.01	37,774
Mule colts	Under 1	24,681	$724,603	$29.36	261
Mules	1 and under 2	28,674	1,284,211	44.79	311
Mules	2 and over	200,302	14,191,731	70.85	10,019
Asses and burros	All ages	8,852	703,702	79.50	543
Lambs	Under 1	188,207	389,743	2.07	1,249
Sheep (ewes)	1 and over	256,032	651,780	2.55	1,570
Sheep (rams and wethers)	1 and over	51,772	137,901	2.66	447
Swine	All ages	1,976,984	4,838,713	2.45	82,912
Goats	All ages	25,884	38,938	1.50	1,457
Fowls:[1]					
Chickens[2]	....	6,184,210	2,275,864	....	....
Turkeys	....	193,397			
Geese	....	391,698			
Ducks	....	202,432			
Bees (swarms of)	....	225,788	486,536	2.15	....
Unclassified	....	....	12,310	....	....
Value of all live stock	....	....	60,818,605	....	....

TABLE 14.—NUMBER OF DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS—Continued.

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.

[2] Including Guinea fowls.

The value of all live stock on farms, June 1, 1900, was $60,818,605. Of this amount, 32.4 per cent represents the value of horses; 26.6 per cent, that of mules; 13.4 per cent, that of dairy cows; 12.0 per cent, that of other neat cattle; 8.0 per cent, that of swine; 3.7 per cent, that of poultry; 1.9 per cent, that of sheep; and 2.0 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms, but it is probable that such animals had higher average values than those on farms. Allowing the same averages, however, the value of all domestic animals not on farms was $4,245,914, and the total value of live stock in the state, exclusive of poultry and bees not on farms, was approximately $65,064,519.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the numbers of the most important domestic animals.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	321,676	590,507	352,388	262,609	307,804	1,976,984
1890	345,311	620,028	311,842	203,639	540,996	1,922,912
1880	303,900	479,774	266,119	173,498	672,789	2,160,495
1870	243,197	400,499	247,254	102,983	826,783	1,828,690
1860	249,514	515,218	290,882	126,345	773,317	2,347,321
1850	250,456	500,306	270,636	75,303	811,591	3,104,800

[1] Lambs not included.

With the exception of sheep and swine, larger numbers of all classes of live stock are reported for 1900 than for 1850. Every class shows fluctuations from decade to decade, but a general increase in the number of horses and mules has been reported, while the raising of meat-producing stock for market has declined in importance.

For the decade following 1890 the following increases in numbers are shown: Mules and asses, 28.9 per cent; horses, 13.0 per cent; and swine, 2.8 per cent; with the following decreases: Sheep, 43.1 per cent; dairy cows, 6.8 per cent; and other neat cattle, 4.8 per cent.

The apparent decrease in numbers of dairy cows is probably due to the term "cows and heifers kept for milk" being restricted in 1900 to those milked at the time of enumeration, while many cows milked at some time in the year, but dry at the time of enumeration, were classed with "cows and heifers not kept for milk," and consequently with "other neat cattle." The increased production of milk in 1899 tends to confirm this statement.

The enumerators in 1900 were instructed to report no fowls under three months old, which limitation was not made in former census reports. This fact probably accounts for the following decreases in numbers of all classes of domestic fowls in the decade 1890 to 1900: Turkeys, 55.1 per cent; geese, 49.7 per cent; chickens, 48.7 per cent; and ducks, 44.1 per cent.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the animal products of 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	1,395,295	$263,351
Mohair and goat hair	Pounds	1,486	428
Milk	Gallons	[1]147,336,961	[2]8,028,466
Butter	Pounds	29,091,696	
Cheese	Pounds	26,622	
Eggs	Dozens	31,807,990	3,115,335
Poultry			4,282,740
Honey	Pounds	2,404,550	259,691
Wax	Pounds	79,590	
Animals sold			11,121,141
Animals slaughtered			8,350,046
Total value			35,421,198

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of all milk sold or consumed and of butter and cheese made.

The value of the animal products for 1899 was $35,421,198. Of this amount, 55.0 per cent represents the value of animals sold and animals slaughtered on farms, 22.7 per cent, that of dairy produce, 20.9 per cent, that of poultry and eggs, 0.7 per cent, that of wool, mohair, and goat hair, and 0.7 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms in 1899 was $19,471,187, or 18.3 per cent of the value of all farm products. Of all farmers in the state, 182,375, or 81.2 per cent, report animals slaughtered, the average value per farm being $45.79. Animals sold were reported by 122,331 farmers, or 54.5 per cent of the total number, the average amount received per farm being $90.91. In obtaining these reports, the enumerators were instructed to secure from each farm operator a statement of the amount received from sales in 1899, less the amount paid for animals purchased during the same year.

DAIRY PRODUCE.

The production of milk in 1899 was 39,679,845 gallons greater than in 1889, a gain of 36.9 per cent. Butter made on farms increased in amount 2.7 per cent, and the production of cheese decreased 61.9 per cent in the same time.

Of the $8,028,466 given in Table 16 as the value of dairy produce, $6,518,283, or 81.2 per cent, represents the value of such products consumed on farms, and $1,510,183, or 18.8 per cent, the amount received from sales. Of the latter amount, $819,203 was received from the sale of 5,192,022 pounds of butter; $676,996, from 5,549,194 gallons of milk; $12,341, from 22,566 gallons of cream; and $1,643, from 15,673 pounds of cheese.

POULTRY AND EGGS.

Of the $7,398,075 given as the value of poultry products in 1899, 57.9 per cent represents the value of poultry raised, and 42.1 per cent that of eggs produced. There were 8,635,677 dozen more eggs reported in 1899 than in 1889, a gain of 37.3 per cent. This increase in production of eggs tends to confirm the statement made elsewhere that the apparent decrease in number of chickens is due to a difference in methods of enumeration.

WOOL.

The production of wool for the state was greatest in 1879, followed by a great decrease in the following decade and a decrease of 2,371 pounds, or less than 0.2 per cent, since 1889. The decrease in the last decade was probably more marked than the small percentage indicates, owing to the fact that in 1890 the fleeces from at least 95,343 sheep were omitted from the tables, but included in a general estimate of the wool shorn after the census enumeration. Wool was reported from about one-sixth of all farms reporting live stock in 1899.

HONEY AND WAX.

The production of honey in 1899 was 2,404,550 pounds, and of wax 79,590 pounds, which, compared with 2,284,155 pounds of honey and 63,290 pounds of wax in 1889, shows an increase in ten years of 5.3 per cent in honey and 25.8 per cent in wax.

HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses, mules, and dairy cows, and the average number of these animals per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.		MULES.		DAIRY COWS.	
	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.
Total	158,355	2.2	112,385	2.3	179,025	1.8
White farmers	138,689	2.3	96,945	2.4	159,681	1.8
Colored farmers	19,666	1.7	15,440	1.6	19,344	1.5
Owners[1]	102,248	2.4	71,751	2.5	115,784	1.9
Managers	977	3.9	803	5.0	1,006	6.4
Cash tenants	19,850	1.9	14,696	1.9	20,230	1.7
Share tenants	35,280	1.8	25,135	1.8	42,005	1.4
Under 20 acres	17,660	1.4	8,715	1.4	20,630	1.3
20 to 99 acres	82,520	1.9	55,623	1.7	94,226	1.5
100 to 174 acres	34,876	2.6	27,605	2.4	38,923	2.0
175 to 259 acres	12,968	3.1	11,085	3.1	14,185	2.4
260 acres and over	10,331	4.1	9,357	4.8	11,061	3.7
Hay and grain	42,427	2.3	30,303	2.4	46,077	1.8
Vegetables	1,689	1.9	957	1.9	1,431	1.6
Fruits	952	1.9	536	1.8	998	1.7
Live stock	52,388	2.5	34,992	2.4	58,156	1.8
Dairy	1,518	4.2	772	2.7	1,850	7.0
Tobacco	3,895	2.0	4,162	2.2	4,573	1.4
Cotton	17,436	1.8	14,550	1.8	18,115	1.6
Miscellaneous[2]	38,050	1.9	26,113	2.2	47,825	1.7

[1] Including "part owners" and "owners and tenants."
[2] Including sugar farms, florists' establishments, and nurseries.

In Tennessee, as in other states where cotton is a staple crop and much of the farm labor is performed by negroes, large numbers of mules are used as work animals. For most classes of farms, the average numbers of mules and horses are about equal, but on farms operated by managers, and on farms of the largest area, more mules than horses are reported. This is due to the fact that these two classes include a relatively large number of cotton plantations.

If the number of horses and mules be combined, the average number of work animals per farm compares favorably with the corresponding figures for the more intensively cultivated farms of New England.

CROPS.

The following table gives the statistics of the principal crops grown in 1899.

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	3,374,574	Bushels	67,307,390	$28,059,508
Wheat	1,426,112	Bushels	11,924,010	7,882,697
Oats	235,313	Bushels	2,725,330	887,940
Barley	1,590	Bushels	21,636	11,273
Rye	16,556	Bushels	107,912	68,381
Buckwheat	1,173	Bushels	8,597	4,690
Broom corn	3,444	Pounds	1,015,460	47,252
Kafir corn	10	Bushels	257	103
Flaxseed	1	Bushels	7	7
Clover seed		Bushels	7,414	34,145
Grass seed		Bushels	76,952	70,332
Hay and forage	645,617	Tons	802,720	6,811,577
Cotton seed		Tons	[1]95,333	974,046
Cotton	623,137	Bales	234,592	8,192,642
Tobacco	71,849	Pounds	49,157,550	2,748,495
Hops	(2)	Pounds	307	32
Peanuts	19,534	Bushels	747,668	392,648
Peppermint	2	Pounds	170	4
Dry beans	5,563	Bushels	48,736	57,660
Dry pease	82,841	Bushels	760,663	767,840
Potatoes	27,103	Bushels	1,404,097	817,419
Sweet potatoes	23,374	Bushels	1,571,575	883,620
Onions	1,124	Bushels	147,679	106,421
Miscellaneous vegetables	74,284			3,339,132
Maple sugar		Pounds	1,160	167
Maple sirup		Gallons	171	169
Sorghum cane	31,364	Tons	[3]21,886	61,793
Sorghum sirup		Gallons	2,047,655	585,336
Small fruits	12,944			593,092
Grapes	[4]1,413	Centals	43,551	[5]120,199
Orchard fruits	[4]208,625			[6]1,479,915
Tropical fruits				112
Nuts				5,828
Forest products				5,086,624
Flowers and plants	140			175,979
Seeds	8			458
Nursery products	2,838			474,133
Miscellaneous	17			3,573
Total	6,890,550			70,745,242

[1] Exclusive of 22,561 tons, valued at $230,571, sold in seed cotton and included with the cotton.
[2] Less than 1 acre.
[3] Sold as cane.
[4] Estimated from number of vines or trees.
[5] Including value of raisins, wine, etc.
[6] Including value of cider, vinegar, etc.

Of the total value of crops, cereals, including Kafir corn, contributed 52.2 per cent; cotton and cottonseed, 13.0 per cent; hay and forage, 9.6 per cent; forest products, 7.2 per cent; miscellaneous vegetables, 4.7 per cent; tobacco, 3.9 per cent; orchard fruits, 2.1 per cent; potatoes, 1.2 per cent; sweet potatoes, 1.2 per cent; dry pease, 1.1 per cent; sorghum cane and sorghum sirup, 9.0 per cent; and all other products, 2.9 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $1,257; nursery products, $167; onions, $95; grapes, $85; miscellaneous vegetables, $45; tobacco, $38; sweet potatoes, $38; potatoes, $30; sorghum cane and sorghum sirup, $21; peanuts, $20; cotton and cotton seed, $15; broom corn, $14; hay and forage, $11; dry beans, $10; dry pease, $9; cereals, including Kafir corn, $7; and orchard fruits, $7.

The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production requires a relatively great amount of labor and large expenditures for fertilizers.

CEREALS.

The following table shows the changes in cereal production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buck-wheat.	Corn.	Oats.	Rye.	Wheat.
1899	1,590	1,173	3,374,574	235,313	16,556	1,426,112
1889	3,585	1,231	2,791,324	588,138	26,443	877,361
1879	2,600	4,907	2,904,873	468,566	32,498	1,196,563

PART 2.—BUSHELS PRODUCED.

YEAR.	Barley.	Buck-wheat.	Corn.	Oats.	Rye.	Wheat.
1899	21,636	8,597	67,307,390	2,725,330	107,912	11,924,010
1889	63,866	7,143	63,635,350	7,355,100	165,621	8,300,789
1879	30,019	33,434	62,764,429	4,722,190	156,419	7,331,353
1869	75,068	77,437	41,343,614	4,513,315	223,335	6,188,916
1859	25,144	14,481	52,089,926	2,267,814	257,989	5,459,268
1849	2,737	19,427	52,276,223	7,703,086	89,137	1,619,386

[1] No statistics of acreage were secured prior to 1879.

The total area devoted to cereals in 1879 was 4,610,002 acres; in 1889, 4,288,082 acres; and in 1899, 5,055,318 acres, an increase in twenty years of 9.7 per cent. The increases in area under cereals in the decade from 1889 to 1899 were: Wheat, 62.5 per cent, and corn, 20.9 per cent. The decreases were: Oats, 60.0 per cent; barley, 55.6 per cent; rye, 37.4 per cent; and buckwheat, 4.7 per cent. The total number of bushels produced in 1849 was 61,709,996, and in 1899, 82,094,875 bushels, an increase of 33.0 per cent in fifty years.

Of the total area devoted to cereals in 1899, 66.7 per cent was devoted to corn; 28.2 per cent, to wheat; 4.7 per cent, to oats; and 0.4 per cent, to rye, barley, and buckwheat.

Corn, wheat, and oats are reported from all the counties. Barley is reported from 53 counties of the 96, Davidson, Maury, Williamson, and Washington reporting 62.3 per cent of the total area. Rye is cultivated in 92 counties, Bedford, Lincoln, Moore, and Giles counties, in the south, reporting over one-third of the total acreage. Johnson and Carter, on the northeastern border, report approximately one-half of the entire area in buckwheat.

HAY AND FORAGE.

In 1900, 118,357 farmers, or 52.7 per cent of the total number, reported hay or forage crops. Excluding cornstalks and corn strippings, they obtained an average yield of 1.05 tons per acre. The total area in hay and forage for 1899 was 645,617 acres, or 13.0 per cent greater than ten years before.

The acreages and yields of the various kinds of hay and forage in 1899 were as follows: Wild, salt, and prairie grasses, 11,528 acres and 10,444 tons; millet and Hungarian grasses, 97,576 acres and 104,690 tons; alfalfa, or lucern, 654 acres and 1,173 tons; clover, 104,134 acres and 106,829 tons; other tame and cultivated grasses, 218,821 acres and 222,795 tons; grains cut green for hay, 181,318 acres and 184,946 tons; crops grown for forage, 31,586 acres and 48,573 tons; and cornstalks and corn strippings, 303,057 acres and 123,270 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is included under "corn," as the forage secured was an incidental product of the corn crop.

COTTON.

The following table is a statement of the changes in cotton production since 1849.

TABLE 20.—ACREAGE AND PRODUCTION OF COTTON: 1849 TO 1899.

YEAR.	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	623,137	[1]16.6	234,592	117,504,070	29.3
1889	747,471	3.4	190,579	90,906,183	[1]39.3
1879	722,562	....	330,621	149,771,313	89.8
1869	....	....	....	78,919,428	[1]40.2
1859	....	....	....	131,926,480	69.5
1849	....	....	....	77,812,800	....

[1] Decrease.

In 1899, 53,405 farmers seeded an area of 623,137 acres to cotton, an average of 11.7 acres per farm, or 6.1 per cent of the total improved land. From this land was produced 117,504,070 pounds of cotton, an average of 2,200 pounds per farm, 189 pounds per acre, and 58 pounds per capita. The total value of this crop, including the value of the cottonseed, was $9,166,688, an average of $171.64 per farm, and $14.72 per acre. This value constituted 10.4 per cent of the gross farm income.

The counties devoting the greatest number of acres to cotton were Shelby, Fayette, Tipton, Haywood, Hardeman, Madison, and Lauderdale, ranking in the order named, and reporting 64.8 per cent of the total acreage.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 may be seen in the following table.

TABLE 21.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	7,714,053	5,020,400	5,387,775	7,283,945
Apricots	4,528	2,977	211	423
Cherries	217,917	68,715	11,688	19,636
Peaches	2,749,203	2,347,699	77,678	2,555,099
Pears	263,585	96,729	43,609	49,923
Plums and prunes	712,256	454,421	73,315	105,359

The total number of trees in 1890 was 7,990,941, and in 1900, 11,708,629, an increase in the decade of 3,717,688 trees, or 46.5 per cent. Increases are shown for the decade as follows: Cherries, 217.1 per cent; pears, 172.4 per cent; plums and prunes, 56.7 per cent; apples, 53.7 per cent; apricots, 52.1 per cent; and peaches, 17.1 per cent.

Of the total number of trees in 1900, 65.9 per cent were apple trees; 23.5 per cent, peach trees; 6.1 per cent, plum and prune trees; and 4.5 per cent, cherry, pear, apricot, and unclassified fruit trees—the latter class, which is not included in the table, numbering 47,087, and yielding 5,412 bushels of fruit.

The value of the orchard products given in Table 18 includes the value of 9,372 barrels of vinegar, and 2,538,810 pounds of dried and evaporated fruits manufactured on farms. Comparisons of yields or their values, when made by decades only, have little significance, owing to seasonal variations.

Knox county in the eastern part of the state, Warren county in the central, and Wilson in the northern, report the largest numbers of apple trees, showing 10.7 per cent of the total number. The largest number of peach trees is reported from Knox and Hamilton counties, and the five counties of Williamson, Knox, Davidson, Maury, and Wilson, ranking in the order named, report 27.8 per cent of the total number of pear trees. McNairy, Henderson, and Jackson counties report 18.1 per cent of the total number of plum and prune trees. Apricots received little attention.

SMALL FRUITS.

The total area devoted to the cultivation of small fruits in 1899 was 12,944 acres, distributed among 17,416 farms. Of the total area, 11,548 acres, or 89.2 per cent, were devoted to strawberries, yielding 13,683,840 quarts. They were raised chiefly in Gibson, Hamilton, Weakly, Rhea, and Crockett counties, which reported 74.0 per cent of the acreage and 68.1 per cent of the production. The acreage and production of the other berries were as follows: Blackberries and dewberries, 733 acres and 839,210 quarts; raspberries and Logan berries, 471 acres and 448,170 quarts; gooseberries, 114 acres and 150,620 quarts; currants, 12 acres and 13,190 quarts; and other small fruits, 66 acres and 65,090 quarts.

VEGETABLES.

The total area used in the cultivation of vegetables, including potatoes, sweet potatoes, and onions, in 1899, was 125,885 acres. Of the total acreage 59.0 per cent was devoted to miscellaneous vegetables, 21.5 per cent to potatoes, 18.6 per cent to sweet potatoes, and 9.0 per cent to onions. Aside from the land devoted to potatoes, sweet potatoes, and onions, 74,284 acres were used in the growing of miscellaneous vegetables. Of this area, 54,387 acres were included in family gardens or farms, the vegetable products of which were not reported in detail. Of the 19,897 acres concerning which detailed reports were received, 9,064 were devoted to watermelons; 4,341, to cabbages; 2,536, to tomatoes; 1,587, to muskmelons; 719, to sweet corn; 562, to beans; 496, to cucumbers; and 592, to other vegetables.

PEANUTS.

Peanuts were grown in 1899 by 4,546 farmers, who devoted to their cultivation 19,534 acres and received therefrom a product of 747,668 bushels. Increases of 20.3 per cent in acreage and 42.9 per cent in production are shown for the last decade. The average yield per acre was 32.2 bushels in 1889 and 38.3 bushels in 1899.

The counties of Perry, Humphreys, Benton, Decatur, Hickman, and Wayne, lying in the Tennessee River Valley and ranking in the order named, report 98.5 per cent of the total acreage in this crop.

TOBACCO.

According to the census of 1850 Tennessee produced in 1849, 20,148,932 pounds of tobacco, while that of 1860 showed a gain of 23,299,165 pounds, or 115.6 per cent. The reports of 1870 showed a decline of 21,982,645 pounds, or 50.6 per cent. Between 1870 and 1880 there was a gain of 36.8 per cent, and between 1880 and 1890, a gain of 23.8 per cent.

The present census shows that in 1899 tobacco was grown in Tennessee by 27,960 farmers, who obtained from 71,849 acres a yield of 49,157,550 pounds, valued at $2,748,495. This was an increase in area since 1889 of 20,378 acres, or 39.6 per cent, and, in production, of 12,789,155 pounds, or 35.2 per cent. The average yield per acre in 1899 was 684 pounds, against 707 pounds in 1889, and 707 pounds in 1879. The average value was 5.6 cents per pound. The average area in tobacco for each farm on which it was grown was 2.6 acres.

The tobacco crop of 1899 was distributed over every county of the state. The leading county was Montgomery, with 17,593 acres; the next in rank being Robertson and Weakly counties, with 13,488 acres and 12,858 acres, respectively. These three counties together contributed 61.2 per cent of the entire acreage, and 64.2 per cent of the entire production.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was grown by 45,461 farmers, on 31,364 acres, an average of 0.69 acre for each farm reporting. From this area they sold 21,886 tons of cane for $61,793, and from the remaining product manufactured 2,047,655 gallons of sirup, valued at $585,336. This was a decrease in acreage since 1889 of 22.2 per cent.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1889 was 140 acres, and the value of the products sold therefrom was $175,979. These flowers and plants were grown by 93 farmers and florists. Of this number 32 made commercial floriculture their principal business. These 32 proprietors reported a glass surface of 525,780 square feet. The capital invested in land, buildings, implements, and live stock was $314,935, of which $107,800 represents the value of buildings. Their sales of flowers and plants amounted to $157,008, and the value of their other products was $10,742. They expended $28,920 for labor and $3,150 for fertilizers. The average value for each farm reporting, including products fed to live stock, was $5,288.

In addition to the 32 principal florists' establishments, 445 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 504,295 square feet, making, with the 394,335 square feet belonging to the florists' establishments, a total of 898,630 square feet.

NURSERIES.

The total value of nursery stock sold in 1899 was $474,133, reported by the operators of 159 farms and nurseries. Of this number 57 derived their principal income from the nursery business. They had 6,840 acres of land, valued at $326,385; buildings worth $102,880; implements and machinery worth $15,730; and live stock worth $14,311. Their total income, exclusive of products fed to live stock, was $491,566, of which $451,213 represents the value of nursery stock, and $40,353 that of other products. The expenditure for labor was $72,380, and for fertilizers, $3,165. The average income from each farm reporting, including products fed to live stock, was $8,767.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $4,730,370, an average of $21 per farm. The average expenditure was $1,270 for nurseries, $904 for florists' establishments, $81 for dairy farms, $64 for fruit farms, $47 for vegetable farms, $35 for tobacco farms, $25 for hay and grain farms, $21 for live-stock farms, $16 for cotton farms, and $4 for sugar farms. "Managers" expended on an average $160; "owners," $26; "cash tenants," $17; and "share tenants," $9. White farmers expended $24 per farm, and colored farmers, $7.

Fertilizers purchased in 1899 cost $898,070, an average of $4 per farm and an increase since 1890 of 148.7 per cent. The average expenditure was $98 for florists' establishments, $56 for nurseries, $13 for tobacco farms, $8 for vegetable farms, $6 for hay and grain farms, $5 for dairy farms, $3 for fruit and live-stock farms, and $1 for cotton farms.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 227. WASHINGTON, D. C. July 3, 1902.

AGRICULTURE.

LOUISIANA.

Hon. WILLIAM R. MERRIAM,

Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture in the state of Louisiana, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

> The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Louisiana, June 1, 1900, numbered 115,969, and were valued at $141,130,610, of which amount $33,400,400, or 23.7 per cent, represents the value of buildings, and $107,730,210, or 76.3 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $28,536,790, and of live stock $28,869,506. These values, added to that of farms, give $198,536,906, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of all such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $72,667,302, of which amount $10,012,759, or 13.8 per cent, represents the value of animal products, and $62,654,543, or 86.2 per cent, the value of crops, including forest products cut or produced on farms. The total value of farm products for 1899 exceeds that for 1889 by $18,323,349, or 33.7 per cent.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $6,528,470, leaving $66,138,832 as the gross farm income. The ratio which this latter amount bears to the "total value of farm property" is referred to in the text as the "percentage of gross income upon investment." For Louisiana in 1899 it was 33.3 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the final report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Louisiana.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN LOUISIANA

GENERAL STATISTICS.

Louisiana has a total land area of 45,420 square miles, or 29,068,800 acres, of which 11,059,127 acres, or 38.0 per cent, are included in farms.

The greater part of the surface of Louisiana is low and level. South of New Orleans, and for 120 miles north of that place, the land along the Mississippi is below the surface of the river at high tide, being protected by levees from inundation. The northern and western portions of the state are diversified by low hills, consisting of pine barrens.

From an agricultural standpoint there is very little waste land in the state. With its rich, alluvial delta, its fertile uplands, and its heavy and well-distributed rainfall, Louisiana presents conditions highly favorable to varied agriculture and horticulture. The only lands whose cultivation is not practicable, except at a great cost, are portions of the coast marsh lands, which, however, afford fine pasturage. The river bottoms are exceedingly productive, and the alluvial lands, which vary from 10 to 40 feet in depth, are easily drained and of an inexhaustible fertility. The uplands are rich, but the prairies are better suited for grazing than for agriculture.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the per cent of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	115,969	11,059,127	4,666,532	6,392,595	95.4	42.2
1890	69,294	9,544,219	3,774,668	5,769,551	137.7	39.5
1880	48,292	8,273,506	2,739,972	5,533,534	171.3	33.1
1870	28,481	7,025,817	2,045,640	4,980,177	246.7	29.1
1860	17,328	9,298,576	2,707,108	6,591,468	536.6	29.1
1850	13,422	4,989,043	1,590,025	3,399,018	371.7	31.9

The number of farms increased rapidly throughout the half century, the rate of gain for the last decade being 67.4 per cent. During the decade 1850 to 1860 the total farm area almost doubled. The effect of the Civil War is plainly shown in the report of 1870, which shows a decreased farm acreage from which the state did not recover until 1890. Since 1860 the average size of farms has steadily decreased. The per cent of farm land improved shows an increase for each decade since 1870. These changes indicate a more intensive cultivation and a more complete utilization of the soil.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$198,536,906	$141,130,610	$28,536,790	$28,869,506	$72,667,302
1890	110,447,005	85,381,270	7,167,355	17,898,380	54,343,953
1880	76,770,547	58,989,117	5,435,525	12,345,905	42,883,522
1870[2]	91,303,942	68,215,421	7,159,333	15,929,188	[3]52,006,622
1860	247,984,827	204,789,662	18,648,225	24,546,940	....
1850	98,543,611	75,814,398	11,576,938	11,152,275	....

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

The remarkable growth of agriculture in the decade from 1850 to 1860, the disastrous effects of the Civil War, and the subsequent partial recovery of the state, are the most interesting features of the above table. While the total value of farm property is still below that of 1860, the loss is wholly in the value of land, improvements, and buildings, as the values of implements and machinery and of live stock show decided gains.

In the last ten years the total value of farm property has increased $88,089,901, or 79.8 per cent. In the same time the value of land, improvements, and buildings increased $55,749,340, or 65.3 per cent; that of live stock, $10,971,126, or 61.3 per cent, and nearly four times as great values for implements and machinery were reported in 1900 as in 1890. The value of farm products for 1899 exceeds that for 1889 by $18,323,349, or 33.7 per cent. Part of the increase in the value of implements and machinery is doubtless due to a more detailed enumeration in 1900 than in previous census years.

PARISH STATISTICS.

Table 3 gives a statement of general agricultural statistics by parishes.

TABLE 3.—NUMBER AND ACREAGE OF FARMS AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY PARISHES.

PARISHES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	115,969	110,796	11,059,127	4,666,532	$107,730,210	$33,400,400	$28,536,790	$28,869,506	$66,138,832	$10,692,710	$1,076,890
Acadia	2,481	2,373	276,490	143,354	3,413,830	599,540	354,150	906,171	1,983,760	237,080	2,860
Ascension	1,200	1,157	115,914	61,519	2,514,980	981,270	1,550,330	585,697	1,061,033	251,640	73,610
Assumption	456	422	111,180	64,331	4,105,940	1,347,360	2,314,960	513,913	1,610,913	619,580	86,630
Avoyelles	4,674	4,502	194,841	117,171	3,836,780	941,830	342,300	838,812	2,097,357	104,350	5,610
Bienville	2,392	2,261	300,563	109,729	815,150	328,070	92,000	421,660	717,248	35,600	7,870
Bossier	3,212	3,058	278,524	128,423	2,671,490	579,210	145,160	553,824	1,534,390	93,720	2,940
Caddo	4,648	4,246	348,957	179,649	3,789,560	1,051,180	178,560	875,953	1,975,827	129,720	4,180
Calcasieu	2,594	2,487	511,254	134,480	2,730,400	620,450	286,150	1,204,682	1,517,122	129,190	12,870
Caldwell	1,070	1,037	136,099	42,169	651,400	228,720	84,300	244,681	323,060	14,040	1,100
Cameron	558	521	197,608	22,617	781,020	174,770	53,950	557,518	349,033	14,350	780
Catahoula	2,273	2,181	197,031	59,657	737,400	340,420	78,230	517,465	868,892	12,450	220
Claiborne	3,595	3,415	418,276	206,131	1,345,250	525,270	132,160	629,578	1,324,826	46,370	9,590
Concordia	1,631	1,598	152,800	65,998	1,339,340	392,500	101,320	364,801	1,271,959	98,930	9,750
De Soto	3,865	3,662	344,487	170,327	1,817,830	496,870	126,240	581,036	1,089,856	45,730	2,750
East Baton Rouge	2,477	2,423	198,253	100,152	1,675,270	634,670	385,950	584,635	1,265,470	196,420	10,840
East Carroll	1,917	1,855	107,087	61,835	1,388,630	377,600	93,090	299,883	1,011,792	115,150	5,700
East Feliciana	2,395	2,351	187,245	96,127	1,070,900	519,110	98,710	438,355	1,099,982	74,850	36,490
Franklin	1,455	1,395	153,484	43,950	784,660	261,650	58,530	364,781	474,127	42,920	490
Grant	1,397	1,352	123,336	41,867	560,570	235,010	66,050	262,128	559,644	8,060	1,240
Iberia	1,828	1,675	149,577	90,209	3,930,950	1,042,380	1,865,630	764,042	1,651,611	482,760	27,600
Iberville	746	709	110,499	61,171	3,044,630	1,191,210	2,101,480	564,207	1,389,609	633,510	44,860
Jackson	1,497	1,445	195,171	55,501	482,760	177,700	54,780	237,055	430,515	12,560	1,080
Jefferson	461	444	39,610	17,880	1,336,240	332,160	296,220	203,985	717,655	225,960	18,850
Lafayette	3,088	2,920	154,921	116,452	2,851,600	732,960	365,360	767,498	1,400,472	91,600	9,350
Lafourche	1,035	994	220,779	67,238	4,234,960	1,589,140	2,618,060	678,229	2,275,043	688,350	91,850
Lincoln	2,213	2,146	245,962	116,143	951,490	362,290	88,180	373,996	787,414	21,530	4,330
Livingston	1,217	1,166	139,875	31,802	441,060	204,230	54,930	236,463	324,472	10,880	4,450
Madison	2,489	2,368	131,086	71,097	1,582,040	525,970	154,800	371,537	922,900	117,370	250
Morehouse	2,395	2,303	171,863	86,929	1,475,030	356,080	122,510	446,511	1,213,694	77,100	3,240
Natchitoches	4,262	4,064	316,071	125,341	2,297,340	724,060	185,730	794,684	1,765,983	153,930	5,950
Orleans	836	807	16,224	7,167	1,780,960	749,530	273,740	330,109	1,318,396	187,220	13,610
Ouachita	1,720	1,633	181,920	78,150	1,323,510	482,150	134,200	426,366	1,178,149	128,140	13,780
Plaquemines	728	671	211,490	34,144	1,468,240	716,240	1,149,410	209,801	957,597	381,210	25,390
Pointe Coupee	3,772	3,623	174,380	102,924	3,224,040	1,050,580	472,950	708,373	2,038,698	272,340	5,270
Rapides	4,249	3,834	285,369	117,568	3,610,360	862,050	545,490	1,017,197	2,340,416	158,710	27,050
Red River	1,702	1,595	131,059	60,055	996,840	256,110	57,170	255,077	727,671	37,900	2,580
Richland	1,936	1,857	109,736	49,506	815,940	245,960	57,410	328,255	659,396	48,200	100
Sabine	2,267	2,096	219,475	85,432	645,210	243,200	66,170	393,472	733,374	15,730	1,470
St. Bernard	210	197	43,633	11,479	577,050	221,280	38,190	129,681	339,862	133,830	11,710
St. Charles	333	318	54,130	31,973	904,450	178,150	353,230	187,802	908,591	200,310	2,090
St. Helena	1,274	1,255	131,484	38,583	497,540	194,390	52,050	220,980	400,869	14,440	13,600
St. James	361	347	95,899	53,506	2,277,760	757,830	1,203,180	412,914	1,456,399	660,480	66,550
St. John the Baptist	311	306	65,507	35,026	2,054,430	615,940	1,192,030	222,353	1,016,174	497,800	40,700
St. Landry	7,549	7,367	480,444	292,894	4,364,370	1,117,600	527,760	1,484,191	2,661,539	182,660	23,140
St. Martin	2,032	1,956	114,515	69,040	1,841,800	389,700	368,310	478,766	930,277	77,310	5,520
St. Mary	609	573	184,126	92,389	6,359,810	1,916,700	3,561,860	816,920	2,781,500	1,187,280	116,040
St. Tammany	397	395	87,667	19,491	226,290	116,730	32,350	171,382	186,428	4,930	7,130
Tangipahoa	1,615	1,550	163,686	38,146	1,027,760	545,970	106,560	393,123	684,254	66,680	38,920
Tensas	2,391	2,297	181,398	89,964	2,039,600	697,570	148,640	515,946	1,479,380	210,480	600
Terrebonne	748	735	168,379	52,780	3,477,260	921,320	1,798,040	457,806	2,036,887	823,410	101,350
Union	2,703	2,524	356,918	129,045	919,910	319,550	91,390	421,474	911,828	29,790	4,260
Vermilion	2,656	2,571	295,044	136,875	3,134,470	578,790	336,550	973,065	1,277,480	96,610	880
Vernon	1,057	1,038	130,871	26,203	391,930	147,630	46,360	269,750	261,305	5,160	4,590
Washington	1,442	1,404	224,540	48,775	570,550	302,600	69,580	328,768	579,555	23,600	27,740
Webster	2,136	2,030	221,210	93,829	641,940	294,860	64,560	318,650	663,749	30,330	8,110
West Baton Rouge	769	741	59,091	39,750	1,866,120	759,100	1,154,400	323,121	878,681	367,150	17,990
West Carroll	733	723	49,001	21,688	273,390	102,780	29,090	151,118	300,047	10,160	....
West Feliciana	2,325	2,296	146,761	66,574	1,216,080	516,830	92,440	428,080	987,183	39,720	6,550
Winn	1,587	1,527	246,327	54,327	544,100	225,580	63,860	311,186	427,488	15,430	2,840

An increase since 1890 in the number of farms is reported for all parishes except Assumption and St. James. About one-third of the parishes report decreases in farm area, all of these except Red River parish being in the eastern part of the state. The decreased improved acreage reported for some of the parishes is due to a more intensive cultivation of smaller areas of farm land, and to the use of a more strict definition of the term "improved" by the Twelfth than by any preceding census. The average size of farms for the state is 95.4 acres, ranging from 19.4 acres in Orleans parish to 354.1 acres in Cameron parish. The larger farms are, as a rule, in the parishes containing a number of rice and sugar plantations, and the smaller farms in the cotton-growing parishes.

For the state, the average value of farms (including land, improvements, and buildings) is $1,217. Nine-tenths of the parishes report increased total values of farms in the last decade. Only four parishes—Concordia, Red River, St. Bernard, and Tensas—report decreases in the value of implements and machinery. The same number of parishes report smaller values of live stock.

FARM TENURE.

Table 4 is an exhibit of farm tenure for 1900, showing the number and per cent of farms operated by owners and by tenants. Tenants are divided into two groups: "Cash tenants," who pay a rental in cash or in a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms in 1900 is given by race of farmer, and "farms operated by owners" are subdivided into groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it and the other, or others, owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	115,969	48,735	28,922	38,312	42.0	25.0	33.0
1890	69,294	38,539	11,745	19,010	55.6	17.0	27.4
1880	48,292	31,286	6,669	10,337	64.8	13.8	21.4

[1] Including "part owners." "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	115,969	44,715	2,634	352	1,034	28,922	38,312
White	57,809	36,255	1,759	309	955	7,721	10,810
Colored[1]	58,160	8,460	875	43	79	21,201	27,502

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	38.6	2.3	0.3	0.9	24.9	33.0
White	100.0	62.7	3.0	0.5	1.7	13.4	18.7
Colored[1]	100.0	14.5	1.5	0.1	0.1	36.5	47.3

[1] Comprising 2 Chinese, 62 Indians, and 58,096 negroes.

In the period from 1880 to 1900 the total number of farms increased 140.1 per cent, the gain in the last decade being 67.4 per cent. Since 1890 the number of farms operated by owners has increased 26.5 per cent; by cash tenants, 146.2 per cent; and by share tenants, 101.5 per cent. The percentages shown in Table 4 indicate that the number of farms operated by owners has not increased so rapidly since 1880 as the number operated by tenants.

In 1900, 49.8 per cent of the farms were operated by white farmers, and 50.2 per cent, by colored farmers. Of the white farmers, 66.2 per cent owned all or part of the farms they operated, and 33.8 per cent operated farms owned by others. The corresponding percentages for colored farmers are 16.1 and 83.9.

In 1890, 61.8 per cent of all tenants were share tenants, and in 1900, 57.0 per cent. The relative number of farms rented for cash or for a share of the products is determined largely by the race of farmers and the kind of crops grown. In the parishes along the Mississippi River, where colored farmers predominate, and where cotton and cane are the principal products, cash tenants equal or exceed share tenants, while in the western parishes, where more diversified farming prevails, share tenants outnumber cash tenants. In parishes where local contract systems prevail, the distinction between cash and share tenure is hard to draw.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	115,969	95.4	11,059,127	100.0	$198,536,906	100.0
White farmers	57,809	150.7	8,711,079	78.8	160,506,608	80.8
Negro farmers	58,096	40.3	2,343,365	21.2	37,995,093	19.2
Indian farmers[1]	64	73.2	4,683		35,205	
Owners	44,715	151.7	6,782,742	61.3	94,092,053	47.4
Part owners	2,634	130.8	344,483	3.1	6,630,651	3.3
Owners and tenants	352	115.3	40,582	0.4	701,237	0.4
Managers	1,034	941.7	973,721	8.8	43,966,519	22.1
Cash tenants	28,922	49.1	1,420,053	12.8	26,405,049	13.3
Share tenants	38,312	39.1	1,497,546	13.6	26,741,397	13.5

[1] Including 2 Chinese.

TABLE 7.—AVERAGE VALUE OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$929	$288	$246	$249	$571	33.3
White farmers	1,445	481	468	382	812	29.2
Negro farmers	416	96	25	117	330	50.5
Indian farmers[1]	347	59	17	128	259	47.1
Owners	1,105	385	258	356	662	31.5
Part owners	1,343	459	349	366	734	29.1
Owners and tenants	1,052	364	176	400	658	33.0
Managers	19,701	6,784	13,345	2,691	9,008	21.2
Cash tenants	564	143	44	162	425	46.5
Share tenants	462	97	25	114	334	47.8

[1] Including 2 Chinese.

In 1900, 21.2 per cent of the total acreage was operated by colored farmers, while less than 10 per cent was actually owned by them. The value of the farms operated by colored farmers was 19.1 per cent of the total state value of farm property, while the value of farms actually owned by negroes was less than 5 per cent. The large per cent of gross income shown in Table 7 for colored farmers is due to the smaller size and consequent more intensive cultivation of their farms, and to the lower value of their farm property or capital invested. It is also due in some degree to the fact that in many cases the most productive part of the plantations are rented in small areas to negroes and appear as the farms of colored tenants, while larger areas of less fertile land, comprising the remainder of the plantation, appear as the farms of white owners. The valuable buildings are all on the part retained, which tends to reduce the rate of income by increasing the base used in the computation.

Farms conducted by share tenants have the smallest average area, 39.1 acres, and those of managers the largest, 941.7 acres. The farms conducted by the last-named class are, as a rule, favorably located and highly improved, and the average values of the various forms of farm property, shown in Table 7, are much larger for this than for any other tenure group. The ratio which the gross income of these farms bears to the total value of farm property, however, is smaller than for the other groups, owing to the high average valuation of the land and buildings.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	115,969	95.4	11,059,127	100.0	$198,536,906	100.0
Under 3 acres	992	1.5	1,448	(1)	1,593,073	0.8
3 to 9 acres	4,730	6.7	31,586	0.3	2,803,705	1.4
10 to 19 acres	20,060	14.4	288,991	2.6	9,623,871	4.8
20 to 49 acres	44,622	29.8	1,330,953	12.0	30,208,673	15.2
50 to 99 acres	18,179	70.0	1,272,079	11.5	20,169,566	10.2
100 to 174 acres	15,633	137.6	2,150,489	19.5	21,191,849	10.7
175 to 259 acres	4,839	210.0	1,016,191	9.2	10,870,306	5.5
260 to 499 acres	4,176	343.9	1,435,925	13.0	16,443,391	8.3
500 to 999 acres	1,688	662.9	1,118,940	10.1	18,975,368	9.5
1,000 acres and over	1,050	2,297.6	2,412,525	21.8	66,657,104	33.6

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$929	$288	$246	$249	$571	33.3
Under 3 acres	752	524	62	268	832	51.8
3 to 9 acres	310	166	23	94	190	32.1
10 to 19 acres	275	94	19	92	291	60.7
20 to 49 acres	404	109	29	135	369	54.6
50 to 99 acres	629	190	51	239	483	43.5
100 to 174 acres	756	237	66	297	536	39.5
175 to 259 acres	1,318	379	116	433	694	30.9
260 to 499 acres	2,271	696	314	657	1,357	34.5
500 to 999 acres	6,124	1,907	1,950	1,260	2,324	20.7
1,000 acres and over	30,966	9,740	18,648	4,129	11,407	18.0

The group of farms of 1,000 acres and over contains the largest percentage of the total farm area. Over one-half of these farms are sugar or cotton plantations, and 288 of them are operated by managers. They report the highest average values of all forms of farm property and products, but on account of the high valuation of the property, the percentage of gross income on total investment is smallest for this group, though the gross income is in itself far in advance of that of any other group.

For the two groups of farms containing less than 10 acres each the average values given in Table 9 are relatively high, as these groups contain most of the florists' establishments of the state and a number of city dairies, poultry farms, and market gardens. It should be borne in mind that the income from these industries depends less upon the acreage of land used than upon the amount of capital invested in buildings and implements, and the amount expended for labor and fertilizers.

The average gross incomes per acre for the various groups classified by area are as follows: Farms under 3 acres, $569.72; 3 to 9 acres, $28.51; 10 to 19 acres, $20.23; 20 to 49 acres, $12.38; 50 to 99 acres, $6.90; 100 to 174 acres, $3.90; 175 to 259 acres, $3.31; 260 to 499 acres, $3.95; 500 to 999 acres, $3.51; 1,000 acres and over, $4.96.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40 per cent of the value of the products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40 per cent of their income from any one class of products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	115,969	95.4	11,059,127	100.0	$198,536,906	100.0
Hay and grain	6,003	101.8	610,831	5.5	11,913,632	6.0
Vegetables	2,596	55.2	143,326	1.3	3,995,789	2.0
Fruits	613	84.1	51,560	0.5	861,297	0.4
Live stock	7,119	153.1	1,089,753	9.9	13,263,763	6.7
Dairy produce	1,646	90.7	149,256	1.4	4,708,806	2.4
Tobacco	76	64.3	4,886	(1)	123,283	0.1
Cotton	79,468	71.9	5,712,170	51.7	67,505,143	34.0
Rice	2,733	163.1	445,713	4.0	10,011,143	5.0
Sugar	3,870	312.6	1,209,837	10.9	70,430,069	35.5
Flowers and plants	40	3.8	151	(1)	150,720	0.1
Nursery products	15	140.3	2,104	(1)	94,830	(1)
Miscellaneous	11,790	139.1	1,639,540	14.8	15,478,431	7.8

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$929	$288	$246	$249	$571	33.3
Hay and grain	1,170	401	190	224	279	14.1
Vegetables	965	358	61	155	508	33.0
Fruits	743	387	68	207	549	39.1
Live stock	929	341	108	485	368	19.8
Dairy produce	1,579	641	120	521	846	29.6
Tobacco	860	414	64	284	508	31.4
Cotton	501	141	37	170	422	49.7
Rice	2,466	427	303	467	1,581	43.2
Sugar	8,544	2,849	5,579	1,227	4,304	23.6
Flowers and plants	2,717	889	129	33	1,911	50.7
Nursery products	4,333	1,480	268	241	4,291	67.9
Miscellaneous	735	239	72	267	349	26.6

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $506.16; nursery products, $30.59; sugar, $13.77; rice, $9.70; dairy produce, $9.33; vegetables, $9.21; tobacco, $7.91; fruits, $6.53; cotton, $5.87; hay and grain, $2.74; miscellaneous, $2.51; and live stock, $2.41.

The wide variations shown in the averages and in the percentages of gross income are largely due to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than in the case of "hay and grain," "live stock," or "miscellaneous" farms. Were it possible to present the average net incomes, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	115,969	95.4	11,059,127	100.0	$198,536,906	100.0
$0	2,285	55.9	127,744	1.1	1,888,580	0.9
$1 to $49	5,039	46.1	232,399	2.1	2,568,180	1.3
$50 to $99	7,447	49.3	367,437	3.3	3,915,710	2.0
$100 to $249	32,631	58.3	1,901,788	17.2	19,564,770	9.9
$250 to $499	40,302	72.4	2,917,805	26.4	35,491,014	17.9
$500 to $999	20,117	106.7	2,146,264	19.4	31,658,672	15.9
$1,000 to $2,499	5,721	212.1	1,213,432	11.0	21,365,840	10.8
$2,500 and over	2,427	886.8	2,152,258	19.5	82,084,140	41.3

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$929	$288	$246	$249	$571	33.3
$0	533	135	62	97	....	....
$1 to $49	323	93	20	74	25	4.9
$50 to $99	317	97	23	89	70	13.3
$100 to $249	339	113	26	122	200	33.4
$250 to $499	499	156	38	188	373	42.4
$500 to $999	904	267	80	323	743	47.2
$1,000 to $2,499	2,234	641	226	634	1,503	40.2
$2,500 and over	16,647	5,304	9,416	2,454	8,393	24.8

The absence of income in the first group is due in part to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The persons in charge of such farms on June 1, 1900, could not always give definite information concerning the products of the preceding year. The same statement is true, also, of some of the farms with reported incomes of less than $100. To this extent the reports fall short of giving a complete statement of farm income in 1899.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping for neat cattle was determined by their present and prospective relations to the dairy industry and to the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits very close comparison with previous census reports.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	169,825	$817,872	$4.82	7,380
Steers	1 and under 2.	57,344	470,339	8.20	1,618
Steers	2 and under 3.	30,094	343,357	11.41	870
Steers	3 and over	26,589	586,360	22.05	3,117
Bulls	1 and over	10,783	207,261	19.22	377
Heifers	1 and under 2.	66,076	620,250	9.39	1,993
Cows kept for milk	2 and over	184,815	3,607,033	19.52	12,449
Cows and heifers not kept for milk.	2 and over	124,769	1,928,524	15.46	1,532
Colts	Under 1	13,510	166,312	12.31	556
Horses	1 and under 2.	12,076	274,190	22.71	534
Horses	2 and over	168,786	6,184,115	36.64	25,255
Mule colts	Under 1	2,325	52,950	22.77	79
Mules	1 and under 2.	6,225	293,765	47.19	104
Mules	2 and over	135,420	10,290,267	75.99	6,829
Asses and burros	All ages	683	51,685	75.67	270
Lambs	Under 1	50,610	49,746	0.98	346
Sheep (ewes)	1 and over	114,414	185,840	1.62	960
Sheep (rams and wethers).	1 and over	54,820	97,454	1.78	793
Swine	All ages	788,425	1,494,284	1.90	24,392
Goats	All ages	38,308	35,697	0.93	2,091
Fowls:[1]					
Chickens[2]	....	3,890,563	1,057,889	....	....
Turkeys	....	115,921			
Geese	....	169,936			
Ducks	....	123,059			
Bees (swarms of)	....	35,231	54,316	1.54	....
Value of all live stock	....	....	28,869,506	....	....

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.

[2] Including Guinea fowls.

The value of all live stock on farms, June 1, 1900, was $28,869,506. Of this amount, 36.8 per cent represents the value of mules; 23.0 per cent, that of horses; 17.2 per cent, that of neat cattle other than dairy cows; 12.5 per cent, that of dairy cows; 5.2 per cent, that of swine; 3.7 per cent, that of poultry; and 1.6 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same average values, however, the value of live stock not on farms would be $1,962,128, and the total value of live stock in the state, exclusive of poultry and bees not on farms, would be approximately $30,831,634.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the number of the most important classes of live stock.

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 to 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	184 815	485,480	194,372	144,653	169,234	788,425
1890	167,223	413,880	126,777	88,028	186,167	569,935
1880	146,454	324,147	104,428	76,674	135,631	633,489
1870	102,076	233,185	59,738	61,338	118,602	338,326
1860	129,662	387,145	78,703	91,762	181,253	634,525
1850	105,576	469,766	89,514	44,849	110,333	597,301

[1] Lambs not included.

In the Civil War decade all classes of live stock show decreases in numbers, but by the year 1880 practically all, with the exception of neat cattle, had regained the numbers reported in 1850. Uninterrupted progress since 1870 is shown in the numbers of all neat cattle, horses, and mules. For the last decade increases in number are as follows: Dairy cows, 10.5 per cent; other neat cattle, 17.3 per cent; horses, 53.3 per cent; mules and asses, 64.3 per cent; and swine, 38.3 per cent. A decrease of 9.1 per cent in the number of sheep is shown for the last decade.

Although the enumerators in 1900 were instructed to report no fowls under three months old, and no such limitation was made in previous census reports, the last decade shows the following increases in the numbers of fowls: Ducks, 83.4 per cent; chickens, 73.2 per cent; turkeys, 55.2 per cent; and geese, 13.8 per cent.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the products of the animal industry in 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	547,641	$90,317
Mohair and goat hair	Pounds	385	92
Milk	Gallons	[1]39,251,413	[2]4,168,015
Butter	Pounds	4,918,229	
Cheese	Pounds	135,104	
Eggs	Dozens	12,820,290	1,281,713
Poultry			1,425,116
Honey	Pounds	426,490	45,200
Wax	Pounds	20,440	
Animals sold			1,072,869
Animals slaughtered			1,929,437
Total			10,012,759

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of milk sold and consumed, and of butter and cheese made.

The value of animal products in 1899 was $10,012,759, or 13.8 per cent of the value of all farm products, and 15.1 per cent of the gross farm income. Of the total value, 41.6 per cent represents the value of dairy products; 30.0 per cent, that of animals sold and animals slaughtered on farms; 27.0 per cent, that of poultry and eggs; 0.9 per cent, that of wool, mohair, and goat hair; and 0.5 per cent, that of honey and wax.

DAIRY PRODUCE.

In 1899, 1,646 farmers, or 1.4 per cent of all in the state, derived their principal income from the sale of dairy produce. Of the $4,168,015 given in Table 16, as the value of all dairy produce, $3,059,959, or 73.4 per cent, represents the value of such produce consumed on farms, and $1,108,056, or 26.6 per cent, the receipts from sales. Of the latter amount, $986,824 was received from the sale of 4,356,979 gallons of milk; $109,774, from 564,250 pounds of butter; $8,770, from 116,177 pounds of cheese; and $2,688, from 3,853 gallons of cream.

The great progress in dairying since 1890 is shown by the fact that in 1900 more than three times as much milk, twice as much butter and thirty-four times as much cheese made on farms, were reported as in 1890.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms in 1899 was $3,002,306, or 4.1 per cent of the value of all farm products. Animals slaughtered were reported by 48,339 farmers, or 41.7 per cent of all in the state, the average value per farm being $39.91. Sales of animals were reported by 17,600 farmers, or 15.2 per cent, the average value per farm being $60.96. In obtaining these reports the enumerators were instructed to secure from each farm operator a statement of the amount received from sales in 1899, less the amount paid for animals purchased during the same year.

POULTRY AND EGGS.

The production of eggs in 1899 was more than twice as great as in 1889. The three parishes, St. Landry, Vermilion, and Lafayette are first in poultry products, each reporting more than 800,000 dozen eggs for the year 1899. The total value of poultry products was $2,706,829, of which 52.6 per cent represents the value of poultry raised, and 47.4 per cent, that of eggs produced.

WOOL.

Each decade since 1870 shows an increased production of wool, the product of 1899 being 106,955 pounds greater than that of 1889, a gain of 24.3 per cent. The following parishes in the southern part of the state, ranking in the order named, report more than half the state total of wool for 1899: Calcasieu, Vernon, St. Tammany, St. Landry, Rapides, Tangipahoa, and Washington.

HONEY AND WAX.

In 1899 there were reported 426,490 pounds of honey and 20,440 pounds of wax, while in 1889 the production was 271,962 pounds of honey and 8,584 pounds of wax.

HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses, mules, and dairy cows, and the average number of these animals per farm. In computing the averages presented, only those farms which report the kind of live stock under consideration are included.

TABLE 17.—HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.		MULES.		DAIRY COWS.	
	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.
Total	82,289	2.4	53,948	2.7	63,967	2.9
White farmers	48,130	2.8	24,858	4.0	43,270	3.4
Colored farmers	34,159	1.8	29,090	1.5	20,697	1.9
Owners[1]	40,536	2.8	22,044	3.1	37,957	3.4
Managers	837	5.4	810	26.1	711	5.5
Cash tenants	19,360	1.9	15,145	1.9	11,782	2.3
Share tenants	21,556	1.9	15,949	1.6	13,517	1.8
Under 20 acres	14,229	1.7	8,688	1.2	7,500	2.7
20 to 99 acres	44,857	2.1	29,266	1.8	33,529	2.3
100 to 174 acres	12,942	2.6	7,924	1.9	12,855	3.1
175 to 259 acres	4,127	3.1	2,961	3.1	4,258	3.8
260 acres and over	6,134	4.8	5,109	10.9	5,825	5.3
Hay and grain	4,098	2.2	2,110	3.3	2,857	2.5
Vegetable	1,873	1.8	729	2.3	1,070	2.3
Fruit	508	1.9	115	1.7	424	2.8
Live stock	6,322	3.7	2,714	2.8	6,002	3.5
Dairy	1,469	3.1	441	2.7	1,646	9.6
Cotton	52,362	2.1	39,307	1.9	38,278	2.5
Rice	2,311	4.0	1,268	5.0	1,710	3.1
Sugar	3,342	3.1	3,314	10.9	2,367	3.1
Miscellaneous[2]	10,004	2.6	3,950	2.3	9,613	3.1

[1] Including "part owners" and "owners and tenants."
[2] Including tobacco farms, florists' establishments, and nurseries.

In Louisiana, as in all states where cotton is a staple crop and much of the farm labor is performed by negroes, large numbers of mules are used as work animals. For most classes of farms the average number of mules exceeds that of horses. If the numbers of horses and mules be combined, the average number of work animals per farm compares favorably with the corresponding figures for the more intensively cultivated farms of New England.

CROPS.

The following table gives the statistics of the principal crops grown in 1899.

TABLE 18.—ACREAGE, QUANTITIES, AND VALUES OF PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	1,343,756	Bushels	22,062,580	$10,327,723
Wheat	214	Bushels	2,345	1,888
Oats	28,033	Bushels	316,070	117,312
Barley	16	Bushels	110	61
Rye	55	Bushels	372	323
Broom corn	107	Pounds	41,120	2,130
Rice	201,685	Pounds	172,732,430	4,044,489
Clover seed		Bushels	7	35
Grass seed		Bushels	264	465
Hay and forage	97,136	Tons	248,601	1,353,118
Cottonseed		Tons	[1]338,388	3,481,669
Cotton	1,376,254	Bales	709,041	23,523,143
Tobacco	275	Pounds	102,100	20,488
Peanuts	3,107	Bushels	45,713	44,785
Dry beans	335	Bushels	3,371	3,948
Dry pease	15,190	Bushels	146,298	156,843
Potatoes	9,220	Bushels	549,280	309,082
Sweet potatoes	27,372	Bushels	1,865,482	$859,733
Onions	1,655	Bushels	152,683	106,426
Miscellaneous vegetables	24,851			1,647,424
Sugar cane	276,966	Tons	3,137,338	
a. Cane sold		Tons	1,038,496	3,533,507
b. Cane kept for seed		Tons	1,013,984	3,483,633
c. Sugar made		Pounds	156,072,199	6,399,187
d. Molasses made		Gallons	6,213,859	782,271
e. Sirup made		Gallons	1,552,641	428,684
Sorghum cane	937	Tons	[1]1,160	3,423
Sorghum sirup		Gallons	48,727	14,944
Small fruits	1,408			172,803
Grapes	[2]85	Centals	1,770	[3]5,927
Orchard fruits	[2]12,686			[4]225,476
Tropical fruits				8,727
Nuts				51,457
Forest products				1,381,867
Flowers and plants	89			76,628
Seeds	36			5,000
Nursery products	276			63,593
Miscellaneous	7			16,331
Total	3,421,751			62,654,543

[1] Exclusive of 11,515 tons, valued at $118,490, sold in seed cotton and included with the cotton.

[1] Sold as cane.
[2] Estimated from number of vines or trees.
[3] Including value of raisins, wine, etc.
[4] Including value of cider, vinegar, etc.

Of the total value of crops, cotton and cottonseed contributed 43.1 per cent; sugar cane and sugar cane products, 23.3 per cent; cereals, including rice, 23.1 per cent; miscellaneous vegetables, 2.6 per cent; hay and forage, 2.2 per cent; forest products, 2.2 per cent; sweet potatoes, 1.4 per cent; and all other products, 2.1 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $861; nursery products, $230; small fruits, $123; tobacco, $75; miscellaneous vegetables, $66; onions, $64; sugar cane and sugar cane products, $53; potatoes, $34; sweet potatoes, $31; cotton and cottonseed, $20; sorghum cane and sorghum sirup, $20; orchard fruits, $18; peanuts, $14; dry pease, $10; and cereals, including rice, $9.

The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production requires a relatively great amount of labor and large expenditures for fertilizers.

COTTON.

The following table is a statement of the changes in cotton production since 1849.

TABLE 19.—ACREAGE AND PRODUCTION OF COTTON: 1849 TO 1899.

YEAR.	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	1,376,254	8.4	709,041	349,760,572	11.2
1889	1,270,154	46.9	659,180	314,428,860	36.5
1879	864,787		508,569	230,381,757	51.3
1869			350,832	152,261,088	[1]56.0
1859			777,738	346,093,410	384.1
1849			178,737	71,494,800	

[1] Decrease.

In 1859 Louisiana produced more than four times the amount of cotton reported for 1849, but in the next decade the state suffered from the effects of the Civil War, and the cotton crop decreased 56.0 per cent. The decades following have shown a rapid increase, though the percentage of gain has become smaller with each succeeding census. The parishes in which decreases are shown for the last decade are located in the northeastern part of the state.

In 1899, 88,328 farmers reported a total area of 1,376,254 acres devoted to cotton, 29.5 per cent of the total improved farm land of the state, and an average of 15.6 acres per farm. This land produced 349,760,572 pounds of lint, an average of 254 pounds per acre, 7,701 pounds per square mile of land service for the state, and 253 pounds per capita. The total value of the crop of 1899, including both lint and seed, was $27,004,812, the average value of these products being $305.73 per farm reporting and $19.62 per acre.

The parishes having the largest area devoted to cotton in the last decade were St. Landry, Caddo, Claiborne, Bossier, De Soto, Natchitoches, Avoyelles, Morehouse, and Pointe Coupee, ranking in the order named, and reporting 39.6 per cent of the total acreage.

SUGAR CANE.

Table 20 presents a comparative statement of the acreage of sugar cane and the production of sugar and sirup: 1849 to 1899.

TABLE 20.—ACREAGE OF SUGAR CANE AND PRODUCTION OF SUGAR AND SIRUP: 1849 TO 1899.

YEAR.[1]	Acreage in cane.	SUGAR.		SIRUP.	
		Production in pounds.	Average yield per acre in pounds.	Production in gallons.	Average yield per acre in gallons.
1899	276,966	156,072,199	563.5	7,766,500	28.0
1889	193,694	292,124,050	1,508.2	14,341,081	74.0
1879	181,592	206,047,200	1,134.7	11,696,248	64.4
1869	....	96,847,200	....	4,585,150	....
1859	....	266,071,200	....	13,439,772	....
1849	....	271,201,200	....	....	....

[1] No statistics of acreage were secured prior to 1879.

Of the 3,421,751 acres of land under cultivation in 1899, 277,903, or 8.1 per cent, were used for growing cane for the production of sugar, molasses, and sirup. Of this acreage, 276,966, or over 99.7 per cent, were devoted to cane, which, because it was introduced from the West Indies, is often called the West India cane, but is more often designated "ribbon cane," from its appearance. The remaining 937 acres, or 0.3 per cent, were used for growing sorghum cane, sometimes, though improperly, spoken of as Chinese sugar cane, by reason of its introduction from China.

NUMBER AND CHARACTER OF FARMS RAISING CANE.

Of the 115,969 farms reported in Louisiana, June 1, 1900, 13,870, or 12.0 per cent, raised cane used for making sugar or sirup. Of this number 11,763, or 84.8 per cent, grew sugar cane, with an average area per farm reporting of 23.5 acres, and 2,107, or 15.2 per cent, grew sorghum cane, the average area per farm being 0.4 of an acre. The area devoted to sugar cane has increased 42.9 per cent, while that devoted to sorghum cane has decreased 46.6 per cent since 1889. In addition, 11 large plantations and a great number of smaller farms raised cane used for seed, but made no sugar or sirup. The record of these operations with growing cane was not given upon the schedules.

The total farm value of sugar cane and sorghum cane in 1899, including in that total the receipts from sales of cane, the value of sugar cane reserved for seed and that of sugar, sirup, and molasses made by planters from cane which they grew, but not including the value of the sugar, etc., made from purchased cane, was $14,645,649. Of this amount, $14,627,282 represents the value of sugar cane and its products, and $18,367 that of sorghum cane and its products. The average value, as above described, of sugar cane per farm growing it, was $1,243, while the average of sorghum cane was less than $9; the average values per acre being $52.81 and $19.60, respectively.

Of the 11,774 farms growing sugar cane, 3,870 made its cultivation their principal source of income, and are here spoken of as sugar farms. The remainder, 7,904, made the growing of sugar cane a subordinate branch of agriculture. Sorghum is grown by few, if any, farmers as their principal source of income, but only as an incidental product in connection with other farming operations. It is principally grown in parishes in which the sugar cane does not flourish, Claiborne and Union parishes reporting 39.4 per cent of the total acreage and 46.4 per cent of the total value of the product.

Of the farmers growing sugar cane in 1899, 281 manufactured sugar and molasses therefrom. Of that number, 274 manufactured large quantities, while the manufacturing operations of the remaining 7 were insignificant.

Sirup was manufactured on 5,332 farms, and on 6,150 cane was sold, but no sugar or sirup manufactured. Cane was raised by many farmers from whom no reports were received. Their cane fields were so badly injured by frost that they harvested barely sufficient cane for seed, and as they sold no cane and made no sirup or sugar, the enumerators thought there was nothing to report. Among the plantations having expensive sugarhouses and machinery, there were 18 that made no sugar in 1899, owing to the frost and its consequent damage to cane. There were also 6 of the same class of plantations which, by reason of the frost, raised no cane excepting that reserved for seed, but purchased from others for sugar making. There were also 22 plantations that grew cane and made sirup exclusively. These 46 plantations in this bulletin will be grouped with the 274 which in 1899 manufactured sugar in large quantities, and are referred to as the 320 leading plantations. In this connection mention is made of 8 central refineries, 6 producing sugar and 2 reducing sirup to sugar for farmers but not cultivating any cane. They are considered as part of the sugar industry of the state, but not to be included in the statistics of agriculture proper. Of the 274 plantations making sugar in considerable quantities in 1899, 79 grew cane but did not purchase any, and 195 grew cane and also purchased it.

Of the 2,123,354 tons of cane converted into sugar by these plantations in 1899, 1,072,468 tons were grown by the manufacturers of the sugar on their own land by labor hired by themselves; 314,361 tons were grown on the plantations by tenants and purchased from them by the planter for use in his sugarhouse; and 736,425 tons were purchased by them and by the 8 central refineries from others. Of the total cane converted into sugar, 56.7 per cent was grown by the manufacturers, 8.6 per cent by the tenants, and 34.7 per cent by others. In the crop year 1898 the 351 central factories and large plantations converted 4,677,174 tons of cane into sugar. Of that quantity, 2,844,321 tons, or 60.8 per cent, were grown by owners of the sugarhouses; 350,699 tons, or 7.5 per cent, by their tenants; and 1,482,154 tons, or 31.7 per cent, were purchased from others. No tabulation was made of the relative amount of cane converted into sirup in 1898 or 1899 that was grown by the planters making it, by tenants, or purchased from others.

VALUE AND INCOME OF SUGAR PLANTATIONS.

The 3,870 plantations and farms making the sugar industry their principal source of income in Louisiana constituted only 3.3 per cent of the total number. They contained 1,209,837 acres of land, or 10.9 per cent of all land. The lands with their improvements, exclusive of buildings, had a value of $33,063,960; the value of the buildings was $11,027,060; implements and machinery, including apparatus for making sugar and railroads for handling cane, $21,591,940; and the live stock, $4,747,109; making a total fixed capital of $70,430,069, or 35.5 per cent of all the fixed capital in Louisiana agriculture. The corresponding investments of 79,468 cotton farms was $67,505,143, and of the other 32,631 farms, $60,601,694. The sugar farms numbered 3.3 per cent of all, and controlled 35.5 per cent of all the fixed capital; the cotton plantations numbered 68.5 per cent, and controlled 34.0 per cent of the capital; and the other plantations constituted 28.2 per cent of all, and controlled 30.5 per cent of all capital.

The sugar plantations reported farm products, including those fed to live stock, of a value of $18,019,470; the cotton plantations, of $36,823,212; and other plantations, $17,824,620. The products not fed, or gross farm income, for the three classes of farms amounted to $16,656,300, $33,523,192, and $15,959,340, respectively. These were 23.6, 49.7, and 26.3 per cent, respectively, of the total fixed capital invested in each class.

The expenditures of those 3,870 farms making sugar their chief source of income were, for labor, $6,931,470, and for fertilizers, $709,970, making a total of $7,641,440, or 45.9 per cent of the gross income of the farms, or the value of products less those fed to live stock. The cane kept for seed had a value at the sugarhouse for sugar making of $3,430,930. Mention is made of this large value to show the immense relative and actual cost of seeding to the Louisiana sugar planter as compared with that of the planters of Hawaii and Cuba. In Hawaii the tops are utilized for seed, and in Cuba the lands need reseeding, as a rule, only once in twenty years or more, the cost in either case being comparatively small. The $3,430,930 represents, therefore, the added cost of sugar making in Louisiana for a single year as compared with Hawaii and Cuba, and shows why under equal terms otherwise the planters of Louisiana can not compete successfully in sugar production with those of the islands mentioned. This value of the seed cane is not to be included with that of labor and fertilizers in the total expenses of the farm, because it is already included in the value of the labor and fertilizers used in its production. No reports were secured of the expenses of the 3,870 sugar farms outside of those of labor and fertilizers. Such statements were obtained, however, from 328 of the most important plantations and central factories which converted into sugar the cane grown in 1899.

COST OF RAISING CANE AND MAKING SUGAR.

The 320 leading planters in Louisiana who grew cane extensively in the year 1899 reported expenses for growing the 1,072,468 tons of cane grown by them on their own plantations, as follows: For labor, including salaries, $4,194,862; for fertilizers, $468,589; for feed purchased, $481,502; for maintenance and labor on plantation railroads, $116,276—a total of $5,261,229, and an average of $4.91 per ton utilized for sugar making. The average contract rate at which cane was purchased by the sugarhouses in 1899 was $3.56. After making allowance for the unreported farming expenses alluded to above, there was a margin loss of more than $1.35 a ton of cane converted into sugar in the field operations of 1899. This loss was owing to the severe frost that visited Louisiana in the early part of the year, and so damaged the crop as to leave many planters with barely sufficient cane for seed. The crop year 1898 presented many sharp contrasts with that of 1899. The year 1898 was a very wet season, the cane grew luxuriantly, and after deducting the usual amount for seed there was left a large quantity for delivery to the sugarhouses. The planters who grew only 1,072,468 tons in 1899 for sugar making delivered to the sugarhouses in the preceding year twice that amount, or

2,844,321 tons. The cultivation of the land, including the planting of the cane, cost about the same in the two years, the only extra expense for 1898 being for cutting and handling the extra quantity of cane. The contract price for the cane was $3.41 per ton, and this, with the great quantity raised, left a margin of profit in the field operations.

Of the large sugarhouses located on plantations and of central refineries purchasing all the cane converted by them, 351 were in operation for reducing the crop of 1898, and 310 were in operation for reducing the crop of 1899. The expenses of operating the 351 sugarhouses for the crop of 1898 (exclusive of the cost of cane purchased) were as follows: For labor, including salaries, $3,548,982; for fuel, $1,688,295; for mill supplies, $106,162; for freight expenses, $291,309; for taxes, $437,398; and insurance, interest, repairs, rent of office, and miscellaneous expenses, $1,842,197; total, $7,914,343. This was an average, for each of the 4,677,174 tons converted into sugar, of $1.69.

For the crop of 1899 the expenses of the sugarhouses were: For labor and salaries, $1,316,814; fuel, $644,665; mill supplies, $50,627; freight, $134,172; taxes, $305,355; and insurance, interest, repairs, and miscellaneous expenses, $949,935; total, $3,401,568; an average of $1.60 for each of the 2,123,354 tons converted into sugar.

For the crop year 1898 the sugar output had a value of $5.19 per ton of cane converted; in 1899, $7.11. There was, therefore, a small margin of gain in the sugarhouse operations connected with the crop of 1898, and a large gain for those of 1899. The small gain in the former year was due to the large content of water and the small content of sugar caused by the exceedingly wet season, while the large profit of the succeeding year came from the reverse conditions. Considering the field and sugarhouse work as a unit, the raising of cane and converting it into sugar yielded a good net profit in both 1898 and 1899. The exact amount of the former profit can not be determined from the reports, but in 1899 the growers of cane lost $1.35 a ton on all they raised, and the manufacturers of sugar made $1.95 on every ton of cane handled at the average cost of purchase. The net profit in the industry was the difference, or 60 cents a ton for the cane converted, from which must be deducted the interest on investment and allowance made for unreported expenses above mentioned. This profit was enjoyed by only the 310 owners of plantations and central refineries reducing cane. The other 3,568 farmers growing cane as their principal source of income suffered a very great loss. In both the crop years, 1898 and 1899, the largest profit was realized by the establishment with the most modern appliances; some of the others lost money both years.

PLANT AND RATTOON CANE.

In the crop year 1899 the area of cane used for sugar making and seed by the 320 leading plantations was, for plant cane, 59,246 acres; first year rattoon, 61,977 acres; and for second year rattoon, 5,922 acres. Of tons of cane used for sugar making there were, of plant cane, 873,315 tons; first year rattoon, 189,211 tons; and second year rattoon, 9,942 tons. Reserved for seed, plant cane, 96,025 tons; first year rattoon, 339,410 tons; and second year rattoon, 33,069 tons. The per cent of all cane used on these 320 plantations for seed in 1899 was 30.4.

SUGAR AND MOLASSES MADE IN 1899.

The total quantity of sugar made in Louisiana from cane grown in 1899 was 319,166,396 pounds, valued at $13,099,559. Of sirup there was made a total of 2,480,856 gallons, valued at $564,842. In addition, the planters reported 923,466 gallons of sirup, valued at $157,391, that was later converted in factories into sugar. Of molasses there was produced 11,703,877 gallons, valued at $1,277,384. Of the sugar, 8,874,929 pounds were made by the old process of the open kettle and 310,291,467 pounds by modern processes; 251,789,270 pounds were classed as firsts, 47,984,887 pounds, as seconds, and 10,517,310 pounds, as thirds.

For the crop year 1898 there was produced on the large plantations and in the central refineries for cane grown and purchased, a total of 556,994,942 pounds of sugar, valued at $22,197,168, and 24,164,689 gallons of molasses, valued at $1,661,897, and 2,774,961 gallons of sirup, valued at $432,481. Of the sugar made by modern processes, 437,370,968 pounds were firsts; 87,523,291 pounds, seconds; and 14,196,078 pounds, thirds; 17,904,605 pounds were made by the open kettle process.

LOSSES TO PLANTERS BY FROSTS IN 1899.

The very heavy frost of the early part of 1899 destroyed a large part of the cane planted in the fall of 1898, and extensively injured the rattoon cane, which constitutes a large part of the crop in Louisiana. The effect of this injury was far reaching; it not only greatly shortened the crop used for sugar making, but by destroying the stubble (rattoon cane), made necessary the replanting of a much larger area than usual, requiring the saving of a greatly increased quantity of cane for seed.

The reports furnished by the proprietors of the 320 large plantations considered in this report show an estimated loss of 297,491,424 pounds of sugar, or very nearly one-half of the entire crop, a cause amply sufficient to account for the net loss of 81 cents per ton, sustained by the growers.

CEREALS.

Table 21 is a statement of the changes in cereal production since 1849.

TABLE 21.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	16	1,343,756	28,033	201,685	55	214
1889	41	837,516	27,023	84,377	73	41
1879	....	742,728	26,861	42,000	201	1,501

PART 2.—BUSHELS PRODUCED.[2]

YEAR.[1]	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	110	22,062,580	316,070	172,732,430	372	2,345
1889	598	13,081,954	297,271	75,645,433	374	257
1879	....	9,889,689	229,840	23,188,311	1,013	5,034
1869	1,226	7,596,628	17,782	15,854,012	984	9,906
1859	224	16 853,745	89,377	6,331,257	36,065	82,208
1849	....	10,266,373	89,637	4,425,349	475	417

[1] No statistics of acreage were secured prior to 1879.
[2] Rice reported in pounds.

The total area devoted to cereals in 1879 was 813,291 acres; that in 1889, 949,071 acres; and in 1899, 1,573,759 acres, an increase for the twenty years of 93.5 per cent. The increases in the areas devoted to the various cereals in the decade from 1889 to 1899 were as follows: Wheat, over fivefold; rice, 139.0 per cent; corn, 60.4 per cent; and oats, 3.7 per cent. Rye decreased 24.7 per cent, and barley, 61.0 per cent.

Of the total area under cereals in 1899, 85.4 per cent was devoted to corn; 12.8 per cent, to rice; 1.8 per cent, to oats; and less than one-tenth of 1 per cent to wheat, rye, and barley.

Exclusive of rice, the total number of bushels of cereals reported in 1849 was 10,356,902, and in 1899, 22,381,477, an increase of 116.1 per cent in the half century. The production of rice in 1899 was about thirty-nine times as great as in 1849.

Corn and oats were reported from nearly all parts of the state. Wheat was grown in 11 parishes in the northern and central portions of the state, the two parishes of Bienville and De Soto contributing 56.5 per cent of the total acreage. Rye was grown in 10 parishes in the northern part of the state, and barley in 3 parishes, Caddo parish furnishing 87.5 per cent of the total acreage of the latter cereal.

The introduction of improved machinery has resulted in a transfer of the rice-growing industry from the Mississippi delta parishes, where the subsoil is too soft to permit the use of heavy modern reapers, to the southwest prairie parishes where an impervious clay subsoil soon becomes solid after the water is drawn off. Assumption, Ascension, and St. Mary parishes, which in 1890 reported 15.4 per cent of the total production, in 1900 reported only 1.5 per cent of the total. Acadia, Calcasieu, and Vermilion contributed 23.5 per cent of the crop of 1889 and 68.3 per cent of the crop of 1899.

HAY AND FORAGE.

In 1900, 14,635 farmers, or 12.6 per cent of the total number, reported hay and forage crops. Exclusive of cornstalks and corn strippings, an average yield of 1.7 tons per acre was obtained. The acreage in hay and forage in 1899 was 97,136, or 252.2 per cent greater than ten years before. Of the area mown, 66,823 acres, or 68.8 per cent, produced 112,481 tons of grains cut green for hay.

In 1899 the acreages and yields of the various other kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 5,086 acres and 6,278 tons; millet and Hungarian grasses, 426 acres and 728 tons; alfalfa or lucern, 2,365 acres and 4,156 tons; clover, 1,637 acres and 2,769 tons; other tame and cultivated grasses, 14,724 acres and 19,606 tons; forage crops, 6,075 acres and 17,425 tons; cornstalks and corn strippings, 84,607 acres and 85,158 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is included under "corn," as the forage secured was an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table.

TABLE 22.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	138,833	101,848	68,735	117,748
Apricots	674	584	89	469
Cherries	2,976	750	336	901
Peaches	758,877	317,182	153,808	310,217
Pears	74,669	9,807	29,405	3,993
Plums and prunes	186,158	91,602	29,682	17,977

In 1900, 7,288 farmers reported 1,168,792 fruit trees, while in 1890 the total number of trees was 521,723, the increase in the decade being 647,069, or 124.0 per cent. The number of pear trees has increased to nearly eight times that reported in 1890. The gains in the other varieties were as follows: Cherry trees, 296.8 per cent; peach trees, 139.3 per cent; plum and prune trees, 103.2 per cent; apple trees, 36.3 per cent; and apricot trees, 15.4 per cent.

Of the total number in 1900, 64.9 per cent were peach trees; 15.9 per cent, plum and prune trees; 11.9 per cent, apple trees; 7.3 per cent, pear, apricot, cherry, and unclassified fruit trees, the last-named class, which is not given in Table 20, numbering 6,605 trees and yielding 1,032 bushels of fruit.

The three adjacent parishes of Claiborne, Lincoln, and Webster, in the extreme northern part of the state, report 29.3 per cent of the total number of trees. Morehouse parish, in the northeastern part of the state, is the only parish reporting no fruit trees in 1900. The southeastern parish of Jefferson, which reported no fruit trees in 1890, reported more than 6,000 trees in 1900, ranking first in the number of cherry trees. As a rule, however, the semitropical fruits receive more attention in the southern part of the state than do the temperate fruits.

The value of orchard products, given in Table 18, includes the value of 101 barrels of cider, 77 barrels of vinegar, and 5,020 pounds of dried and evaporated fruit. The quantity of fruit produced in any given year is determined largely by the nature of the season. Comparisons between the crop of 1889 and that of 1899 have little significance, because in the latter year there was an almost complete failure of peaches and apricots, and very small yields of other fruits.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 1,408 acres, distributed among 932 farms, an average of 1.5 acres per farm. Of the total acreage, 1,395 acres, or 99.1 per cent, were devoted to strawberries, with a production of 1,841,800 quarts, 90.2 per cent of these berries being raised in Tangipahoa parish, where the average area per farm reporting was 2.4 acres. The production of other berries was as follows: Blackberries and dewberries, 10,170 quarts; raspberries and Logan berries; 110 quarts; gooseberries, 50 quarts; currants, 50 quarts; and other small fruits, 4,330 quarts.

VEGETABLES.

The total area used in the cultivation of vegetables, including potatoes, sweet potatoes, and onions, in 1899 was 63,098 acres. Of the acreage, 43.4 per cent was devoted to sweet potatoes; 14.6 per cent, to potatoes; 2.6 per cent, to onions; and 39.4 per cent, to miscellaneous vegetables. To sweet potatoes 29,014 farmers devoted 27,372 acres, producing 1,865,482 bushels, an average of 68.2 bushels per acre. They were grown throughout the state, but the southwestern parishes of Acadia, Calcasieu, Iberia, St. Landry, and St. Martin report 25.9 per cent of the product, and 32.1 per cent of the acreage. The area devoted to potatoes was 9,220 acres, yielding 549,280 bushels, an average of 59.6 bushels per acre.

The total area devoted to miscellaneous vegetables was 24,851 acres, of which the products grown on 14,648 acres were not reported in detail. Of the remaining 10,203 acres, 2,705 acres were devoted to watermelons; 1,993, to cabbages; 1,297, to sweet corn; 1,021, to muskmelons; 807, to cucumbers; 697, to tomatoes, 619, to beans; 288, to radishes; 162, to pease; 155, to beets; 135, to turnips; and 324, to other vegetables.

TOBACCO.

According to the census of 1850, Louisiana produced in 1849, 26,878 pounds of tobacco. The census of 1860 showed a gain of 13,062 pounds, or 48.6 per cent, and that of 1870, a loss of 24,399 pounds, or 61.1 per cent. Between 1870 and 1880 there was an increase of 40,413 pounds, or 260.0 per cent, while in the next decade there was a decline of 9,109 pounds, or 16.3 per cent.

The present census shows that in 1899 tobacco was grown in Louisiana by 522 farmers, who obtained from 275 acres a yield of 102,100 pounds. This was an increase over the crop area of 1889 of 166 acres, or 152.3 per cent, and a gain in production of 55,255 pounds, or 118.0 per cent. The total value of the crop was $20,488, an average of $39.25 for each farm reporting. The average area for each farm reporting was about one-half acre. The average yield per acre in 1899 was 371 pounds, against 430 pounds in 1889 and 221 pounds in 1879. The average value was 20 cents per pound.

Tobacco was grown in 1899 in 30 parishes of the state. The leading parish was St. James, which furnished 53.5 per cent of the entire area and 52.6 per cent of the entire production of the state.

PEANUTS.

Peanuts were grown in 1899 by 2,467 farmers who devoted to their cultivation 3,107 acres and secured therefrom a product of 45,713 bushels, an average of 14.7 bushels per acre. The acreage has increased approximately fourteenfold, and the production eightfold, since 1889. Of the total acreage, 78.3 per cent was reported from 12 extreme western and northern parishes. The parishes of Calcasieu, Claiborne, De Soto, Union, Lincoln, and Jackson, ranking in the order named, report the largest areas.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 356 acres, and the value of the products sold therefrom was $76,628. These flowers and plants were grown by 74 farmers and florists, of whom 40 made commercial floriculture their principal business. They had invested in the aggregate $150,720, of which $108,675 represents the value of land and improvements other than buildings, $35,575 that of buildings, $5,140 that of implements and machinery, and $1,330 that of live stock. The value of their products in 1899 was $76,510, of which $70,310 represents the value of flowers and plants, $80 the value of products fed to live stock, and $6,120 the value of other products. The expenditure for labor was $12,030, and for fertilizers $800. The average income per farm of all products was $1,913.

In addition to the 40 principal florists' establishments, 48 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 151,962 square feet, making, with the 43,357 square feet belonging to the florists' establishments, a total of 195,320 square feet.

NURSERIES.

The total value of nursery stock sold in 1899 was $63,593, reported by the operators of 43 farms and nurseries. Of this number, 15 derived their principal income from the nursery business. They had 2,104 acres of land, valued at $65,000; buildings worth $22,200; implements and machinery, $4,020; and live stock, $3,610. Their total income was $65,668, of which $57,508 represents the value of nursery stock; $1,310 the value of products fed to live stock; and $6,850, the value of other products. They expended $10,770 for labor and $815 for fertilizers. The average gross income for each farm reporting was $4,378, and the average income per acre, exclusive of the products fed to live stock, was $30.59.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $10,692,710, an average of $92 per farm. The average was $1,791 for sugar farms, $718 for nurseries, $368 for rice farms, $301 for florists' establishments, $76 for hay and grain farms, $68 for dairy farms, $62 for vegetable farms, $59 for fruit farms, $34 for tobacco farms, $26 for live-stock farms, and $19 for cotton farms. "Managers" expended on an average, $3,677; "owners," $104; "cash tenants," $38; and "share tenants," $17. White farmers expended $174 per farm, and colored farmers, $11.

Fertilizers purchased in 1899 cost $1,076,890, an average of $9 per farm, and an increase since 1890 of 18.8 per cent. The average expenditure was $183 for sugar farms, $54 for nurseries, $22 for fruit farms, $20 for florists' establishments, $9 each for hay and grain, and vegetable farms, $6 for tobacco farms, $5 for dairy farms, $3 for live-stock farms, and $2 for cotton farms.

IRRIGATION STATISTICS.

During the periods preceding the census year of 1890 and continuing up to 1894–5, the areas in rice were mainly on the lowlands along the lower Mississippi River and its outlying bayous. Being comparatively level and low, with a slope from the streams, these lands are subject to overflow unless protected by dikes to confine the river to its channel. Drainage is as essential as irrigation and the ditches are made to serve the double purpose of carrying water upon the land for irrigation and drawing it off when the crop is ready for harvest.

The water supply for the lowlands is obtained in various ways, the most common being by means of a flume, or "dahl," in the river levee, constructed on much the same principle as the trunk which is used in the Carolinas in irrigating plantations on tidal streams. The "dahl" was formerly made of sound 3-inch cypress plank of one length. This was supported by three brick walls built so as to extend some distance below the top of the woodwork to keep out crawfish and muskrats, which would otherwise work along the flume and create openings in the levee. The present flumes, under the requirements of a state law, are made of iron without brick supports or mortar protection and are not as substantial or satisfactory in all cases as those of cypress.

The land cultivated in many of the plantations was formerly planted to sugar cane. As it lies below the surface of the river, siphons are replacing the flumes and take the water from the river over the levees. The siphon is usually made of boiler iron, heavy enough to be calked the same as a steam boiler. Powerful steam pumps, taking the water from the river and bayous, are used on several of the large plantations.

Another method of irrigation is by the use of tiles, which are placed at a certain distance below the surface. By stopping these at the lower end of the field, the water is forced up through a layer of earth until irrigation is no longer required, when the plugs are withdrawn and the water passes off the land through the tiles. This system is especially advantageous in a season of excessive rainfall. All of these methods are expensive and failures are numerous owing to inadequate drainage, breaks in the levees, and frequent floods.

The discovery, a few years ago, that a vast area in the southwestern part of the state is admirably adapted to the cultivation of this cereal, revolutionized the growing of rice in this country and placed Louisiana far in the lead among the rice-producing states. This rice belt, extending north from the Gulf for a distance of 20 to 90 miles, is an undulating, gently sloping prairie, having ten navigable rivers and numerous lakes and bayous, and comprising over 12,000 square miles in Louisiana and Texas. At first the rice was cultivated in an exceedingly primitive way, the land being laid off in blocks and squares and irrigated with rain water collected and stored for use when needed. The success of this method, while not extraordinary, attracted many farmers and the country began to develop rapidly. It was found that "Providence" rice, as all rice grown by the aid of rain water is called, was not always a profitable crop. Experiments proved the value of abundant irrigation and quickly demonstrated that the prairie soil, when sufficiently watered, was unequaled for rice growing. This marked the beginning of the real development of this industry, which has made wonderful progress in the three years preceding the census. In 1899 the acreage in rice in southwest Louisiana was more than 77 per cent of that of the state.

Rice irrigation on the prairies is comparatively simple. Throughout the region are numerous ridges slightly higher than the rest of the land. It is upon these ridges that the canals are built, varying in width from 20 to 100 feet. Branching from the main canals are the laterals which run to outlying farms. The pumping plants at the head of the canals lift the water from the streams, whence it is carried in the main canal to the point of diversion on the land. More than one pumping plant is required on some of the large canals, owing to the necessity of several lifts to get the water into the canal.

The land to be planted in rice is usually broken and leveled in December and January, levees turned up around the fields, and cross levees put in, the levee work being accomplished by means of a large plow made for the purpose. Rice may be planted any time from February to June. One and one-fourth bushels of seed are used per acre, being sown broadcast or drilled, as preferred. When the rice reaches a height of from 6 to 8 inches, the water is turned on the land to a depth of 2 to 10 inches to secure the best results. Stooling begins when the rice is about 11 inches high. The water is kept on the land until the heads are filled, when the levees are cut and the water turned off to permit the rice to ripen and the ground to become dry enough for the harvester. Herein the prairie region possesses a distinct advantage over the delta lands. In the former the crop is harvested the same as wheat in the Northwest, while in the latter, owing to the moist soil, harvesting must be done with the sickle and requires many laborers and much time.

The numerous pumping plants, drawing millions of gallons daily from the streams and bayous, in many places have lowered the water levels, and some alarm was occasioned as to the future of the water supply. It was then ascertained that this region is underlaid with inexhaustible beds of water-bearing gravel, and flowing wells or wells with pressure sufficient to bring the water nearly to the surface are employed in large numbers to augment the supply. Many of these are of sufficient capacity to supply water to 100 acres of rice without diminution in their flow. A well and pumping outfit sufficient to irrigate 200 acres cost from $1,500 to $2,000. It is estimated that not less than 25,000 acres were irrigated in 1899 from wells.

The following table gives, by parishes, the number, length, and cost of the principal canals and ditches, and the acreage irrigated in 1899.

Table A.—RICE IRRIGATION STATISTICS, 1899.

PARISHES.	NUMBER OF IRRIGATION SYSTEMS— Supplied with water from— Streams.	Wells.	Total.	ACREAGE IRRIGATED— From streams.	From wells.	Total.	COST OF IRRIGATION SYSTEMS— Supplied with water from— Streams.	Wells.	Total.	Average per acre irrigated, 1899.	Total length of main ditches, in miles.
The State	542	54	596	194,788	6,897	201,685	$2,475,964	$53,355	$2,529,319	$12.54	386
Acadia	21	7	28	67,305	650	67,955	1,074,200	3,225	1,077,425	15.85	132
Calcasieu	29	26	55	40,731	3,590	44,321	836,000	26,820	862,820	19.47	159
Cameron	6	2	8	9,200	349	9,549	151,600	2,700	154,300	16.16	30
Plaquemines	394	....	394	11,546	....	11,546	92,135	....	92,135	7.98	(1)
Vermilion	9	7	16	24,025	885	24,910	232,200	9,350	241,550	9.70	42
All other parishes	83	12	95	41,981	1,423	43,404	89,829	11,260	101,089	2.33	23

[1] Siphon irrigation; no large ditches used except for drainage.

Irrigation of vegetables was reported on 6 farms having a total irrigated area of 48 acres. Wells supplied water for 24 acres, 8 acres were irrigated from streams by means of gravity diversion ditches, and 16 acres from streams by means of siphons. The total cost of construction of these systems was $755, or an average cost of $23.44 per acre.

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 228. WASHINGTON, D. C. July 3, 1902.

MANUFACTURES.

GLASS MANUFACTURE.

Hon. WILLIAM R. MERRIAM,

Director of the Census.

SIR: I transmit herewith, for publication in bulletin form, a report on glass manufacture, prepared under my direction by Mr. Shirley P. Austin, of Pittsburg, Pa., acting in the capacity of an expert special agent of the division of manufactures of the Census Office.

The statistics of glass manufacture were reported in 1880 and 1890 under four subdivisions, that is: Plate glass, window glass, glassware, and green and black glass. A separate schedule was prepared for each subdivision. In 1900 it was decided to assign the reports for the industry to two classes of products: Building glass, including plate glass, all varieties of cast and rolled sheet glass, and window glass; and pressed and blown ware and bottles and jars, including all pressed or blown flint glassware, and bottles and jars of flint, green, or amber glass.

The statistics seem to show a satisfactory rate of growth in the several branches of the industry, notwithstanding the fact that in nearly all lines the domestic manufacturers have been compelled to meet a vigorous foreign competition. The development of the industry has been marked by a noteworthy increase in the use of tank furnaces, and mechanical processes in lieu of hand work, which have resulted in an increased output combined with greater economy of operation. The distribution of the factories has depended to a considerable extent upon the supply of natural gas, the discovery of new fields being marked by an influx of glass factories from other localities having less favorable advantages in respect to fuel.

The statistics are presented in 14 tables: Table 1, comparative figures for the industry at the several censuses; Table 2, the statistics for idle establishments; Table 3, value of new construction; Tables 4 and 5, comparative statistics, by states, and by classes of products, respectively, 1880 to 1900; Table 6, rank of states according to value of products, with per cent of total value, 1880 to 1900; Tables 7 and 8, comparative statistics of the manufacture of building glass and the manufacture of pressed and blown glass and bottles and jars, respectively, by states, 1890 and 1900; Table 9, number of bottles manufactured, classified by capacity, by states; Table 10, imports and exports of glass; Table 11, comparative summary of materials used, 1890 and 1900; Tables 12, 13, and 14, presenting detailed statistics of the combined industry, the manufacture of building glass, and the manufacture of pressed and blown glass and bottles and jars, respectively.

In drafting the schedules of inquiry for the census of 1900, care was taken to preserve the basis of comparison with prior censuses. Comparison may be made safely with respect to all the general heads of the inquiry except those relating to capital, salaried officials, clerks, etc., and their salaries, the average number of employees, and the total amount of wages paid. Live capital, that is, cash on hand, bills receivable, unsettled ledger accounts, raw materials, stock in process of manufacture, finished products on hand, and other sundries, was first called for at the census of 1890. No definite attempt was made, prior to the census of 1890, to secure a return of live capital invested.

Changes were made in the inquiries relating to employees and wages, in order to eliminate defects found to exist on the form of inquiry adopted in 1890. At the census of 1890 the average number of persons employed during the entire year was called for, and also the average number employed at stated weekly rates of pay, and the average number was computed for the actual time the establishments were reported as being in operation. At the census of 1900 the greatest and least number of employees were reported, and also the average number employed during each month of the year. The average number of wage-earners (men, women, and children) employed during the entire year was ascertained by using 12, the number of calendar months, as a divisor into the total of the average numbers reported for each month. This difference in the method of ascertaining the average number of wage-earners during the entire year may have resulted in a variation in the number, and should be considered in making comparisons.

At the census of 1890 the number and salaries of proprietors and firm members actively engaged in the business or in supervision were reported, combined with clerks and other officials. In cases where proprietors and firm members were reported without salaries, the amount that would ordinarily be paid for similar services was estimated. At the census of 1900 only the number of proprietors and firm members actively engaged in the industry or in supervision was ascertained, and no salaries were reported for this class. It is therefore impossible to compare the number and salaries of salaried officials of any character for the two censuses.

Furthermore, the schedules for 1890 included in the wage-earning class overseers, foremen, and superintendents (not general superintendents or managers), while the census of 1900 separates from the wage-earning class such salaried employees as general superintendents, clerks, and salesmen. It is possible and probable that this change in the form of the question has resulted in eliminating from the wage-earners, as reported by the present census, many high-salaried employees included in that group for the census of 1890. With the exception of several other changes in the special features of the schedule, the investigation has been conducted along the lines followed at the census of 1890.

In some instances the number of proprietors and firm members, shown in the accompanying tables, falls short of the number of establishments reported. This is accounted for by the fact that no proprietors or firm members are reported for corporations. The reports show a capital of $61,423,903 invested in the 355 establishments reporting for the industry. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the corporations. The value of the products is returned at $56,539,712, to produce which involved an outlay of $2,792,376 for salaries of officials, clerks, etc.; $27,084,710 for wages; $3,588,641 for miscellaneous expenses, including rent, taxes, etc.; and $16,731,009 for materials used, mill supplies, freight, and fuel. It is not to be assumed, however, that the difference between the aggregate of these sums and the value of the products, is, in any sense, indicative of the profits in the manufacture of the products during the census year. The census schedule takes no cognizance of the cost of selling manufactured articles, or of interest on capital invested, or of the mercantile losses incurred in the business, or of depreciation in plant. The value of the product given is the value as obtained or fixed at the factory. This statement is necessary in order to avoid erroneous conclusions from the figures presented.

Very respectfully,

S. N. D. North

Chief Statistician for Manufactures

GLASS MANUFACTURE.

By Shirley P. Austin, *Expert Special Agent.*

The manufacture of glass in this country dates almost from the arrival of the first English colonists in what is now the United States. One of the earliest attempts, if not the first, at manufacturing in the original thirteen colonies was directed toward the production of glass, and a glass works erected for that purpose in 1608 or 1609, and located about a mile from Jamestown, Va., was probably the first manufactory erected in America by the English colonists. In 1608 the London Company sent glassworkers to America to operate the plant, and in the following year some of the products constituted a part of the first cargo of goods exported from this country.[1] This first glass factory probably produced bottles exclusively. Its career was brief, as in 1617 it was reported fallen into decay, and later was swept entirely away in the Indian massacre of 1622. In 1620 a subscription list was started in Jamestown to erect a factory for the manufacture of glass beads, the currency among the Indians, and in 1621 the London Company sent Italian workmen for this plant, which seems to have been located some distance from Jamestown, as it escaped the massacre of 1622, and is referred to as late as 1623. In 1639 a glass factory was located at Salem, Mass., and previous to this, although the exact date is not known, glass was first made in New York on Manhattan Island.[2] The first mention of a glass factory in Pennsylvania is contained in a very vague reference in a letter written by William Penn in 1683. The progress of the industry during the colonial period was slow and financial reverses were the rule. The scarcity of glass during the Revolutionary War stimulated factory erection, and early in the Nineteenth century the industry assumed much prominence, being confined largely to Massachusetts, New York, eastern Pennsylvania, New Jersey, and Maryland. These early factories were usually situated within easy access to forests, from which the fuel supply was obtained. Not until the erection of the first factory west of the Allegheny Mountains, at Pittsburg in 1797, was coal used as a fuel in glass manufacture, and it was many years before it came into general use.[3] The Atlantic seaboard long held supremacy in the manufacture of glass, but with the westward spread of population and the discovery of rich fuel resources in western Pennsylvania, West Virginia, Ohio, and Indiana, the center of the industry has steadily moved westward and the bulk of the production has been for some time west of the Alleghenies.

This report, with the statistical tables accompanying it, includes only establishments manufacturing glass from the crude material and does not include the large number of separate establishments engaged in the reworking of glass, such as silvering, beveling, cutting, engraving, decorating, etc. A number of the glass establishments, however, carry on these processes in direct connection with the manufacture of the "metal" in the same factory, and such establishments are included.

The inquiry into glass manufacture for this census was based on the following classification of the industry: (1) Building glass, all establishments making common window glass, plate glass, and all varieties of cast and rolled sheet glass; (2) pressed and blown glass, all establishments manufacturing pressed or blown flint glassware, tableware, jellies, tumblers, goblets, lamps, chimneys, lantern globes, gas and electric lighting ware, stem ware, opal ware, cut glass, etc.; (3) bottles and jars, all establishments manufacturing bottles and jars in flint, green, or amber glass. It has been found necessary to combine the last two divisions, as several firms reported production in both these branches.

Table 1 is a comparative summary of the statistics for the industry as returned at the censuses of 1850 to 1900, inclusive, with the percentages of increase for each decade.

[1] Stith's History of Virginia, pages 77 and 82.

[2] Bishop's History of American Manufactures, Vol. I, pages 233 and 234.

[3] History of Pittsburg, by Neville B. Craig, 1851, pages 276 and 277.

TABLE 1.—COMPARATIVE SUMMARY, 1850 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.						PER CENT OF INCREASE.				
	1900	1890	1880	1870	1860	1850	1890 to 1900	1880 to 1890	1870 to 1880	1860 to 1870	1850 to 1860
Number of establishments	355	294	169	201	112	94	20.7	74.0	[1]15.9	79.5	19.1
Capital	$61,423,903	$40,966,850	$18,804,599	$14,111,642	$6,133,666	$3,402,350	49.9	117.9	33.3	130.1	80.3
Salaried officials, clerks, etc., number	2,268	[2]1,095	(3)	(3)	(3)	(3)	107.1	......	......	......	......
Salaries	$2,792,376	[2]$1,232,561	(3)	(3)	(3)	(3)	126.6	......	......	......	......
Wage-earners, average number	52,818	44,892	24,177	15,822	9,016	5,668	17.7	85.7	52.8	75.5	59.1
Total wages	$27,084,710	$20,885,961	$9,144,100	$7,846,425	$2,903,832	$2,094,576	29.7	128.4	16.5	170.2	38.6
Men, 16 years and over	42,173	36,064	17,778	11,505	8,765	5,571	16.9	102.9	54.5	31.3	57.3
Wages	$24,901,233	$19,546,351	(3)	(3)	(3)	(3)	27.4	......	......	......	......
Women, 16 years and over	3,529	1,885	741	715	251	97	87.2	154.4	3.6	184.9	158.8
Wages	$840,001	$332,245	(3)	(3)	(3)	(3)	152.8	......	......	......	......
Children, under 16 years	7,116	6,943	5,658	3,602	(3)	(3)	2.5	22.7	67.1	......	......
Wages	$1,343,476	$1,007,365	(3)	(3)	(3)	(3)	33.4	......	......	......	......
Miscellaneous expenses	$3,588,641	$2,267,696	(4)	(4)	(4)	(4)	68.3	......	......	......	......
Cost of materials used	$16,731,009	$12,140,985	$8,028,621	$6,133,168	$2,914,303	$1,556,833	37.8	51.2	30.9	110.5	87.2
Value of products	$56,539,712	$41,051,004	$21,154,571	$19,235,862	$8,775,155	$4,641,676	37.7	94.1	10.0	119.2	89.1

[1] Decrease. [2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 12.)
[3] Not reported separately. [4] Not reported.

The remarkable growth of the glass making industry in the last half century is shown in Table 1. With the exception of a decrease in the number of establishments between 1870 and 1880, the table shows a steady increase in every item from 1850 to 1900. From 1850 to 1900 the number of establishments increased 261, or 277.7 per cent. The great improvement in factory construction and equipment and the broadening of the scope of the business during the same period are indicated by the increase in capital from $3,402,350 in 1850 to $61,423,903 in 1900, or 1,705.3 per cent. The number of wage-earners has increased from 5,668 in 1850 to 52,818 in 1900, or 831.9 per cent; and wages paid, from $2,094,576 in 1850 to $27,084,710 in 1900, or 1,193.1 per cent. During the same period the cost of materials used has increased from $1,556,833 to $16,731,009, or 974.7 per cent; and the value of products, from $4,641,676 to $56,539,712, or 1,118.1 per cent.

The growth from 1890 to 1900 was vigorous, as shown by an increase of 20.7 per cent in number of active establishments, and of 49.9 per cent in capital invested. The increase in capital was largely caused by the general introduction during the decade of the tank melting furnace, which necessitates much more costly and permanent factory construction and equipment than the pot furnace, which it is fast supplanting.

Of the total cost of materials used in 1900, $16,731,009, the principal item was the cost of packages and package materials, which was $3,390,627, and in 1890 was $1,853,462, an increase of $1,537,165, or 82.9 per cent. This large increase was caused in part by the demand for a neater package for finished products in nearly all lines of glass manufacture, created by increased competition, and by the more general use of the carton package for lamp chimneys, shades, globes, and the great variety of high-grade glassware, and the increased use of paper between sheets in packing building glass. In addition to the above package materials, establishments manufacturing pressed and blown ware, bottles, and jars reported in 1900, $1,522,917 as the cost of caps, metal trimmings, and rubber supplies. The cost of these materials was not reported separately at the census of 1890, but there has been an enormous increase in their consumption.

The total cost of fuel in 1900 was reported as $3,203,146. Of this amount, natural gas cost $1,575,278; coal, $1,074,074; and oil, $409,158; the remainder being divided between coke and wood. A number of establishments, particularly in Indiana, reported little or no cost for fuel, as they were either getting "free gas" as an inducement for location, or owned the source of their supply, and reported the small cost of maintenance under the item of general expense. Hence there was a large amount of natural gas used as fuel which was not reported.

Soda ash is the third largest item of cost in materials used, 157,779 tons being reported, at a cost of $2,259,939. In 1890, 96,777 tons were reported, costing $3,108,233. The average cost per ton in 1900 was $14.32, and in 1890, $32.12. While the quantity of soda ash used in glass manufacture during the decade increased 63 per cent, the cost decreased 27.3 per cent. The comparison shows the benefits derived by the glass industry from the development of the American soda-ash manufacture in the last ten years, a development that received the greater share of its impetus from men actively connected with the glass industry.

The increase in the value of products between 1890 and 1900 was 37.7 per cent, but it is safe to say the increase in the quantity of products was in excess of that, especially in the output of bottles, jars, and glassware, owing to the general introduction of the tank melting furnace and the adoption of improved mechanical equipment. The number of pieces of glassware, bottles, jars, etc., manufactured, was not reported at the census of 1890. It is therefore impossible to make a comparison with such data at the present census. The total production of plate glass, rough and polished, in 1890, was 12,206,942 square feet; and in 1900, 17,512,262 square feet, an increase of 43.5 per cent. There were 2,773,824 square feet of cathedral glass manufactured in 1890, and 8,846,361 square feet in 1900, or an increase of 218.9 per cent. The quantities of skylight and wire glass manufactured in 1900 were 3,679,694, and 1,295,504 square feet, respectively. No report was made of these products at the census of 1890. In 1890 there were 3,768,884 boxes of window glass manufactured, and 4,341,282 boxes in 1900, an increase of only 15.2 per cent. The comparatively small increase is explained by the much shorter "run" of factories during the "fire" covered by the present census, the average "run" being about six months in 1900 and nearly ten months in 1890. In addition, a large percentage of the available capacity of the factories was idle in 1900 for want of workmen.

Table 2 shows the idle establishments, by states, with the capital invested and the equipment of the factories, for 1900.

TABLE 2.—IDLE ESTABLISHMENTS, BY STATES: 1900.

	United States.	Illinois.	Indiana.	Kentucky.	New Jersey.	New York.	Ohio.	Pennsylvania.	Washington.	West Virginia.
Number of establishments	60	6	7	2	8	4	8	19	1	5
Capital	$3,544,536	$258,000	$121,035	$70,581	$84,700	$337,900	$308,018	$1,968,582	$60,000	$335,720
Equipment and character of works:										
Furnaces, number	41	8			6		8	13		6
Pots, number	488	140			42		87	156		63
Tanks—										
Continuous, number	27	1	6		3	4	2	10		1
Rings, number	248	6	46		29	52	15	90		10
Pot capacity, number	592	18	92		82	132	30	218		20
Intermittent or day, number	16		3	3	1		2	4	1	2
Pot capacity, number	139		41	18	36		4	18	10	12
Flattening ovens, number	38	2			11	10		14		1
Monkey ovens, number	32						30	2		
Blow furnaces, number	20				2	4		12		2
Casting tables, number	6	3						3		
Annealing ovens, number	67	4	12	29	4			16		2
Bending ovens, number	3							2		1
Clay grinding mills, number	2							2		
Grinding machines, number	13				3		5	5		
Polishing machines, number	3				2			1		
Shops, number	167	15	51	11	5	26	16	43		
Glory holes, number	118	8	16	6	1	4	22	55		6
Lehrs, number	153	8	14		12	20	29	47		23
Decorating kilns, number	11						1			10
Decorating lehrs, number	2						1	1		
Hand presses, number	56			5			3	29		19
Mechanical presses, number	12							7		5
Blowing machines, number	10					10				
Finishing machines, number	15							13		2
Crimping machines, number	16						10	6		
Sand-blast machines, number	3						1			2
Grinding machines for fruit-jar tops, number	4		1					3		

In addition to the 355 active establishments reported in 1900, Table 2 shows that 60 establishments, with a capital of $3,544,536, were reported as idle during the census year. These establishments were located as follows, by states: Illinois, 6; Indiana, 7; Kentucky, 2; New Jersey, 8; New York, 4; Ohio, 8; Pennsylvania, 19; Washington, 1; West Virginia, 5. Only those idle establishments that seemed reasonably certain of being again put in operation in the near future are included in Table 2. No account was taken of the many dismantled and abandoned glass factories in the country.

Of the 60 idle establishments reported, 41, with a capital of $2,296,587, were for the manufacture of pressed and blown ware or bottles and jars. The equipment of these establishments was as follows: 22 furnaces of 257 pots; 19 continuous tanks of 152 rings, or 304 pots capacity; 11 intermittent or day tanks of 120 pots capacity; 118 glory holes; 61 annealing ovens; 117 lehrs; 11 decorating kilns; 2 decorating lehrs; 56 hand presses; 12 mechanical presses; 10 blowing machines; 15 finishing machines; 16 crimping machines; 3 sand-blast machines; and 4 machines for grinding fruit jar tops. The remaining 19 idle establishments were building-glass factories, which reported a total capital of $1,247,949, and the following equipment: 19 furnaces of 231 pots; 8 continuous tanks of 96 rings or 288 pots capacity; 5 day tanks of 19 pots capacity; 38 flattening ovens; 32 monkey ovens; 20 blow furnaces; 6 casting tables; 6 annealing ovens; 3 bending ovens; 36 lehrs; 13 grinding machines; 3 polishing machines; and 2 clay grinding mills.

In addition to the establishments that were idle throughout the census year, a certain portion of the furnace equipment of active establishments was reported as idle. In active building glass factories, 29 pot furnaces with 471 pots, and one intermittent or day tank furnace of 7 pots capacity were reported as idle. In active pressed and blown ware and bottle and jar factories, 31 pot furnaces with 336 pots, 14 continuous tank furnaces with 79 rings of 158 pots capacity, and 16 intermittent or day tank furnaces of 76 pots capacity were reported as idle. The entire idle furnace equipment of active establishments in both branches of glass manufacture was as follows: 60 pot furnaces with 807 pots, 14 continuous tank furnaces with 79 rings of 158 pots capacity, and 17 intermittent or day tank furnaces of 83 pots capacity. It should be stated in this connection that this idle equipment is included in all tables presenting such data in this report, except Table 2. Adding the statistics of active establishments to those shown in Table 2 gives a total of 415 active and idle establishments in the United States, with a capital of

$64,968,439. The combined equipment of all establishments is as follows: Furnaces, 492; pots, 5,595; continuous tanks, 233; pot capacity of continuous tanks, 4,525; intermittent or day tanks, 163; pot capacity of intermittent or day tanks, 1,040; flattening ovens, 323; monkey ovens, 34; blow furnaces, 279; casting tables, 106; annealing ovens, 936; bending ovens, 12; clay grinding mills, 73; grinding machines, 240; polishing machines, 297; shops, 4,145; glory holes, 1,537; lehrs, 1,480; decorating kilns, 116; decorating lehrs, 25; hand presses, 971; mechanical presses, 61; blowing machines, 179; finishing machines, 155; crimping machines, 510; mechanical polishers, 16; sand-blast machines, 76; grinding machines for fruit jar tops, 141.

Table 3 presents the value of new construction, by states, during the census year. Only the value of additions to existing factories is given in the table, not including ordinary repairs and the value of new plants constructed.

TABLE 3.—NEW CONSTRUCTION, BY STATES: 1900.

STATES.	Cost of new construction (additions to old works, not including ordinary repairs) during census year.
United States	$578,917
Georgia	2,500
Illinois	43,448
Indiana	186,004
Michigan	4,848
New Jersey	22,664
New York	37,429
Ohio	26,141
Pennsylvania	184,682
West Virginia	12,201
Wisconsin	59,000

Table 4 presents comparative statistics of glass manufacture, by states, for the years 1880, 1890, and 1900.

TABLE 4.—COMPARATIVE STATISTICS, BY STATES: 1880 TO 1900.

STATES.	Year.	Number of establishments.	Capital.	Salaried officials, clerks, etc.: Number.	Salaried officials, clerks, etc.: Salaries.	Total: Average number.	Total: Wages.	Men, 16 years and over: Average number.	Men, 16 years and over: Wages.	Women, 16 years and over: Average number.	Women, 16 years and over: Wages.	Children, under 16 years: Average number.	Children, under 16 years: Wages.
United States	1900	355	$61,423,903	2,268	$2,792,376	52,818	$27,084,710	42,173	$24,901,233	3,529	$840,001	7,116	$1,343,476
	1890	294	40,966,860	[1] 1,095	[1] 1,232,561	44,892	20,885,961	36,064	19,546,351	1,885	332,245	6,943	1,007,365
	1880	[2] 194	[2] 19,329,699	(3)	(3)	24,177	9,144,100	17,778	(3)	741	(3)	5,658	(3)
Illinois	1900	6	2,181,801	75	110,100	3,304	1,621,286	2,607	1,496,891	148	28,456	649	95,939
	1890	13	1,721,878	31	44,710	2,762	1,188,051	2,215	1,121,526	20	3,860	527	62,665
	1880	6	425,000	(3)	(3)	732	342,027	632	(3)	...	(3)	100	(3)
Indiana	1900	110	12,775,389	509	649,227	13,015	7,226,047	10,910	6,808,042	634	129,808	1,471	288,197
	1890	21	3,656,663	79	76,682	3,010	1,469,149	2,633	1,422,104	197	27,811	180	19,234
	1880	4	1,442,000	(3)	(3)	862	284,207	695	(3)	53	(3)	114	(3)
Kentucky	[4] 1900	...	...	...	...	...	...	...	...	...	...	...	...
	[5] 1890	...	...	...	...	...	...	...	...	...	...	...	...
	1880	5	795,000	...	...	522	150,322	364	(3)	11	(3)	147	(3)
Maryland	1900	7	581,086	31	38,976	742	339,518	562	313,920	54	8,673	126	16,925
	1890	11	871,111	16	12,176	1,397	696,560	1,045	650,921	24	6,864	328	38,775
	1880	7	406,000	(3)	(3)	612	234,254	524	(3)	...	(3)	88	(3)
Massachusetts	1900	5	258,949	39	28,060	387	188,674	343	179,236	19	4,392	25	5,046
	1890	6	365,051	18	17,774	496	201,653	455	195,221	19	3,732	22	2,700
	1880	10	723,000	(3)	(3)	946	383,342	828	(3)	58	(3)	60	(3)
Missouri	1900	3	2,198,316	26	47,448	650	341,376	648	340,825	...	...	2	550
	1890	5	2,201,353	39	54,082	1,113	542,157	1,016	524,373	...	...	97	17,784
	1880	6	1,430,000	(3)	(3)	965	381,098	709	(3)	36	(3)	220	(3)
New Jersey	1900	26	6,397,662	317	284,960	5,383	2,462,745	4,366	2,278,306	170	32,726	847	151,713
	1890	34	3,744,894	152	132,619	5,688	2,730,100	4,601	2,605,798	42	8,405	1,045	115,897
	1880	22	2,568,021	(3)	(3)	3,578	1,300,038	2,762	(3)	46	(3)	770	(3)
New York	1900	27	2,242,834	117	139,698	2,556	1,305,264	2,201	1,239,971	73	17,831	282	47,462
	1890	30	2,297,699	56	61,413	3,229	1,422,626	2,587	1,319,607	92	17,025	550	85,994
	1880	29	1,875,600	(3)	(3)	3,078	1,046,812	2,116	(3)	50	(3)	912	(3)
Ohio	1900	28	5,451,513	199	249,029	4,546	2,067,384	3,505	1,844,958	405	46,017	636	126,409
	1890	59	4,094,677	216	230,823	6,435	2,901,255	5,053	2,700,036	538	74,227	844	126,992
	1880	19	1,172,850	(3)	(3)	1,688	644,520	1,170	(3)	81	(3)	437	(3)
Pennsylvania	1900	119	28,287,187	842	1,110,383	19,420	10,287,491	15,136	9,338,261	1,546	414,250	2,738	534,980
	1890	99	20,459,049	424	518,640	18,510	8,728,520	14,824	8,090,926	749	154,689	2,937	482,905
	1880	77	7,609,706	(3)	(3)	9,784	3,897,306	6,999	(3)	294	(3)	2,491	(3)
West Virginia	1900	16	1,338,084	85	97,551	1,949	789,422	1,319	657,984	468	103,748	162	27,690
	1890	7	825,313	34	46,946	1,371	511,079	970	446,349	190	32,632	211	32,098
	1880	4	650,522	(3)	(3)	946	311,650	615	(3)	100	(3)	231	(3)
All other states [6]	1900	8	711,082	28	36,944	866	455,504	576	402,839	12	4,100	278	48,565
	1890	9	829,262	30	38,196	881	494,811	665	469,490	14	3,000	202	22,321
	1880	5	332,000	(3)	(3)	464	168,524	364	(3)	12	(3)	88	(3)

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900 but not included in this table. (See Table 12.)
[2] Includes 25 establishments idle or in process of construction, with a capital of $525,100. Not separately reported by states in 1880.
[3] Not reported separately.
[4] No establishments reported.
[5] Included in "all other states."
[6] Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1. 1890—California, 1; Colorado, 1; Delaware, 1; Georgia, 2; Kentucky, 2; Michigan, 1; Wisconsin, 1. 1880—California, 1; Connecticut, 1; Iowa, 1; Michigan, 1; New Hampshire, 1.

TABLE 4.—COMPARATIVE STATISTICS, BY STATES: 1880 TO 1890—Continued.

STATES.	Year.	Miscellaneous expenses.	MATERIALS USED.							
			Total cost.	Mixing sand, tons.	Grinding sand, tons.	Soda ash (carbonate of soda) tons.	Salt cake (sulphate of soda), tons.	Nitrate of soda, tons.	Pearlash, pounds.	Litharge, pounds.
United States	1900	$3,588,641	$16,731,009	581,720	265,438	157,779	53,257	10,770	4,406,211	8,386,106
	1890	2,267,696	12,140,985	369,328	227,416	96,777	38,092	7,031	2,544,978	5,501,559
	1880	(1)	8,028,621	155,447	39,500	49,626	7,877	2,859	592,932	2,313,203
Illinois	1900	210,588	674,008	32,978	...	12,017	...	440	...	115,600
	1890	134,626	682,248	23,693	...	7,324	2,143	592	...	40,000
	1880	(1)	297,842	9,767	...	2,495	648	...	...	...
Indiana	1900	690,165	4,582,141	179,367	71,152	48,629	14,371	2,329	453,481	1,482,887
	1890	360,384	865,374	31,821	50,000	7,608	4,694	263	...	...
	1880	(1)	433,733	7,124	52,300	2,854	...	...	...	...
Kentucky	1900	...	...	...	...	...	...	...	...	...
	1890	...	...	...	...	...	...	...	...	...
	1880	(1)	134,104	3,543	...	840	337	49	20,000	7,000
Maryland	1900	26,065	151,500	3,493	...	1,601	...	149	75,000	36,982
	1890	35,847	295,337	12,703	...	2,558	112	230	77,000	94,000
	1880	(1)	239,682	5,344	...	1,902	36	36	...	...
Massachusetts	1900	14,243	137,185	1,622	...	194	125	24	207,967	364,448
	1890	35,760	127,180	1,920	...	386	157	16	74,300	140,750
	1880	(1)	329,864	2,205	...	392	255	75	130,111	298,260
Missouri	1900	98,119	231,615	10,366	4,743	3,048	226	...	...	...
	1890	116,397	657,874	11,690	22,652	4,130	180	63	...	...
	1880	(1)	351,871	8,042	7,200	3,071	...	31	...	...
New Jersey	1900	241,655	1,488,700	81,260	433	20,630	697	1,314	60,270	72,049
	1890	116,009	1,310,953	49,278	...	16,644	1,542	263	34,035	39,873
	1880	(1)	1,088,346	26,282	...	8,274	1,320	120	100	20,000
New York	1900	145,605	899,590	22,820	60	7,508	1,453	548	469,186	822,130
	1890	167,900	825,498	21,050	...	6,444	2,116	232	500,334	1,213,264
	1880	(1)	944,691	16,122	...	5,865	26	194	142,456	559,257
Ohio	1900	155,512	1,253,164	37,707	6,897	11,072	1,751	1,269	850,171	2,063,000
	1890	294,744	1,602,599	54,406	...	12,894	6,607	1,628	335,216	786,991
	1880	(1)	459,333	10,008	...	3,244	233	332	28,000	210,000
Pennsylvania	1900	1,867,879	6,435,463	191,859	182,117	46,398	34,297	4,330	1,938,334	3,143,727
	1890	911,178	5,294,992	149,239	154,764	34,287	20,251	3,277	1,474,093	3,086,681
	1880	(1)	3,350,660	61,452	...	18,419	4,822	1,841	268,496	1,218,686
West Virginia	1900	112,791	593,261	10,025	46	2,847	337	307	351,802	285,283
	1890	40,805	277,033	5,350	...	2,209	...	416	50,000	100,000
	1880	(1)	208,064	3,183	...	1,315	...	179	3,769	...
All other states[2]	1900	26,119	284,492	10,223	...	3,835	...	70	...	...
	1890	54,047	301,897	8,178	...	2,293	290	51	...	...
	1880	(1)	190,431	2,375	...	955	200	2	...	...

STATES.	Year.	MATERIALS USED—continued.							PRODUCTS.
		Lime and quicklime, bushels.	Limestone, tons.	Arsenic, pounds.	Manganese, pounds.	Fire clay and pot clay, pounds.	Pots (not including those made at works), number.	Cost of fuel.[1]	Aggregate value.[3]
United States	1900	993,349	91,016	2,349,261	1,493,538	32,151,017	8,941	$3,203,146	$56,539,712
	1890	929,706	45,482	1,823,007	610,915	37,066,652	8,006	2,340,912	41,051,004
	1880	869,886	2,597	713,974	191,146	17,233,891	13,655	(1)	21,154,671
Illinois	1900	56,734	4,815	46,607	59,838	642,000	309	155,400	2,834,398
	1890	25,525	3,387	121,308	14,336	859,332	498	146,834	2,372,011
	1880	49,607	300	26,100	...	833,000	627	(1)	901,343
Indiana	1900	287,685	27,993	837,487	521,980	8,624,298	2,429	355,300	14,757,883
	1890	61,818	6,877	214,100	87,052	3,153,600	701	89,866	2,995,409
	1880	47,842	...	32,000	...	692,000	1,100	(1)	790,781
Kentucky	1900[4]	...	...	...	...	...	...	...	...
	1890[5]	...	...	...	...	...	...	...	...
	1880	10,300	12	302	1,600	166,000	202	(1)	388,405
Maryland	1900	18,910	185	4,621	11,167	245,900	164	47,980	557,895
	1890	87,698	...	16,520	14,600	2,487,620	363	89,145	1,256,697
	1880	62,865	...	2,710	1,500	692,000	587	(1)	587,000
Massachusetts	1900	699	100	7,789	8,101	66,158	110	33,047	418,468
	1890	20	390	4,275	8,150	330,738	45	44,691	431,437
	1880	2,348	346	6,697	9,049	466,479	150	(1)	854,345
Missouri	1900	762	4,112	24,233	33,000	426,520	58	75,689	765,564
	1890	12,916	2,278	104,811	56,022	2,210,091	98	157,928	1,215,329
	1880	47,275	360	24,000	3,960	951,350	601	(1)	919,827

1 Not reported in 1880.

2 Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1. 1890—California, 1; Colorado, 1; Delaware, 1; Georgia, 2; Kentucky, 2; Michigan, 1; Wisconsin, 1. 1880—California, 1; Connecticut, 1; Iowa, 1; Michigan, 1; New Hampshire, 1.

3 While the aggregate value for the respective states is the aggregate value of products reported for all branches of glass manufacture, this total can not be obtained by adding the amounts given, as the reports of certain products have been suppressed, to avoid disclosing the operations of individual establishments.

4 No establishments reported.

5 Included in "all other states."

TABLE 4.—COMPARATIVE STATISTICS, BY STATES: 1880 TO 1900—Continued.

STATES.	Year.	MATERIALS USED—continued.							PRODUCTS.
		Lime and quicklime, bushels.	Limestone, tons.	Arsenic, pounds.	Manganese, pounds.	Fire clay and pot clay, pounds.	Pots (not including those made at works), number.	Cost of fuel.[1]	Aggregate value.[2]
New Jersey	1900	248,654	8,577	102,490	143,465	2,108,845	366	445,828	5,093,822
	1890	198,086	3,397	75,256	17,065	3,841,290	518	384,951	5,218,152
	1880	174,680	455	38,453	12,000	2,880,998	2,118	(1)	2,810,170
New York	1900	41,024	2,462	101,570	90,721	1,033,200	475	227,158	2,756,978
	1890	90,502	778	52,026	32,489	2,775,355	450	244,893	2,723,019
	1880	98,854	...	6,600	27,505	1,837,650	1,661	(1)	2,420,796
Ohio	1900	94,547	3,356	228,587	76,117	2,549,910	1,199	249,405	4,547,083
	1890	108,597	6,932	375,196	124,581	7,141,278	1,780	156,404	5,649,182
	1880	45,635	...	28,916	16,436	848,025	835	(1)	1,549,320
Pennsylvania	1900	184,969	38,309	896,074	457,581	15,926,246	3,461	1,421,710	22,011,130
	1890	268,674	20,248	746,393	216,910	13,086,298	3,223	858,281	17,179,137
	1880	309,122	1,124	547,266	110,178	6,495,169	5,170	(1)	8,720,584
West Virginia	1900	19,660	450	80,503	58,944	154,940	350	88,905	1,871,795
	1890	14,107	...	89,822	16,450	662,550	170	54,885	945,234
	1880	7,533	...	...	8,518	933,720	332	(1)	748,500
All other states[3]	1900	39,705	656	20,300	32,624	373,000	20	102,724	924,706
	1890	61,763	1,195	23,300	23,260	518,500	160	113,034	1,065,397
	1880	13,825	...	930	400	437,500	272	(1)	463,600

STATES.	Year.	PRODUCTS—continued.							
		Building glass.							Pressed and blown glass and bottles and jars, value.
		Total value.	Window.		Plate.				
			50-foot boxes, number.	Value.	Total value.	Total cast, square feet.	Sold rough, square feet.	Polished plate made, square feet.	
United States	1900	[4]$17,096,234	4,341,282	$10,879,355	[5]$6,194,279	[5]34,758,994	628,684	16,883,578	$39,443,478
	1890	13,928,296	3,768,884	9,058,802	[5]4,869,494	[5]19,319,509	3,106,831	9,100,111	27,122,708
	1880	5,915,618	1,864,734	5,047,313	[5]868,305	[6]1,700,227	377,227	1,042,000	15,238,953
Illinois	1900	...	...	...	...	...	...	...	2,810,398
	1890	...	...	...	...	...	...	...	1,945,790
	1880	373,343	115,271	373,343	...	...	...	...	528,000
Indiana	1900	5,711,948	1,701,729	4,176,587	1,520,361	[5]8,553,838	31,917	5,177,160	9,045,935
	1890	1,831,745	360,114	885,745	946,000	2,383,793	100,000	1,758,248	1,163,664
	1880	725,797	91,759	229,397	496,400	970,000	130,000	642,000	64,984
Kentucky	[6]1900	...	...	...	...	...	...	...	...
	[7]1890	...	...	...	...	...	...	...	...
	1880	3,512	...	...	3,512	20,684	20,684	...	384,893
Maryland	1900	...	...	...	...	...	...	...	454,633
	1890	...	...	...	...	...	...	...	674,900
	1880	332,000	141,000	332,000	...	...	...	...	255,000
Massachusetts	1900	...	...	...	...	...	...	...	402,258
	1890	72,748	...	...	72,748	569,375	434,150	...	...
	1880	149,845	41,866	104,002	45,843	209,543	209,543	...	704,600
Missouri	1900	...	...	...	...	...	...	...	...
	1890	...	...	...	...	...	...	...	...
	1880	390,550	24,000	68,000	322,550	500,000	17,000	400,000	529,277
New Jersey	1900	274,011	124,541	267,611	...	...	...	...	4,819,811
	1890	1,316,170	622,432	1,316,170	...	...	...	...	3,901,982
	1880	729,155	296,685	729,155	...	...	...	...	2,081,015
New York	1900	346,790	89,522	243,085	...	...	...	...	2,410,188
	1890	...	...	...	...	...	...	...	2,000,842
	1880	540,903	216,748	540,903	...	...	...	...	1,879,893
Ohio	1900	671,422	200,854	519,187	...	...	...	...	3,875,661
	1890	...	...	...	...	...	...	...	4,073,385
	1880	358,000	127,122	358,000	...	...	...	...	1,191,320
Pennsylvania	1900	9,213,545	2,068,340	5,301,131	3,912,414	[5]19,546,674	579,905	10,877,250	12,797,585
	1890	6,406,924	1,430,455	3,648,577	2,758,347	9,024,273	515,177	5,849,519	10,772,213
	1880	2,222,513	780,283	2,222,513	...	...	...	...	6,498,071
West Virginia	1900	...	...	...	...	...	...	...	1,770,553
	1890	...	...	...	...	...	...	...	945,234
	1880	...	...	...	...	...	...	...	748,500
All other states[3]	1900	878,518	156,296	371,754	761,504	6,658,482	16,862	829,168	1,056,456
	1890	4,300,709	1,355,883	3,208,310	1,092,399	7,342,068	2,057,504	1,492,344	1,644,698
	1880	90,000	30,000	90,000	...	...	...	...	373,500

[1] Not reported in 1880.
[2] While the aggregate value for the respective states is the aggregate value of products reported for all branches of glass manufacture, this total can not be obtained by adding the amounts given, as the reports of certain products have been suppressed, to avoid disclosing the operations of individual establishments.
[3] Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin; 1. 1890—California, 1; Colorado, 1; Delaware, 1; Georgia, 2; Kentucky, 2; Michigan, 1; Wisconsin, 1. 1880—California, 1; Connecticut, 1; Iowa, 1; Michigan, 1; New Hampshire, 1.
[4] Includes "all other products" for building glass as follows: Indiana, $15,000; New Jersey, $6,400; and Massachusetts, $1,200; total, $22,600.
[5] Includes "cathedral," "skylight," "wire," and "all other products" for this class.
[6] No establishments reported.
[7] Included in "all other states."

TABLE 4.—COMPARATIVE STATISTICS, BY STATES: 1880 TO 1900—Continued.

STATES.	Year.	EQUIPMENT AND CHARACTERISTICS OF WORKS.[1]									
		Furnaces, number.	Pots, number.	Tanks.[2]		Flattening ovens, number.	Monkey ovens, number.	Casting tables, number.	Annealing ovens, number.	Lehrs, number.	Clay grinding mills, number.
				Number.	Pot capacity.						
United States	1900	451	5,107	353	4,834	285	2	100	2,409	1,350	71
	1890	564	4,932			135	19	62	2,142	599	153
	1880	285	2,421			68	16	16	1,704		171
Illinois	1900	10	129	18	306	1	2	4	289	31	
	1890	27	225			8		6	269	11	4
	1880	8	74								
Indiana	1900	125	1,354	112	1,551	116		17	419	437	23
	1890	48	449			13	2	8	217	43	9
	1880	10	108								
Kentucky	[3]1900										
	[4]1890										
	1880	6	47								
Maryland	1900	12	107	1	6	2			21	20	2
	1890	19	161			4			34	23	6
	1880	9	68								
Massachusetts	1900	7	65	1	90	1			15	13	1
	1890	11	69			1		6	25	8	2
	1880	11	99								
Missouri	1900	7	110	5	73			14	130	2	1
	1890	13	148			1		23	117		7
	1880	7	51								
New Jersey	1900	33	255	51	769	6			266	100	4
	1890	80	469			22	1		352	60	22
	1880	44	289								
New York	1900	29	247	22	282	5		5	131	67	6
	1890	55	400			14	6	2	105	47	25
	1880	43	339								
Ohio	1900	42	539	18	237	12		3	144	119	5
	1890	85	806			25	1	1	123	142	21
	1880	20	187								
Pennsylvania	1900	168	2,117	93	1,303	138		57	880	485	27
	1890	197	1,982			45	9	16	788	241	48
	1880	112	1,029								
West Virginia	1900	15	156	20	90	2			18	65	1
	1890	17	144						18	33	3
	1880	8	82								
All other states[5]	1900	3	28	12	127	2			96	11	1
	1890	12	79			2			94	1	6
	1880	7	48								

STATES.	Year.	EQUIPMENT AND CHARACTERISTICS OF WORKS—continued.									
		Grinding machines, number.	Polishing machines, number.	Shops, number.	Glory holes, number.	Presses or pressing machines, number.	Finishing machines, number.	Crimping machines, number.	Grinding and engraving machines, number.	Horses and mules, number.	Wagons, carts, and drays, number.
United States	1900	227	294	3,978	1,419	964	140	494	137	409	407
	1890	186	214	2,894	880	801	91	233	798	590	484
	1880	70	70	1,353	437	522			716	749	679
Illinois	1900			427	146	13	2	1	3	23	24
	1890	4	50	115	48	2			1	25	13
	1880										
Indiana	1900	61	86	1,397	351	201	33	169	29	21	23
	1890	43		77	32	8			4	29	27
	1880										
Kentucky	[4]1900										
	[5]1890										
	1880										
Maryland	1900	1		67	24	7			4	13	17
	1890	3		148	23	4	50	15	17	21	21
	1880										
Massachusetts	1900			38	16	9		5		8	9
	1890			33	7	9			85	11	11
	1880										
Missouri	1900	21	24	26	6					9	7
	1890	26	50	23						30	24
	1880										

[1] The equipment of glass manufacturing plants, other than furnaces and pots, not having been reported by state totals in 1880, the comparison can be made only for the United States for that year.
[2] Not reported in 1880 and 1890.
[3] No establishments reported.
[4] Included in "all other states."
[5] Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1. 1890—California, 1; Colorado. 1; Delaware, 1; Georgia, 2; Kentucky, 2; Michigan, 1; Wisconsin, 1. 1880—California, 1; Connecticut, 1; Iowa, 1; Michigan, 1; New Hampshire, 1.

TABLE 4.—COMPARATIVE STATISTICS, BY STATES: 1880 TO 1900—Continued.

STATES.	Year.	EQUIPMENT AND CHARACTERISTICS OF WORKS—continued. Grinding machines, number.	Polishing machines, number.	Shops, number.	Glory holes, number.	Presses or pressing machines, number.	Finishing machines, number.	Crimping machines, number.	Grinding and engraving machines, number.	Horses and mules, number.	Wagons, carts, and drays, number.
New Jersey	1900	...	...	718	301	55	1	...	22	98	111
	1890	12	...	323	199	17	...	...	47	122	107
	1880	...	...	...	...	...	...	...	...	...	...
New York	1900	3	...	312	66	49	2	32	9	49	47
	1890	7	...	236	41	30	...	...	23	67	65
	1880	...	...	...	...	...	...	...	...	...	...
Ohio	1900	12	10	613	93	125	59	35	5	18	18
	1890	13	...	441	130	243	21	57	258	31	33
	1880	...	...	...	...	...	...	...	...	...	...
Pennsylvania	1900	129	174	144	351	444	42	252	54	134	126
	1890	73	114	1,316	370	408	20	151	303	213	147
	1880	...	...	...	...	...	...	...	...	...	...
West Virginia	1900	...	...	158	28	60	1	...	10	6	6
	1890	2	...	104	24	85	...	10	60	12	12
	1880	...	...	...	...	...	...	...	...	...	...
All other states[1]	1900	...	...	78	37	1	...	...	1	30	19
	1890	3	...	78	6	...	...	...	...	29	24
	1880	...	...	...	...	...	...	...	...	...	...

Table 5 presents comparative statistics of glass manufacture, by classes of products, for the years 1880, 1890, and 1900, with the per cent of increase for each decade.

TABLE 5.—COMPARATIVE SUMMARY, BY CLASSES OF PRODUCTS, 1880 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	Year.	Total.	Building glass.	Pressed and blown glass and bottles and jars.	PER CENT OF INCREASE. Total.	Building glass.	Pressed and blown glass and bottles and jars.
Number of establishments	1900	355	124	231	20.7	24.0	19.1
	1890	294	100	194	74.0	85.2	68.7
	1880	169	54	115	...	...	...
Capital	1900	$61,423,903	$26,617,122	$34,806,781	49.9	45.0	53.9
	1890	$40,966,850	$18,353,576	$22,613,274	117.9	151.8	96.4
	1880	$18,804,599	$7,290,155	$11,514,444	...	...	...
Salaried officials, clerks, etc., number	1900	2,268	615	1,653	107.1	110.6	105.9
	1890	1,095	292	803	...	...	...
	1880	(2)	(2)	(2)	...	...	...
Salaries	1900	$2,792,376	$811,983	$1,980,393	126.6	140.2	121.4
	1890	$1,232,561	$338,112	$894,449	...	...	...
	1880	(2)	(2)	(2)	...	...	...
Wage-earners, average number	1900	52,818	11,902	40,916	17.7	[3]0.7	24.3
	1890	44,892	11,982	32,910	85.7	147.3	70.2
	1880	24,177	4,846	19,331	...	...	...
Total wages	1900	$27,084,710	$9,029,673	$18,055,037	29.7	26.1	31.5
	1890	$20,885,961	$7,159,903	$13,726,058	128.4	194.4	104.5
	1880	$9,144,100	$2,431,789	$6,712,311	...	...	...
Men, 16 years and over	1900	42,173	11,801	30,372	16.9	1.4	24.3
	1890	36,064	11,633	24,431	102.9	154.2	85.1
	1880	17,778	4,577	13,201	...	...	...
Wages	1900	$24,901,233	$8,999,613	$15,901,620	27.4	27.2	27.5
	1890	$19,546,351	$7,073,965	$12,472,386	...	...	...
	1880	(2)	(2)	(2)	...	...	...
Women, 16 years and over	1900	3,629	20	3,509	87.2	[3]70.1	93.0
	1890	1,885	67	1,818	154.4	[3]27.2	180.1
	1880	741	92	649	...	...	...
Wages	1900	$840,001	$4,901	$835,100	152.8	[3]76.2	168.0
	1890	$332,245	$20,593	$311,652	...	...	...
	1880	(2)	(2)	(2)	...	...	...
Children, under 16 years	1900	7,116	81	7,035	2.6	[3]71.3	5.6
	1890	6,943	282	6,661	22.7	59.3	21.5
	1880	6,658	177	5,481	...	...	...
Wages	1900	$1,343,476	$25,159	$1,318,317	33.4	[3]61.5	39.9
	1890	$1,007,365	$65,345	$942,020	...	...	...
	1880	(2)	(2)	(2)	...	...	...

[1] Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1. 1890—California, 1; Colorado, 1; Delaware, 1; Georgia, 2; Kentucky, 2; Michigan, 1; Wisconsin, 1. 1880—California, 1; Connecticut, 1; Iowa, 1; Michigan, 1; New Hampshire, 1.

[2] Not reported separately.

[3] Decrease.

TABLE 5.—COMPARATIVE SUMMARY, BY CLASSES OF PRODUCTS, 1880 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE—Continued.

	Year.	Total.	Building glass.	Pressed and blown glass and bottles and jars.	PER CENT OF INCREASE.		
					Total.	Building glass.	Pressed and blown glass and bottles and jars.
Miscellaneous expenses	1900	$3,588,641	$1,365,865	$2,222,776	58.3	27.7	85.5
	1890	$2,267,696	$1,069,545	$1,198,151			
	1880	(1)	(1)	(1)			
Cost of materials used	1900	$16,731,009	$4,679,084	$12,051,925	37.8	1.2	60.3
	1890	$12,140,985	$4,621,535	$7,519,450	51.2	102.0	31.0
	1880	$8,028,621	$2,287,987	$5,740,634			
Value of products	1900	$56,539,712	$17,096,234	$39,443,478	37.7	22.7	45.4
	1890	$41,051,004	$13,928,296	$27,122,708	94.1	135.4	78.0
	1880	$21,154,571	$5,915,618	$15,238,953			
Pot and tank furnaces, number	1900	804	241	563	42.6	23.6	52.6
	1890	564	195	369	97.9	137.8	81.8
	1880	285	82	203			
Pot capacity of furnaces, number	1900	9,941	3,726	6,215	101.6	84.1	113.7
	1890	4,932	2,024	2,908	103.7	173.1	73.1
	1880	2,421	741	1,680			

[1] Not reported.

Tables 4 and 5 show large increases in the number of salaried officials and their salaries, between 1890 and 1900, caused by the organization of large consolidations in the glass business within the last five years. The most interesting disclosure, however, is the widespread substitution of the tank for the pot furnace for melting glass. No statistics of tank furnaces appear in the report on glass manufacture at the census of 1890, although a number were in existence at that time. These tanks were then largely regarded as in the experimental stage, although it had been demonstrated in 1888 that their operation was a success, particularly in the manufacture of window glass. It was several years before glass manufacturers were convinced of the advantages of the tank over the pot furnace; but from 1890 on, the introduction of the tank has been steady and is the prominent feature of the progress of the American glass industry during the last decade. A larger production and a more uniform quality of glass are rendered possible by the use of the tank system of melting than by the pot-furnace system, especially in the manufacture of window glass and bottles and jars. Although the cost of the installation of the tank system is considerably greater than that of the pot system, the former is much more economical and regular in operation. In many departments of the glass industry it meets the demand for more glass for less money. The introduction of the continuous tank in the manufacture of bottles and jars has been fully as general as in the manufacture of window glass, and continuous and intermittent or day tanks are being more and more extensively used in the manufacture of common tumblers and jellies, opal ware, lantern globes, lamp founts, chimneys, shades, and globes, and novelties and specialties in pressed and blown ware.

The statistics of furnaces are of little value for comparative purposes, owing to the general introduction of the tank furnace during the last decade. The following comparisons have been made on the assumption that all furnaces reported in 1890 were pot furnaces; this is not strictly correct, as it is known that there were several tank furnaces in operation at that time, but they were not shown separately in the published statistics. The number of tank furnaces reported was small, however, and would not materially affect the comparisons.

Since 1890 there has been a decrease of 20 per cent in the total number of pot furnaces, 564 being reported in 1890 and 451 in 1900. In building glass, 195 pot furnaces were reported in 1890 and 193 in 1900, a decrease of only 2, while the decrease in the number of pot furnaces for pressed and blown glass and bottles and jars was 111, or 30.1 per cent, 369 being reported in 1890 and 258 in 1900. However, in 1900 there is a total increase for the United States of 353 tanks—206 continuous and 147 day—making a gain in the total number of melting furnaces in 1900 over 1890 of 240, or 42.6 per cent. In building glass, 34 continuous and 14 day tanks were reported in 1900, making an increase in the total number of furnaces for that class in 1900 of 23.6 per cent over the number reported in 1890. In the class of pressed and blown ware and bottles and jars, 172 continuous and 133 day tanks were reported in 1900, making a gain of 52.6 per cent in the total number of furnaces in that division in 1900 over the total for 1890.

By estimating the ring capacity of the continuous tank in building glass establishments as equal to 3 pots, and in pressed and blown glass and bottle and jar establishments as equal to 2 pots, and estimating the ton capacity of the day tank in both classes as equal to a like pot capacity, the 353 tanks have a total capacity of 4,834 pots, 1,430 of which are in building glass factories and 3,404 in pressed and blown glass and bottle and jar factories. A comparison of the capacity of the pot furnaces reported in 1900 with the capacity reported in 1890, shows an increase in capacity of 3.5 per cent; an increase in building glass capacity of 13.4 per cent; and a decrease in pressed and blown ware and bottle and jar capacity of 3.3 per cent. However, the total capacity of both pot furnaces and tanks for the entire industry in 1900 increased 101.6 per cent over 1890; of building glass capacity, 84.1 per cent; and of pressed and blown ware and bottles and jars, 113.7 per cent. The increase of only 23.6 per cent in the number of furnaces in building glass factories, with an increase of 84.1 per cent in the pot capacity, indicates the much larger capacity of the average window tank than that of the tank used in the production of pressed and blown ware and bottles and jars, where the number of furnaces increased 52.6 per cent and the pot capacity increased 113.7 per cent. The day tank in building glass factories is used in the manufacture of skylight, tile glass, etc.

The general introduction of the tank for glass melting has created, within the past decade, a separate industry of considerable magnitude—the preparation of the clay for the construction of tanks. At the same time the manufacture of the glass melting pot has been transferred largely from the glass factory to a few establishments that make a specialty of its manufacture.

Table 6 presents the rank of states in glass manufacture as a whole from 1880 to 1890, according to value of products, with the percentages of total value of products for the United States.

TABLE 6.—RANK OF STATES ACCORDING TO VALUE OF PRODUCTS: 1880 TO 1900, WITH PER CENT OF TOTAL VALUE.

STATES.	RANK.			VALUE OF PRODUCTS.			PER CENT OF TOTAL VALUE.		
	1900	1890	1880	1900	1890	1880	1900	1890	1880
United States				$56,539,712	$41,051,004	$21,154,571	100.0	100.0	100.0
Pennsylvania	1	1	1	22,011,130	17,179,137	8,720,584	38.9	41.8	41.2
Indiana	2	4	8	14,757,883	2,995,409	790,781	26.1	7.3	3.7
New Jersey	3	3	2	6,093,822	6,218,152	2,810,170	9.0	12.7	13.3
Ohio	4	2	4	4,547,083	5,649,182	1,549,320	8.1	13.8	7.3
Illinois	5	6	6	2,834,398	2,372,011	901,343	5.0	5.8	4.3
New York	6	5	3	2,756,978	2,723,019	2,420,796	4.9	6.6	11.5
West Virginia	7	9	9	1,871,795	945,234	748,500	3.3	2.3	3.5
Missouri	8	8	5	765,564	1,215,329	919,827	1.4	3.0	4.4
Maryland	9	7	10	557,895	1,256,697	587,000	1.0	3.1	2.8
Massachusetts	10	10	7	418,458	431,437	854,345	0.7	1.0	4.0
Wisconsin	11	13		(1)	(1)	(2)			
California	12	14	13	(1)	(1)	140,000			0.7
Virginia	13			(1)	(2)	(2)			
Delaware	14	16		(1)	(1)	(2)			
Georgia	15	12		(1)	(1)	(2)			
Michigan	16	17	14	(1)	(1)	90,000			0.4
Colorado	17	15		(1)	(1)	(2)			
Kentucky		11	11	(2)	(1)	388,405			1.8
Connecticut			12	(2)	(2)	160,000			0.8
New Hampshire			15	(2)	(2)	70,000			0.3
Iowa			16	(2)	(2)	3,500			(3)
All other states[4]				924,706	1,065,397		1.6	2.6	

[1] Included in "all other states."
[2] Not reported.
[3] Less than one-tenth of 1 per cent.
[4] Includes the following states: 1890—California, Colorado, Delaware, Georgia, Kentucky, Michigan, Wisconsin; 1900—California, Colorado, Delaware, Georgia, Michigan, Virginia, Wisconsin.

Glass manufacture was reported in 17 states in 1900; in 17, in 1890; and in 16, in 1880. Wisconsin, Virginia, Delaware, Georgia, and Colorado were not reported in 1880. Iowa, New Hampshire, and Connecticut dropped out of the producing column in 1890, but Wisconsin, Delaware, Georgia, and Colorado were added. In 1900, Virginia, the home of the first glass factory, was again reported. No reports of glass manufacture were made from Kentucky in 1900. Since 1900 glass factories have been projected in Washington, Kansas, Tennessee, and South Carolina.

Pennsylvania has occupied first place as a glass-producing state for the last three decades. The discovery of gas in Indiana attracted many factories early in the last decade, especially from Ohio, where the gas was practically exhausted for factory purposes after a few years' existence. As a result, in 1900 Indiana has changed places with Ohio as a glass-producing state, the value of its product in 1900 being nearly five times that of 1890. New Jersey, the third state in 1900 and 1890, and the second in 1880, has held its prominent position by virtue of good sand deposits and advantageous geographical position, and largely from the fact that there are numerous native glass workers in the state not at all inclined to leave, even when better positions are offered elsewhere. There are indications, however, that this reserve on the part of the New Jersey workman is disappearing, and it is a question if the state will continue to hold its present position. West Virginia, which was ninth in glass manufacture in 1890, was seventh in the value of its glass products in 1900, increasing nearly 100 per cent during the decade. The excellent fuel resources of this state, in view of the rapid decline of the gas fields of Indiana, have recently greatly stimulated the growth of its glass manufacture, and will no doubt have the effect of placing it among the leading states in the industry.

The direction of the growth of the industry has always closely followed the fuel supply. The evident failing of the gas supply in Indiana has fixed attention on the gas field of southeastern Kansas, and it is probable that in a short time the industry will be established in that section, although unfavorable freight rates and the refusal of the citizens to hold out tempting cash bonuses for the location of factories have so far kept the glass factory out of that field. Some establishments now in Indiana are likely to be soon moved to the gas fields of West Virginia or western Pennsylvania, and some have already been transferred into the coal fields of Indiana and Illinois and will operate with gas produced from the coal of these states. The largest factories in the Indiana gas field are likely to be soon equipped to operate with gas produced from coal, which will give the glass industry of the state a permanency always lacking when cheap natural gas is the fuel used. During the present decade, owing to the absence of a great cheap fuel supply and the steady adoption of the producer gas-fuel system, many factories will be located at new points within convenient access to the great glass consuming sections, particularly in the West. The Pacific coast is attracting more and more attention as a field for glass manufacture, and the cheap fuel oil of southern California, coupled with the growing demand for a glass package from the fruit packers, will probably lead to a decided increase in the glass production of that state within a very short time.

BUILDING GLASS.

Table 7 presents comparative statistics, by states, for the building glass industry, for 1890 and 1900.

TABLE 7.—COMPARATIVE STATISTICS, BUILDING GLASS: 1890 AND 1900.

STATES.	Year.	Number of establishments.	Capital.	Salaried officials, clerks, etc.		Average number of wage-earners and total wages.							
						Total.		Men, 16 years and over.		Women, 16 years and over.		Children, under 16 years.	
				Number.	Salaries.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.
United States	1900	124	$26,617,122	615	$811,983	11,902	$9,029,673	11,801	$8,999,613	20	$4,901	81	$25,159
	1890	100	18,353,576	[1]292	[1]338,112	11,982	7,159,903	11,633	7,073,965	67	20,593	282	65,345
Indiana	1900	51	7,080,415	224	274,105	3,912	3,251,819	3,908	3,250,119	....	....	4	1,700
	1890	11	2,897,100	52	45,377	1,530	914,539	1,499	907,201	17	5,860	14	1,478
Massachusetts	[2]1900	....	....	....	....	....	....	....	....	....	....	....	....
	1890	3	58,750	3	1,250	84	26,602	84	26,602	....	....	....	....
New Jersey	1900	4	218,990	8	6,325	230	163,245	230	163,245	....	....	....	....
	1890	12	967,923	22	16,288	1,082	720,184	1,048	717,104	....	....	34	3,080
New York	1900	7	334,035	11	15,160	228	164,291	226	163,979	....	....	2	312
	[2]1890	....	....	....	....	....	....	....	....	....	....	....	....
Ohio	1900	7	2,039,134	25	22,570	477	376,006	477	376,006	....	....	....	....
	[2]1890	....	....	....	....	....	....	....	....	....	....	....	....
Pennsylvania	1900	46	14,661,120	307	435,015	6,459	4,706,720	6,368	4,679,801	20	4,901	71	22,018
	1890	28	9,715,850	104	145,152	5,399	3,258,692	5,172	3,192,078	50	14,733	177	51,881
All other states[3]	1900	9	2,283,428	40	58,807	596	367,592	592	366,463	....	....	4	1,129
	1890	46	4,713,953	111	130,045	3,887	2,239,886	3,830	2,230,980	....	....	57	8,906

STATES.	Year.	Miscellaneous expenses.	Materials used.										
			Aggregate cost.	Glass sand.		Soda ash (carbonate of soda).		Salt cake (sulphate of soda).		Nitrate of soda.		Limestone.	
				Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.
United States	1900	$1,365,865	$4,679,084	177,966	$298,879	25,500	$338,534	52,789	$512,835	614	$9,262	60,274	$106,540
	1890	1,069,545	4,621,535	157,792	352,904	22,715	718,098	35,624	561,398	76	3,605	38,912	117,690
Indiana	1900	348,665	1,319,675	59,746	102,019	8,037	106,833	14,158	180,018	50	1,875	18,911	31,987
	1890	297,127	510,845	18,785	47,431	2,567	79,137	4,409	55,970	....	....	6,467	15,577
Massachusetts	[2]1900	....	....	....	....	....	....	....	....	....	....	....	....
	1890	2,112	32,921	958	2,626	210	6,560	157	4,710	....	....	195	450
New Jersey	1900	12,141	86,720	2,763	2,833	615	11,396	500	5,700	....	....	350	850
	1890	40,258	366,203	14,594	16,991	4,183	129,866	42	876	....	....	3,337	13,528
New York	1900	14,569	120,748	2,977	3,773	59	1,433	1,453	13,605	23	1,056	917	1,621
	[2]1890	....	....	....	....	....	....	....	....	....	....	....	....
Ohio	1900	19,505	158,526	5,851	7,836	666	9,669	1,751	18,428	....	....	1,982	3,102
	[2]1890	....	....	....	....	....	....	....	....	....	....	....	....
Pennsylvania	1900	867,168	2,697,041	95,176	172,003	13,206	168,022	34,239	286,548	541	6,331	34,910	62,380
	1890	391,847	2,236,396	71,085	190,178	7,017	240,799	20,036	342,947	....	....	18,193	60,734
All other states[3]	1900	103,817	296,374	11,453	10,415	2,917	41,181	688	8,536	....	....	3,204	6,600
	1890	338,201	1,475,170	52,370	95,678	8,738	261,736	10,980	156,895	76	3,605	10,720	27,401

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900 but not included in this table. (See Table 13.)
[2] Included in "all other states."
[3] Includes establishments distributed as follows: 1900—Illinois, 1; Maryland, 2; Massachusetts, 1; Missouri, 2; West Virginia, 2; and Delaware, 1. 1890—Plate glass: Illinois, 2; Missouri, 2; New York, 1; and Ohio, 1. 1890—Window glass: Delaware, 1; Illinois, 3; Maryland, 4; Massachusetts, 1; Michigan, 1; Missouri, 1; New York, 8; and Ohio, 21.

TABLE 7.—COMPARATIVE STATISTICS, BUILDING GLASS: 1890 AND 1900—Continued.

STATES.	Year.	MATERIALS USED—continued.											
		Lime and quicklime.		Arsenic.		Manganese.		Grinding sand.		Rouge.		Fire clay and pot clay.	
		Cwt.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Tons.	Cost.	Pounds.	Cost.	Pounds.	Cost.
United States	1900	125,030	$12,315	1,321,130	$63,067	68,600	$2,316	263,933	$160,305	835,749	$24,448	23,510,700	$170,522
	1890	92,026	17,590	1,092,622	38,191	126,322	5,335	227,416	151,995	1,116,669	64,390	26,050,242	240,137
Indiana	1900	12,060	1,745	517,839	25,867	13,000	735	70,853	36,811	267,345	9,061	7,282,228	57,310
	1890	1,772	435	113,500	4,479	42,000	1,760	50,000	20,000	150,000	7,350	2,918,000	25,985
Massachusetts	[1]1900	...	...	...	...	...	...	...	...	...	...	...	...
	1890	16	6	2,000	60	5,000	250	...	...	...	...	105,212	727
New Jersey	1900	72,922	2,373	5,085	280	...	...	...	...	...	...	196,840	2,148
	1890	14,050	5,613	11,724	403	...	...	...	...	...	...	1,057,500	14,653
New York	1900	...	...	40,552	2,066	1,200	63	...	...	...	...	288,750	2,438
	[1]1890	...	...	...	...	...	...	...	...	...	...	...	...
Ohio	1900	3,150	482	105,243	4,875	...	...	6,800	2,040	14,900	723	1,603,910	4,749
	[1]1890	...	...	...	...	...	...	...	...	...	...	...	...
Pennsylvania	1900	20,185	3,919	610,807	27,923	20,400	643	181,537	119,557	532,524	13,971	13,365,852	97,832
	1890	13,117	3,697	582,279	19,663	4,500	190	154,764	120,669	640,669	52,154	9,587,565	112,544
All other states[2]	1900	16,713	3,796	41,604	2,056	34,000	875	4,743	1,897	20,980	693	773,120	6,045
	1890	63,071	7,839	383,119	13,586	74,822	3,135	22,652	11,326	326,000	4,886	12,381,965	86,228

STATES.	Year.	MATERIALS USED—continued.									
		Pots (not including those made at works).		Fuel.							All other materials, cost.
				Total cost.	Natural gas, cost.	Oil.		Coal.		All other fuel, cost.	
		Number.	Cost.			Gallons.	Cost.	Tons.	Cost.		
United States	1900	3,830	$101,061	$1,119,022	$751,354	723,654	$23,161	269,611	$335,856	$8,651	$1,759,978
	1890	2,587	87,434	990,993	328,274	47,250	2,250	414,576	611,743	48,726	1,271,775
Indiana	1900	1,482	45,035	195,376	193,590	489	78	432	1,138	570	525,003
	1890	447	15,885	81,958	200	...	...	64,525	80,758	1,000	154,878
Massachusetts	[1]1900	...	...	...	...	...	...	...	...	...	...
	1890	26	340	13,483	...	...	...	4,083	10,500	2,983	3,709
New Jersey	1900	65	1,300	30,343	...	133,414	4,070	12,406	24,905	1,368	29,497
	1890	159	4,445	119,741	...	47,250	2,250	33,581	101,198	16,293	60,087
New York	1900	332	10,395	42,741	...	54,171	2,742	20,769	37,450	2,549	41,557
	[1]1890	...	...	...	...	...	...	...	...	...	...
Ohio	1900	336	9,110	35,772	11,212	113	25	28,593	24,323	212	61,740
	[1]1890	...	...	...	...	...	...	...	...	...	...
Pennsylvania	1900	1,366	25,641	710,415	535,070	177,256	5,679	161,368	166,866	2,800	1,001,856
	1890	912	43,042	375,254	298,590	...	...	67,643	74,125	2,539	674,525
All other states[2]	1900	249	9,580	104,375	11,482	358,211	10,567	46,043	81,174	1,152	100,325
	1890	1,043	23,722	400,557	29,484	...	...	244,744	345,162	25,911	378,576

[1] Included in "all other states."

[2] Includes establishments distributed as follows: 1900—Illinois, 1; Maryland, 2; Messachusetts, 1; Missouri, 2; West Virginia, 2; and Delaware, 1. 1890—Plate glass: Illinois, 2; Missouri, 2; New York, 1; and Ohio, 1. 1890—Window glass: Delaware, 1; Illinois, 3; Maryland, 4; Massachusetts, 1; Michigan, 1; Missouri, 1; New York 8; and Ohio 21.

TABLE 7.—COMPARATIVE STATISTICS, BUILDING GLASS: 1890 AND 1900—Continued.

STATES.	Year.	PRODUCTS. Building glass. Total value.[1]	Window. Boxes.	Window. Value.	Plate. Total cast. Square feet.	Plate. Rough, sold. Square feet.	Plate. Rough, sold. Value.	Plate. Polished plate made. Square feet.	Plate. Polished plate made. Value.	Plate. Cathedral. Square feet.	Plate. Cathedral. Value.	All other products, value.
United States	1900	$17,096,234	4,341,282	$10,879,355	34,758,994	628,684	$75,887	16,883,578	$5,158,598	8,846,361	$567,252	$415,142
	1890	13,928,296	3,768,884	9,037,187	[2]19,319,509	3,106,831	337,057	9,100,111	4,172,484	2,773,824	279,407	102,161
Indiana	1900	5,711,948	1,701,729	4,176,587	8,553,838	31,917	4,780	5,177,160	1,415,224	....	....	15,000
	1890	1,831,745	360,114	885,745	2,383,793	100,000	20,000	1,758,248	886,000	....	....	40,000
Massachusetts	[3]1900	....	....	....	....	....	....	....	....	....	....	....
	1890	72,748	....	....	569,375	434,150	59,025	....	....	....	....	13,723
New Jersey	1900	274,011	124,541	267,611	....	....	....	....	....	....	....	6,400
	1890	1,316,170	622,432	1,295,100	....	....	....	....	....	....	....	21,070
New York	1900	346,790	89,522	243,085	....	....	....	....	....	....	....	57,011
	[3]1890	....	....	....	....	....	....	....	....	....	....	....
Ohio	1900	671,422	200,854	519,187	....	....	....	....	....	....	....	....
	[3]1890	....	....	....	....	....	....	....	....	....	....	....
Pennsylvania	1900	9,213,545	2,068,340	5,301,131	19,546,674	579,905	68,032	10,877,250	3,441,734	....	....	331,648
	1890	6,406,924	1,430,455	3,648,577	9,024,273	615,177	82,232	5,849,519	2,676,115	....	....	....
All other states[4]	1900	878,518	156,296	371,754	6,658,482	16,862	3,075	829,168	301,640	8,846,361	567,252	5,083
	1890	4,300,709	1,356,883	3,207,765	7,342,068	2,057,504	175,800	1,492,344	610,369	2,773,824	279,407	27,368

STATES.	Year.	EQUIPMENT AND CHARACTERISTICS OF WORKS. Furnaces, number.	Pots, number.	Tanks.[5] Number.	Tanks.[5] Pot capacity.	Flattening ovens, number.	Monkey ovens, number.	Casting tables, number.	Annealing ovens, number.	Clay-grinding mills, number.	Grinding machines, number.	Polishing machines, number.	Horses and mules, number.	Wagons, carts, and drays, number.
United States	1900	193	2,296	48	1,430	285	2	100	869	63	227	294	92	93
	1890	195	2,024	....	....	135	19	62	542	75	123	214	220	187
Indiana	1900	82	825	13	552	116	....	17	258	22	61	86	14	13
	1890	27	333	....	....	13	2	8	172	9	39	50	22	21
Massachusetts	[3]1900	....	....	....	....	....	....	....	....	....	....	....	....	....
	1890	6	22	....	....	....	....	6	21	....	....	....	3	3
New Jersey	1900	3	24	3	72	6	....	....	....	3	....	....	6	7
	1890	24	188	....	....	22	1	....	....	9	....	....	27	28
New York	1900	9	65	....	....	5	....	5	6	6	3	....	5	3
	[3]1890	....	....	....	....	....	....	....	....	....	....	....	....	....
Ohio	1900	13	162	2	66	12	....	3	23	3	12	10	3	2
	[3]1890	....	....	....	....	....	....	....	....	....	....	....	....	....
Pennsylvania	1900	66	1,014	29	731	138	....	57	485	23	129	174	47	52
	1890	61	750	....	....	45	9	16	245	22	59	114	93	60
All other states[4]	1900	20	206	1	9	8	2	18	98	6	22	24	17	16
	1890	77	731	....	....	55	7	32	104	35	25	50	75	75

[1] While the total value for the respective states is the total value of products reported for all classes of the building glass manufacture, this total can not be obtained by adding the amounts given, as the reports of certain products have been suppressed to avoid disclosing the operations of individual establishments.
[2] Includes 4,338,743 square feet of skylight, ribbed glass, opalescent glass, etc.
[3] Included in "all other states."
[4] Includes establishments distributed as follows: 1900—Illinois, 1; Maryland, 2; Massachusetts, 1; Missouri, 2; West Virginia, 2; and Delaware, 1. 1890—Plate glass: Illinois, 2; Missouri, 2; New York, 1; and Ohio, 1. 1890—Window glass: Delaware, 1; Illinois, 3; Maryland, 4; Massachusetts, 1; Michigan, 1; Missouri, 1; New York, 8; and Ohio, 21.
[5] Not reported in 1890.

Of the 124 establishments reporting for 1900, 13 manufacture polished plate glass, 9 of which also make skylight; 11, rough, rolled, or ribbed glass, cathedral, wire, or skylight glass, or glass tiling and no plate glass; and 100, window glass.

Plate Glass.—The plate-glass establishments are located as follows, by states: 8 in Pennsylvania; 3 in Indiana; and 1 each in Missouri and Ohio. The total capacity of these plants is 53 furnaces with 1,100 pots, having an estimated capacity of 31,866,000 square feet a year. However, only 696 pots were active during the census year, casting 21,172,129 square feet of glass, 16,883,578 square feet of which were polished, and 628,684 square feet sold as rough glass. In 1900, 85.5 per cent more polished plate glass was made than in 1890, while the prices at which it sold were 33.3 per cent under those of 1890. In 1876, three years after the first substantial success in the manufacture of polished plate glass in the United States, the domestic production was about 600,000 square feet, and importations for consumption were 4,628,439 square feet, indicating a total plate-glass consumption in the United States of 5,228,439 square feet, against sales of foreign and domestic glass in 1900 of about 18,000,000 square feet, the imports of plate glass for consumption for the year amounting to 1,064,079 square feet.

After abortive attempts to successfully manufacture polished plate glass in this country, at Cheshire, Mass., in 1852–53, and at Lenox Furnace, Mass., in 1855–1871,[1] the first successful production of polished plate glass occurred at the plant at New Albany, Ind., built in 1869 by Capt. J. B. Ford, and operated after 1872 by W. C. DePauw. Not until 1873 did the plant succeed in producing polished plate glass, and Mr. De Pauw stated[2] that not until 1879 was it possible to produce the glass at a profit. This plant was dismantled at some time during the last decade because of unfavorable location and obsolete equipment. The manufacture of polished plate glass was commenced at Crystal City, Mo., in 1875, by the American Plate Glass Company, which company was reorganized the following year by the Hon. E. A. Hitchcock as the Crystal City Plate Glass Company, and has continued in successful operation since, the plant now being owned by the Pittsburg Plate Glass Company, which owned 10 of the 13 establishments reported in 1900. When Captain Ford left New Albany in 1872,[3] he at once located a plant at Louisville, Ky., leaving there in 1875, and starting a plant at Jeffersonville, Ind. These 4 establishments were the ones reported at the census of 1880.

The large profits made by these establishments caused a boom in plate glass factory erection, which was further stimulated by the discovery of gas in Indiana about 1890, the success of natural gas in the manufacture of plate glass having been demonstrated in the factory built by Captain Ford at Creighton, Pa., in 1883. In 1893 Hon. E. A. Hitchcock stated before the Ways and Means Committee of the House of Representatives that there were 12 establishments manufacturing polished plate glass, located at Creighton, Tarentum, Charleroi, Ford City, Butler, Duquesne, and Irwin, in Pennsylvania; New Albany, Elwood, Kokomo, and Alexandria, in Indiana; and Crystal City, Mo. These establishments manufactured plate glass largely in excess of the consumption, and a period of low prices followed, that led, in 1895, to the consolidation of eight establishments under the head of the Pittsburg Plate Glass Company. The outside establishments were the DePauw, at New Albany, Ind.; the American, at Alexandria, Ind.; the Standard Plate Glass Company, at Butler, Pa.; and the Penn Plate Glass Company, at Irwin, Pa. The plant at New Albany was soon abandoned and that at Alexandria was closed, but on the burning of the factory at Irwin about two years ago, the Penn Plate Glass Company secured the factory at Alexandria, Ind., and now operates it as the American Plate Glass Company.

In 1897 the Marsh Plate Glass Company erected a plant at Walton (now Floreffe), Pa., to manufacture thin plate glass under the patents of George Marsh, which substituted a table for holding the plate by a vacuum process in place of plaster of paris, during the grinding and polishing. The Marsh Company claimed to be able to successfully manufacture polished plate glass in all popular glazing sizes as thin as one-sixteenth of an inch, and by their improved table and system of holding the glass, to practically eliminate all breakage. Before this claim was fully demonstrated, the plant was bought by the Pittsburg Plate Glass Company, and has since been used largely as an experimental factory. Experiments in the manufacture of thin plate glass are also being tried at the plant of the Pittsburg Company at Ford City, Pa. The Marsh Company was the first to successfully introduce the continuous lehr for annealing plate glass, a process that promises to soon displace the slower and more expensive annealing kiln system. A factory was erected near Toledo, Ohio, by the Edward Ford Plate Glass Company in 1900, which was in operation only six months during the census year. This factory is equipped with a continuous lehr, and in the extensive use of electricity as motive power is an innovation.

The principal improvement in plate glass manufacture during the last decade was undoubtedly the successful introduction of the annealing lehr, as noted above, at the plant of the Marsh Plate Glass Company, at Walton, Pa. Although its introduction into the older plants has so far been slow, owing to the expense attending the abandonment of the costly kiln system in use at those plants, yet competition will soon have the effect of bringing the lehr into general use. Previous to the introduction of the lehr, the annealing

[1] Tenth Census of the United States, Report on Glass Manufacture; by Joseph D. Weeks, Special Agent, page 98.
[2] Ibid., page 99.
[3] Ibid., page 99.

of plate glass was done in practically the same manner as at the commencement of the industry in this country. As soon as the cast is made the plate is introduced into the annealing oven or kiln, a large, shallow, reverberatory furnace of brick, on the smooth floor of which the plate is laid. The kiln being heated to near the melting point and all openings tightly closed, it is allowed to cool gradually to a point where it is opened and the plate removed, the process requiring fully three days.

The plate glass annealing lehr averages about 200 feet in length, and starts from the casting table as a continuous, connected series of five kilns, after which it is the usual rod lehr common in window glass manufacture. The five stations at the start are on a solid hearth of especially prepared clay, giving an absolutely smooth, level bed. The whole interior of the lehr is brilliantly lighted by electricity, and the heat at any point can be controlled with the utmost nicety by the use of pyrometers. After the cast is made the plate is introduced into the first station of the lehr, where the temperature is near the melting point. In due time the plate passes into the second station, where the temperature is lower. So the plate passes through the five stations with a diminishing temperature. When the plate leaves the fifth station, it has become thoroughly "set," and passes to the rod lehr, which carries it along through decreasing temperatures until, three hours after the cast was made, the annealing process is complete, and the plate is taken out of the lehr ready for the grinding process. The time required to anneal a plate under the lehr system, compared with that under the kiln system—three hours as against three days—indicates the revolutionizing possibilities of the lehr, when cost of construction is also taken into consideration. A lehr that will anneal the product of 96 pots, or 96 plates of glass a day, costs about $20,000 to build, and displaces 96 old-style three-plate kilns, which cost about $1,000 each to build. The lehr takes up far less space than does the kiln system, and the building required for the lehr costs about $6,000, as against $30,000 for the construction of the proper building for the 96 kilns it would displace.

With the lehr, smaller pots are used and thinner and smaller plates cast, resulting in a great increase in the average size of the finished plate, as the smaller the original cast, the better are the chances for the plate going through the annealing, grinding, and polishing processes successfully without diminution of size. The lehr-annealed plate, is much straighter than that annealed in the kiln, owing to the solid hearth of the first five stations of the lehr; the floor of the kiln is much more liable to develop inequalities which misshape the plate. The thinness of the lehr-annealed plate means less time spent in grinding, and the smaller size of the rough plate, makes it possible to lay and relay the lehr-annealed plate on the grinding and polishing tables, much quicker, and with less labor, than the kiln-annealed plate.

H. L. Dixon, the well-known glass furnace engineer, asserts that 90 per cent of the polished plate glass manufactured can be annealed in the lehr, the remaining 10 per cent being glass in extremely large sizes, requiring the old style kiln. He is convinced that it is only a question of time until the very largest sizes can be annealed in the lehr. It is claimed that actual practice has shown that the average size of the lehr-annealed glass, cast from small pots, is 90 square feet per plate when squared, while under the kiln system, with large pots and the attempt to continually cast extreme sizes, the average size of the plate taken from the kiln and squared is about 60 square feet, and when finished, about 18 square feet. In addition to the lehr at Floreffe, Pa., the Pittsburg Plate Glass Company reported 3 lehrs at Ford City, Pa., 2 of the 3 being for large sizes and the third for small sizes of about 50 to 60 square feet. The Ford Plate Glass Company, near Toledo, Ohio, report 1 lehr that is said to operate successfully on sizes of 50 to 60 square feet. At Alexandria, Ind., the American Plate Glass Company have a lehr which is said to be working satisfactorily with plates from 75 to 80 square feet.

As is often the case with important inventions, the successful introduction of the lehr in plate glass manufacture came, not from experts, but from novices in the plate glass business, who carried it to success, while the plate glass manufacturers greeted it with derision and declared it impossible. Henry Fleckner, a veteran window glass factory manager of Pittsburg, was the man who first operated the lehr with success at Walton, and the successful operation of the lehrs at Ford City and Toledo, is said to be largely due to Eugene Morenus, a window glass factory manager, and Ralph Gray, a manufacturer of skylight glass.

In addition to the lehr, the Marsh Plate Glass Company at Walton introduced, in the Marsh patent table, the idea of reducing the temperature of the glass while being ground and polished, by the circulation of a constant flow of water under the table. This cooling device, which permits the operation of the grinders and polishers at a much higher speed, has been installed in several foreign factories by Mr. Marsh, and will no doubt soon be put into use in this country. The transfer tables introduced at Ford City, Pa., in the last decade, have added considerably to the rapidity and ease of production, as has also the extended use of electricity as a lifting and motive power. Prior to the adoption of the transfer table, the grinding and polishing tables were stationary, and after one side of the plate had been ground and polished, it was necessary to remove it from its bed of plaster to continue the process. The transfer table is movable from grinder to polisher, thus making it possible to grind and polish one side of a plate without turning it, effecting a great saving in time and decreasing the loss by breakage attending the operation of moving the plate from its bed of plaster of paris.

President John Pitcairn, of the Pittsburg Plate Glass Company, testified[1] before the subcommission of the United States Industrial Commission, at Philadelphia, Pa., December 22, 1900, that since the inception of the plate glass industry in this country, the tendency of prices has been downward, except during 1900, when prices were increased, as a result of an average increase in the cost of raw materials of about 85 per cent, increased cost of manufacture, owing to the diminution of the gas supply, and the substitution of coal, and a better understanding among the manufacturers. He submitted the following table of prices, at periods of five years from 1875 to 1900:

SQUARE FEET.	1875	1880	1885	1890	1895	1900
1 to 3	$0.71	$0.51	$0.46	$0.40	$0.30	$0.31
3 to 5	0.84	0.61	0.55	0.48	0.36	0.38
5 to 10	1.12	0.80	0.72	0.64	0.48	0.60
10 to 25	1.49	1.06	0.96	0.85	0.63	0.81
25 to 50	1.56	1.11	1.01	0.89	0.66	0.85
50 to 100	1.69	1.21	1.09	0.97	0.72	0.90

During 1897, overproduction resulted in a demoralized condition of the industry, and prices were very low. The advance in prices from that time to 1900 was estimated by Mr. Pitcairn to amount to from 50 to 60 per cent. According to the same authority, about two-thirds of the American plate-glass production is sold in sizes under 10 square feet and without profit, a very large part of this two-thirds being sold at a loss. This glass comes into competition with the imported German looking-glass plate, which is blown, ground, and polished, and imported largely into this country to be silvered and used in cheap mirrors. For several years the American plate-glass manufacturers have been meeting this glass, and by a special arrangement with the manufacturers of furniture and mirrors, have succeeded in displacing it with domestic plate glass of a better quality, at prices less than the cost of production. Since 1895 the bulk of the American polished plate glass has been sold direct to the consumer, the Pittsburg Plate Glass Company having established jobbing houses in nearly a score of the large cities, in which branch of the business $4,044,000 was invested in 1900.

For years and with but slight interruptions, the plate-glass manufacturing interests of Europe have been closely allied as to regulation of prices and adjustment of production. As the business of the plate-glass industry in the United States has never been extended beyond the home market, cooperation on that account has not been considered valuable by the European interests; hence, this market has been a "dumping ground" for the surplus European production, and exceptionally low prices have been made on foreign glass for the United States. During the census year prices on stock sizes of European polished plate glass were 36 per cent lower for the United States than for England, while polished plate glass imported into the United States from France, averaged only about 50 per cent of the prices quoted in that country. The fact that the European surplus is placed in this market at a price below average cost, accounts for the heavy importations of polished plate glass. In face of this the domestic production in 1900 increased 85.5 per cent over that of 1890, evincing the steady acquisition of the home market for the domestic product. The production of polished plate glass in Europe in 1900 was given by Mr. Pitcairn in his testimony, in the following table, which shows the regulation of production by giving the productive capacity, and the actual output of the several factories:

NAMES OF COMPANIES.	Producing capacity, square feet.	Actual output, square feet.
Belgium:		
Auvelais	5,000,000	2,500,000
St. Roch	5,000,000	2,600,000
Monstier	3,300,000	1,600,000
Charleroi	2,900,000	1,400,000
Oignies	2,200,000	1,100,000
Courcelles	2,100,000	1,100,000
Roux	1,900,000	1,100,000
Floreffe	1,500,000	700,000
St. Gobain	800,000	400,000
Total, 9 factories	24,700,000	12,400,000
France:		
St. Gobain (4 factories)	7,500,000	3,800,000
Nord	3,700,000	1,800,000
Aniche	1,700,000	1,400,000
Boussoit	1,600,000	
Assevent	800,000	800,000
Total, 8 factories	15,300,000	7,800,000
Germany:		
Stolberg and Mannheim	4,700,000	2,400,000
Eckamp	2,600,000	1,300,000
Schalke	2,000,000	1,000,000
Herzogenrath	1,900,000	1,000,000
Perz-Urbach	1,600,000	
Frieden	1,200,000	600,000
Altwasser	700,000	300,000
Total, 8 factories	14,700,000	6,600,000
England:		
Pilkington Brothers		4,200,000
London and Manchester		2,300,000
British		900,000
Union		500,000
Total, 4 factories	[1] 7,900,000	7,900,000
Austria:		
Stankau		
St. Gobain (Bilen)		
Total, 2 factories	[1] 2,300,000	1,100,000
Russia:		
Nord		1,100,000
LaKash		700,000
Moscow		700,000
Midi		700,000
Total, 4 factories	[1] 3,200,000	3,200,000
Italy:		
Pisa (St. Gobain Company)	800,000	800,000
Grand total	68,900,000	39,800,000

[1] Producing capacity of each factory not reported separately.

The average wages paid in plate glass manufacture in the United States, during the year 1900, was estimated by Mr. Pitcairn to be about 200 per cent higher than in England, and about 300 per cent higher than in Belgium. In support of the latter claim he presented the following table, giving a comparison of American and

[1] Report of the Industrial Commission, Vol. XIII, Trusts and Industrial Combinations, pages 225 to 242.

Belgian wages in the plate glass industry in 1900, the Belgian figures being compiled by the European representative of the Pittsburg Plate Glass Company:

	American rate per month, 30 days.	Belgian rate per month, 30 days.	Per cent American higher than Belgian.
Casting department:			
Foremen	$150.00	$96.50	56.0
Finishers	92.10	28.95	218.0
Melters	82.50	28.95	185.0
Skimmers	70.50	28.95	144.0
Stowers	70.50	28.95	144.0
Furnace cleaners	60.00	20.26	196.0
Kiln dressers	69.00	20.26	241.0
Casting and drawing	57.00	20.26	181.0
Cutters	86.40	20.26	326.0
Fillers	57.00	20.26	181.0
Bookers	57.00	20.26	181.0
Teamers	90.00	28.95	211.0
Kiln heaters	54.00	17.37	211.0
Grinding department:			
Foremen, day	121.20	28.95	318.0
Foremen, night	121.20	28.95	318.0
First grinders	82.80	23.16	257.0
Second grinders	68.40	23.16	195.0
First layers	99.00	23.16	327.0
Second layers	68.40	9.65	609.0
Canal men	52.20	20.26	158.0
Sandpit men	52.20	20.26	158.0
Matchers	71.00	20.26	250.0
Sand wheelers	52.20	20.26	158.0
Polishing department:			
Foremen, day	121.20	34.74	250.0
Foremen, night	121.20	34.74	250.0
First layers	111.60	23.16	382.0
Second layers	95.76	23.16	313.0
Third layers	90.00	23.16	289.0
Fourth layers	79.36	23.16	243.0
Mixers	78.12	17.37	350.0
Plaster wheelers	45.00	20.26	122.0
Matchers	72.00	20.26	255.0
Finishers	54.72	20.26	256.0
Bench boys	39.60	8.40	371.0
Warehouse:			
Foremen	150.00	40.00	275.0
Examiners	75.00	20.26	270.0
Cutters	67.50	20.26	233.0
Gang men	42.00	17.37	141.0
Blockers	45.00	17.37	159.0
Glass washers	37.50	17.37	116.0
Frames:			
Foremen	80.00	30.00	166.0
Examiners	60.00	28.95	108.0
Cutters	63.00	28.95	180.0
Gang men	60.00	20.24	196.0
Emery department:			
Washer	60.00	34.74	73.0
Washer, helper	50.00	17.37	187.0
Machinery department:			
Foremen	150.00	43.42	245.0
Engineers	63.00	25.50	147.0
Machinists	97.50	26.05	274.0
Carpenters	80.00	23.16	245.0
Bricklayers	90.00	23.16	289.0
Laborers	37.50	17.37	116.0
Pipe fitters	67.50	24.00	181.0
Blacksmith	79.50	24.12	230.0
Blacksmith, helper	45.00	17.37	159.0
Boiler men	60.00	25.50	135.0
Pot department:			
Foremen	90.00	28.95	211.0
Pot makers	70.50	28.95	144.0
Tampers	51.10	18.33	179.0
Gas producers:			
Foremen	85.00	28.95	194.0

About 66 per cent of the wage-earners in the plate-glass industry are native Americans. At the commencement of the industry in the United States it was necessary to get foreign workmen of experience, but the American is so much quicker to learn and is so much more steady, that he is preferred at present.

All of the improvement made in the manufacture of plate glass in this country during the last twenty-five years, aside from some details in the construction of machinery, has been for the purpose of increasing the size of the plates cast and improving the quality of the glass. Until very recently the same methods have been employed for casting, annealing, grinding, and polishing that have been in use for years. The liability of breakage during the finishing process that has attended the attempts to cast extremely large-sized plates, has resulted in a very great reduction in the average size of finished plates. The use of smaller pots, casting smaller and thinner plates for annealing in lehrs, and the adoption of new machinery for grinding and polishing, will undoubtedly result in a considerable decrease in the cost per square foot, and an increase in average size of finished plates, along with a material decrease in undesirable small sizes. A few large pots will be sufficient to supply the demand for extremely large sizes. In the manufacture of plate glass, the use of tank melting furnaces in connection with fining-pot furnaces, is likely to appear in the near future, and the size of the plates cast can then be regulated at will. The possibilities of such a process in connection with the continuous lehr, can scarcely be estimated. The introduction of the continuous lehr, has largely reduced the high ratio formerly existing between cost of construction and capacity of plate-glass factories, and has already resulted in the entrance of 6 new companies, into the field; 4 of the projected factories being in Pennsylvania, and 1 each in Michigan and Illinois.

Cathedral Glass.—There were 8,846,361 square feet of cathedral glass manufactured in 1900, valued at $567,252, compared with 2,773,824 square feet in 1890, valued at $279,407, an increase in quantity of 218.9 per cent, and in value of 103 per cent. The quality of this product has been brought to such perfection, that not only has the domestic market been largely supplied, but a good export trade has been developed with Germany, England, and France. The superiority of colors is increasing the demand for American cathedral or opalescent glass, from the leading foreign art centers. During the census year, 4 establishments in New York, Indiana, and Illinois reported export shipments direct from factories to the value of $13,432.

Wire Glass.—The manufacture of wire glass has been established in the United States on a firm basis during the last decade, and it is probable that this branch of the building glass industry will reach large proportions in the next few years. The quantity manufactured during the census year was 1,295,504 square feet, valued at $129,051. During the year several shipments were made to England, but exact details could not be secured. The industry is yet in its infancy. Wire glass, which is made by casting two sheets of glass with a wire net imbedded between them, has been recognized as a perfect fire retardent, especially adapted for partitions, fire shutters, skylights, and glazing in all places subject to the stress of fire or storm. It is manufactured by 4 establishments, 3 in Pennsylvania and 1 in Missouri.

Skylight Glass, etc.—Although no statistics of skylight glass are shown in the report on glass manufacture at the Eleventh Census, it can be stated that the manufacture of this product has considerably increased, reaching 3,679,694 square feet, valued at $165,086, in 1900.

Nearly all the plate-glass establishments make a specialty of its manufacture and 3 separate establishments produce it almost exclusively. The export trade in this glass is developing in an encouraging manner. The production of bent glass, for store fronts, show cases, etc., is becoming a prominent feature in connection with the production of plate glass, and there are several establishments, in addition, exclusively engaged in this business, which obtain the plate and window glass sheets from the factories and rework them, so are not included in this report. Of the 9 bending ovens included in this report, 5 are in Indiana and 4 in Pennsylvania. Within a few years the manufacture of glass tile has been introduced in this country on an extensive scale. One establishment is making it exclusively, while several others report it as a side line. Its use as a perfect sanitary wall, ceiling, and floor material gives promise of a large growth in this branch of glass manufacture.

Window Glass.—During the last decade a very great improvement has been made in the manufacture of window glass in the United States. This has been brought about by the introduction of the continuous tank furnace for melting the crude materials, in preference to the pot furnace which had been used exclusively since the start of the industry in this country in the early colonial days. Separate statistics of tank furnaces are not shown in the report on glass manufacture at the census of 1890, the tank prior to that date being largely an experiment in this country and in such limited use as to be deemed unworthy of special note at that census. At that time, however, the tank furnace was in successful use in Europe, especially in Belgium. The successful introduction of the tank furnace in the United States occurred at Jeannette, Pa., in 1888, and from 1890 it has been steadily displacing the pot furnace, until in 1900, 54.5 per cent of the capacity of active window-glass factories was contained in tank furnaces. The adoption of the tank has given the window-glass industry a permanency that was lacking when pot furnaces were used exclusively, and when the cost of construction was not great enough to prevent the ready abandonment of a plant for a more avantageous location. While the tank melting system is much more economical than the pot-furnace system, the cost of installation and other factory equipment is much greater. As a result the location of the tank factory is more apt to be selected with respect to permanency than is the case with the pot-furnace factory. The operation of tank furnaces by gas produced from coal has proven very satisfactory, both as to the quality of glass produced and cheapness of cost, indicating, in view of the failing supply of natural gas, the fuel likely soon to be in most general use.

The census year covered a portion of a period of great activity in window glass factory construction on a large and permanent scale, an activity possibly the greatest in the history of the industry. For several years prior to 1900 the establishments operating the largest proportion of the capacity had been getting into closer relations as to regulation of prices and factory operation, resulting in the more or less constant maintenance of an exceptionally good price list. These high prices attracted new capital into the field, and during the census year there were over 30 factories reported which were built within two years. At the close of the census year about 30 window-glass factories were either building or definitely planned, notwithstanding the fact that during the year a close combination of establishments, controlling about 65 per cent of the total capacity, had been effected and prices had been sharply cut to discourage further erection of factories.

In 1900 there were 100 establishments reported as manufacturing window glass, an increase of 19 per cent over the number reported in 1890, and 104.1 per cent over the number reported in 1880. Only 19 more melting furnaces were reported in 1900 than were reported in 1890, but, owing to the greater capacity of the tank, the gain in total pot capacity was 87 per cent. In 1900 there were 165 melting furnaces reported, with a total capacity of 2,429 pots; 146 furnaces of a total capacity of 1,299 pots in 1890; and 76 furnaces with a capacity of 665 pots in 1880; showing a gain since then of 117.1 per cent in number of furnaces, and 265.3 per cent in pot capacity. In 1900 the production was 4,341,282 boxes, valued at $10,879,355; in 1890, 3,768,884 boxes, valued at $9,058,802; and in 1880, 1,864,734 boxes, valued at $5,047,313. There is indicated an increase of 15.2 per cent for 1900 over 1890 in the number of boxes produced, and an increase of 20.1 per cent in the total value of products. Compared with 1880, the number of boxes produced in 1900 increased 132.8 per cent, and the total value of product increased 115.5 per cent. The average value of a box of window glass (50 square feet), according to the census returns in 1900 was $2.51; in 1890, $2.40; and in 1880, $2.71.

Of the 165 furnaces with a total capacity of 2,429 pots reported in 1900, 36 were tank furnaces of a total capacity of 1,327 pots and 129 were pot furnaces that contained 1,102 pots, a decrease from the number of pot furnaces and their total capacity as reported in 1890, of 11.6 per cent and 15.2 per cent, respectively. The great increase in capacity in 1900 over 1890 is confined entirely to the tank furnace, but the total production of 1900 compared with 1890 is not in keeping with this increase, owing to the greatly restricted operation of the factories in 1900, due to a "fire" averaging about six months as against a "fire" of ten months in 1890.

The distribution of the window glass capacity of active establishments in furnaces and pot capacity for

1900 is shown in the following statement, by states, in the order of their importance in capacity:

STATES.	Number of establishments.	Total number of furnaces.	Total pot capacity.	Number of tank furnaces.	Pot capacity.	Number of pot furnaces.	Number of pots.
United States.	100	165	2,429	36	1,327	129	1,102
Indiana	46	83	1,109	17	601	66	508
Pennsylvania	32	48	960	14	588	34	372
Ohio	6	10	128	2	66	8	62
New Jersey	4	6	96	3	72	3	24
New York	5	5	40	....	....	5	40
Maryland	2	5	28	....	....	5	28
West Virginia	2	3	22	....	....	3	22
Delaware	1	2	16	....	....	2	16
Massachusetts	1	2	18	....	....	2	18
Illinois	1	1	12	....	....	1	12

The bulk of the capacity of Indiana was in the counties of Grant, Blackford, Madison, Delaware, and Jay, located in the "gas belt." The capacity in Pennsylvania was largely confined to the Pittsburg district and McKean county. The Ohio plants were at Barnesville, Lancaster, Findlay, and Quaker City. The largest proportion of the capacity located in New Jersey was in Cumberland county. In New York there were 5 factories, 3 of which were in Ithaca, and 1 each in Canastota and Durhamville. The 2 factories in Maryland were located in Baltimore. There was 1 factory in Delaware, located at Wilmington. The only plant in Massachusetts, which was originally established in 1853, was at Berkshire. About 75 per cent of the total capacity was controlled from Pittsburg, Pa., the headquarters of the American Window Glass Company, and about ten other companies. The former owned 39 plants during the census year.

At the close of the census year there was either building or definitely planned new capacity amounting to over 600 pots. Over 100 of these new pots were located in West Virginia; nearly 250 in the district of McKean county, Pa.; about 75 in the coal fields of Illinois and Indiana; 75 in southern New Jersey; and about 75 in the "gas belt" of Indiana.

One feature of the manufacture during the census year was the notable scarcity of skilled workmen. This scarcity, together with the increase in the capacity of the plants, made the total capacity greatly exceed the supply of skilled workmen available for its operation in the four divisions of the work, gathering, blowing, flattening, and cutting. The supply of workmen was about sufficient to operate 2,000 pots, and owing to the strong organization of the men and their strict rules of admission, no considerable relief was possible. The result was that the skilled workmen dominated the industry as seldom before in the history of the trade. The wage scales were the highest in years, and most profitable inducements were offered in addition by manufacturers to secure men for their plants. Every window-glass factory in the country operates under union rules, and the wage scales are settled for each "fire" at conferences of committees representing the manufacturers and the union.

The 5 companies of a "miscellaneous" character shown in Table 13 were all cooperative and engaged in the manufacture of window glass, most of them having been established within the census year, and were financially supported by the union, which loaned money proportioned on the pot capacity of each plant. There were 2 establishments of this character reported in the pressed and blown ware and bottle and jar branch of the industry. It should be stated, in this connection, that there were in the glass industry in addition 9 incorporated establishments of a cooperative character operating under charters, which in all the tables are included under the head of corporations. They are in all essential particulars cooperative associations. This movement toward cooperation arose from the desire to secure more work during the year, the capacity of the factories having been for some time so much in excess of current consumption that the "run" of the factories had been getting less each year, averaging about six months where it was formerly ten. The past record of cooperation in the window glass industry of the United States has been unsatisfactory, all going well as long as the market conditions were good, but financial ruin usually appearing with any depression in the trade. The indications at present are very favorable for cooperative manufacture, and it will probably spread very rapidly in the industry in the near future. The greatest impetus it receives comes from the scarcity of workmen, which is leading manufacturers to organize companies in which a large share of the stock is held by the workmen, who are thus less likely to be tempted away by offers from other manufacturers.

Along with these quasi-cooperative companies many real cooperative companies, composed entirely of the men in the factory, are being established, especially among the Belgian workmen, who form a considerable proportion of the entire working force. The window-glass workers compose the only body of organized workmen in the building-glass manufacturing industry of this country, there being no organization among the plate-glass workers, from whom very little skill is required, machinery doing practically all the work in the factory.

The question of machinery is beginning to agitate the window-glass industry. So far, practically the entire process of manufacture requires skilled hand labor. The growing scarcity of workmen has stimulated efforts to perfect a mechanical process which will do the work now done by the gatherer and blower, and it is probable that eventually the smaller sizes of window glass will be successfully manufactured by machinery.

The average normal consumption of window glass in the United States is estimated at 5,400,000 boxes a year. A considerable portion of this demand is supplied by imported glass, chiefly from Belgium. This market has for years received the surplus window glass of that country, and any advance in American prices at once results in increased importations. The 50-foot box of single strength foreign glass weighs about sixty-two and one-half pounds, and the 50-foot box of double strength, about ninety-two and one-half pounds. In reducing the number of pounds of imported glass to boxes, the average weight of a box is placed at 70 pounds, and it is estimated that 25 per cent of the total glass imported is double strength. The total importation of window glass for the year ending June 30, 1900, was 51,343,339 pounds, or 733,476 boxes, valued at $1,555,924. There were imported 47,202,267 pounds in 1899; 38,908,992 pounds in 1898; 55,961,813 pounds in 1897; 53,182,301 pounds in 1896; 40,786,279 pounds in 1895; 52,437,068 pounds in 1894; 63,715,989 pounds in 1893; 72,682,127 pounds in 1892; 58,932,738 pounds in 1891; and 73,112,550 pounds in 1890. A strike, which was threatened in the Belgian factories at the close of 1900, caused a sharp decrease in the importation of window glass in 1901. The quantity imported during the year ending June 30, 1901, was 27,285,607 pounds.

The American window glass exported during the year ending June 30, 1900, was valued at $36,218, and in 1899 at $32,690. The domestic glass can not compete with the cheaper foreign glass, yet an increasing quantity of American window glass is going into Mexico, Canada, and the West Indies.

PRESSED AND BLOWN GLASS AND BOTTLES AND JARS.

Table 8 presents comparative statistics, by states, of the manufacture of pressed and blown glassware and bottles and jars, for 1890 and 1900.

TABLE 8.—COMPARATIVE STATISTICS, PRESSED AND BLOWN GLASS AND BOTTLES AND JARS, BY STATES: 1890 AND 1900.

STATES.	Year.	Number of establishments.	Capital.	SALARIED OFFICIALS, CLERKS, ETC.		AVERAGE NUMBER OF WAGE-EARNERS AND TOTAL WAGES.							
						Total.		Men, 16 years and over.		Women, 16 years and over.		Children, under 16 years.	
				Number.	Salaries.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.
United States	1900	231	$34,806,781	1,653	$1,980,393	40,916	$18,055,037	30,372	$15,901,620	3,509	$835,100	7,035	$1,318,317
	1890	194	22,613,274	[1]803	[1]894,449	32,910	13,726,058	24,431	12,472,385	1,818	311,652	6,661	942,020
Illinois	1900	5	2,143,558	71	106,600	3,291	1,515,786	2,594	1,491,391	148	28,456	549	95,939
	1890	8	1,353,978	28	40,210	2,291	937,515	1,747	871,420	20	3,860	524	62,235
Indiana	1900	59	5,694,974	235	375,122	9,103	3,974,228	7,002	3,557,923	634	129,808	1,467	286,497
	1890	10	659,463	27	30,305	1,480	554,610	1,134	514,903	180	21,951	166	17,756
Maryland	1900	5	479,534	28	36,576	657	275,354	477	249,756	54	8,673	126	16,925
	1890	5	371,205	10	9,768	762	358,783	448	317,005	24	6,864	290	34,914
Massachusetts	1900	4	265,949	38	27,660	375	179,329	331	169,891	19	4,392	25	5,046
	[2]1890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Jersey	1900	22	5,178,672	309	278,634	5,163	2,299,500	4,136	2,115,061	170	32,726	847	151,713
	1890	22	2,776,971	130	116,331	4,506	2,009,916	3,553	1,888,694	42	8,405	1,011	112,817
New York	1900	20	1,908,799	106	124,538	2,328	1,140,973	1,975	1,075,992	73	17,831	280	47,150
	1890	21	1,507,891	45	52,400	2,505	1,054,934	1,869	952,903	92	17,025	544	85,006
Ohio	1900	21	3,412,379	174	226,459	4,069	1,691,378	3,028	1,468,952	405	96,017	636	126,409
	1890	37	2,979,987	163	171,519	5,134	2,037,452	3,752	1,836,233	538	74,227	844	126,992
Pennsylvania	1900	73	13,626,067	535	675,368	12,961	5,580,771	8,768	4,658,460	1,526	409,349	2,667	512,962
	1890	71	10,743,199	320	373,488	13,111	5,469,828	9,652	4,898,848	599	139,956	2,760	431,024
West Virginia	1900	14	1,265,624	80	93,016	1,886	734,676	1,258	603,817	468	103,748	160	27,111
	1890	7	825,313	34	46,946	1,371	511,079	970	446,349	190	32,632	211	32,098
All other states[3]	1900	8	841,125	27	36,420	1,093	563,042	803	510,377	12	4,100	278	48,565
	1890	13	1,395,267	46	63,482	1,650	791,941	1,306	746,031	33	6,732	311	39,178

[1] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 14.)
[2] Included in "all other states."
[3] Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Georgia, 1; Michigan, 1; Missouri, 1; Virginia, 2; Wisconsin, 1. 1890—California, 1; Colorado, 1; Georgia, 2; Kentucky, 2; Maryland, 2; Massachusetts, 2; Missouri, 2; Wisconsin, 1.

TABLE 8.—COMPARATIVE STATISTICS, PRESSED, AND BLOWN GLASS AND BOTTLES AND JARS, BY STATES: 1890 AND 1900—Continued.

STATES.	Year.	Miscellaneous expenses.	MATERIALS USED.										
			Aggregate cost.	Glass sand.		Soda ash (carbonate of soda).		Salt cake (sulphate of soda).		Nitrate of soda.		Limestone.	
				Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.	Tons.	Cost.
United States	1900	$2,222,776	$12,051,925	403,754	$547,943	132,279	$1,921,405	468	$5,755	10,156	$311,675	30,741	$75,177
	1890	1,198,161	7,519,450	211,536	647,094	74,062	2,390,135	2,468	42,781	6,955	274,686	6,570	18,760
Illinois	1900	210,329	664,858	32,778	33,231	11,942	163,694			440	13,720	4,815	9,912
	1890	105,387	566,905	19,378	30,257	7,059	226,608	46	389	579	18,330	2,466	9,377
Indiana	1900	341,500	3,262,466	119,621	139,056	40,592	579,638	213	3,214	2,279	73,368	9,082	15,896
	1890	63,257	354,529	13,036	32,704	5,041	154,757	285	8,321	263	10,190	410	820
Maryland	1900	22,313	120,759	2,076	3,929	1,263	19,080			149	5,000	118	319
	1390	15,966	139,971	6,721	20,133	927	25,170			230	8,371		
Massachusetts	1900	13,483	130,095	1,322	6,265	189	5,217			24	830		
	[1] 1890												
New Jersey	1900	229,514	1,401,980	78,497	75,688	20,016	299,245	197	1,778	1,314	21,165	8,227	24,621
	1890	75,751	944,750	34,684	60,749	12,461	368,946	1,500	22,500	263	11,189	60	120
New York	1900	130,936	778,842	19,843	42,344	7,449	112,163			625	18,118	1,545	5,206
	1890	89,366	582,180	11,996	38,099	4,505	138,003	113	1,450	232	10,797	293	587
Ohio	1900	136,007	1,094,638	31,856	59,199	10,406	147,128			1,259	39,634	1,374	3,434
	1890	196,432	1,139,651	30,975	86,624	11,110	347,833	169	2,888	1,628	69,021	566	1,480
Pennsylvania	1900	1,000,711	3,738,422	96,683	157,462	33,192	471,130	58	763	3,789	126,058	3,399	8,730
	1890	519,331	3,058,596	78,154	234,671	27,270	923,540	215	3,579	3,277	138,658	2,055	5,626
West Virginia	1900	109,904	557,368	9,205	12,958	2,796	42,751			307	10,982	325	575
	1890	40,805	277,033	5,350	20,845	2,209	77,725			416	15,140		
All other states[2]	1900	28,079	302,497	11,873	17,811	4,435	81,369			70	2,800	1,856	6,486
	1890	91,856	455,835	11,242	23,012	3,480	127,553	140	3,654	67	2,990	720	750

STATES.	Year.	MATERIALS USED—continued.											
		Lime.		Arsenic.		Manganese.		Litharge (red lead).		Potash or pearlash.		Fire clay and pot clay.	
		Cwt.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.	Pounds.	Cost.
United States	1900	669,649	$135,586	1,028,131	$49,563	1,424,938	$55,177	8,350,585	$487,927	4,335,828	$183,143	8,640,317	$50,661
	1890	651,739	132,502	730,385	23,384	484,593	25,745	5,501,559	300,096	2,544,978	135,047	11,016,410	88,766
Illinois	1900	45,387	10,175	45,207	2,153	58,838	1,910	115,000	6,200			562,000	4,960
	1890	20,420	3,960	85,881	2,894	13,936	848	40,000	2,400			310,000	1,986
Indiana	1900	218,088	35,854	319,648	14,981	508,980	18,920	1,481,887	76,155	443,481	18,054	1,342,070	7,084
	1890	47,682	7,193	100,600	2,878	45,052	2,419					235,600	1,740
Maryland	1900	14,725	1,233	1,650	83	11,167	566	36,982	1,857	75,000	3,000	141,300	717
	1890	14,140	1,009	14,020	395	14,600	765	94,000	4,975	77,000	3,550	420,000	3,200
Massachusetts	1900	559	112	6,789	330	8,101	207	364,448	24,497	207,967	8,994	26,158	120
	[1] 1890												
New Jersey	1900	126,001	24,500	97,405	4,632	143,465	5,674	72,049	3,918	60,270	2,866	1,912,005	11,727
	1890	144,418	27,372	63,532	1,576	17,065	785	39,873	2,118	34,035	1,877	2,783,790	24,901
New York	1900	32,819	8,885	61,018	2,876	89,521	3,737	790,909	46,114	414,438	17,552	744,450	6,935
	1890	52,850	16,560	20,727	706	29,489	1,615	1,213,264	73,049	500,334	27,237	1,017,673	7,535
Ohio	1900	72,488	14,230	123,344	6,876	76,117	3,672	2,063,000	117,035	850,171	34,129	946,000	2,306
	1890	84,032	16,708	179,406	5,772	111,181	6,907	786,991	35,810	335,216	16,985	1,240,250	10,677
Pennsylvania	1900	127,790	34,027	285,267	13,372	437,181	16,831	3,141,027	191,568	1,932,699	81,991	2,660,394	15,990
	1890	201,822	42,744	164,114	6,117	212,410	11,742	3,086,681	167,499	1,474,093	77,440	3,498,733	27,027
West Virginia	1900	11,228	2,820	69,303	3,295	58,944	2,239	285,283	20,583	351,802	16,557	134,940	1,437
	1890	11,286	3,237	89,822	2,606	16,450	985	100,000	5,800	50,000	3,500	662,550	3,245
All other states[2]	1900	20,564	3,750	18,500	965	32,624	1,421					271,000	385
	1890	75,089	13,719	12,283	440	24,410	779	140,750	8,445	74,300	4,458	847,814	8,456

[1] Included in "all other states."
[2] Includes establishments distributed as follows: 1900—California, 1; Colorado, 1; Georgia, 1; Michigan, 1; Missouri, 1; Virginia, 2; Wisconsin, 1. 1890—California, 1; Colorado, 1; Georgia, 2; Kentucky, 2; Maryland, 2; Massachusetts, 2; Missouri, 2; Wisconsin, 1.

TABLE 8.—COMPARATIVE STATISTICS, PRESSED AND BLOWN GLASS AND BOTTLES AND JARS, BY STATES: 1890 AND 1900—Continued.

STATES.	Year.	MATERIALS USED—continued.										PRODUCT.
		Pots (not including those made at works).		Fuel.							All other materials, cost.	Total value.
				Total cost.	Natural gas, cost.	Oil.		Coal.		All other fuel, cost.		
		Number.	Cost.			Gallons.	Cost.	Tons.	Cost.			
United States	1900	5,111	$280,086	$2,084,124	$823,924	11,967,202	$385,997	485,852	$738,218	$135,985	$5,863,703	$39,443,478
	1890	5,419	306,441	1,349,919	452,124	1,576,470	60,939	308,945	684,739	152,117	1,884,094	27,122,708
Illinois	1900	284	16,930	154,020	....	1,663,301	41,084	113,475	94,232	18,704	247,953	2,810,398
	1890	398	30,448	112,027	....	492,072	23,300	54,781	66,403	22,324	127,382	1,945,790
Indiana	1900	947	56,849	159,924	157,963	135	37	520	1,478	446	2,063,474	9,045,935
	1890	254	14,170	7,908	....	....	....	4,900	6,258	1,650	111,429	1,163,664
Maryland	1900	164	7,286	33,416	....	148,396	6,234	12,315	22,089	5,093	44,273	454,633
	1890	240	10,970	31,360	....	....	....	12,756	26,974	4,386	30,073	674,900
Massachusets	1900	110	5,175	30,287	....	371,867	15,619	3,416	12,782	1,886	48,061	402,258
	[1]1890	....	....	....	....	....	....	....	....	....	....	....
New Jersey	1900	301	11,217	415,486	....	4,964,767	155,257	92,520	194,457	65,771	499,464	4,819,811
	1890	359	12,279	265,210	....	....	....	71,486	205,175	60,035	145,128	3,901,982
New York	1900	143	7,125	184,417	9,190	1,293,521	45,603	48,190	121,302	8,322	324,381	2,410,188
	1890	150	6,005	151,650	....	55,944	2,664	39,707	124,027	24,959	108,987	2,000,842
Ohio	1900	863	52,861	213,633	99,404	1,250,637	31,874	48,816	78,138	4,217	400,501	3,875,661
	1890	1,152	71,172	96,167	64,579	33,054	1,575	33,565	27,972	2,041	382,607	4,073,385
Pennsylvania	1900	2,095	110,124	711,295	481,833	938,873	44,548	139,116	159,503	25,411	1,799,081	12,797,585
	1890	2,311	132,402	483,027	336,545	46,200	1,650	55,128	124,716	20,116	804,524	10,772,213
West Virginia	1900	184	11,199	77,423	75,534	18,650	585	1,271	1,304	....	354,549	1,770,553
	1890	170	12,222	54,885	51,000	....	....	3,160	2,085	1,800	76,843	945,234
All other states[2]	1900	20	1,320	104,224	....	1,317,055	45,156	26,213	52,933	6,135	81,966	1,056,456
	1890	385	16,773	147,685	....	949,200	31,750	33,462	101,129	14,806	97,121	1,644,698

STATES.	Year.	EQUIPMENT AND CHARACTERISTICS OF WORKS.															
		Furnaces, number.	Pots, number.	Tanks.[3]		Clay-grinding mills, number.	Grinding machines, number.	Shops, number.	Glory holes, number.	Annealing ovens, number.	Lehrs, number.	Presses or presses mechanical, number.	Finishing machines, number.	Crimping machines, number.	Grinding and engraving machines, number.	Horses and mules, number.	Wagons, carts, and drays, number.
				Number.	Pot capacity,												
United States	1900	258	2,811	305	3,404	8	20	3,978	1,419	1,540	1,025	964	140	494	137	317	314
	1890	369	2,908	....	....	78	63	2,894	880	1,600	599	801	91	233	798	370	297
Illinois	1900	9	117	18	306	....	....	427	146	289	31	13	2	1	3	23	24
	1890	18	140	....	....	3	4	115	48	263	11	2	....	....	1	24	12
Indiana	1900	43	529	99	999	1	1	1,397	351	161	321	201	33	169	29	7	20
	1890	21	116	....	....	....	4	77	32	45	43	8	....	....	4	7	6
Maryland	1900	7	79	1	6	....	....	67	24	21	18	7	....	....	4	8	11
	1890	7	77	....	....	1	....	113	15	15	20	4	50	15	17	5	4
Massachusetts	1900	5	47	1	90	....	....	38	16	15	12	9	....	5	....	7	8
	[1]1890	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
New Jersey	1900	30	231	48	697	1	4	718	301	266	95	55	1	....	22	92	104
	1890	56	281	....	....	13	12	323	199	352	50	17	....	....	47	95	79
New York	1900	20	182	22	282	....	....	312	66	126	55	49	2	32	9	44	44
	1890	39	259	....	....	15	7	236	41	104	47	30	....	....	23	49	46
Ohio	1900	29	377	16	171	2	....	613	93	121	102	125	59	35	5	15	6
	1890	55	521	....	....	10	13	441	130	122	142	243	21	57	258	21	2
Pennsylvania	1900	102	1,103	64	572	4	15	144	351	395	323	444	42	252	54	87	74
	1890	136	1,232	....	....	26	14	1,316	370	543	241	403	20	151	303	120	87
West Virginia	1900	12	134	20	90	....	....	158	28	18	59	60	1	....	10	5	5
	1890	17	144	....	....	3	2	104	24	18	33	85	....	10	60	12	12
All other states[2]	1900	1	12	16	191	....	....	104	43	128	9	1	....	....	1	29	18
	1890	20	138	....	....	7	7	169	21	138	12	9	....	....	85	37	29

[1] Included in "all other states."
[2] Includes establishments distributed as follows: 1900—California, 1: Colorado, 1; Georgia, 1; Michigan, 1; Missouri, 1; Virginia, 2; Wisconsin, 1. 1890—California, 1; Colorado, 1; Georgia, 2; Kentucky, 2; Maryland, 2; Massachusetts, 2; Missouri, 2; Wisconsin, 1.
[3] Not reported in 1890.

Table 8 shows that there were 231 establishments engaged in the manufacture of pressed and blown ware and bottles and jars during the census year, as compared with 194 in 1890, an increase of 19.1 per cent. Of the number in operation in the census year, 84 manufactured pressed and blown flint and lime glassware, such as tableware, jellies, common tumblers, goblets, lamps, chimneys, lantern globes, shades, globes, gas and electric lighting goods, blown tumblers, stem ware, bar ware, opal ware, cut glass, etc. The remaining 147 establishments manufactured bottles and jars in every variety of flint, green, and amber glass. As several establishments had products in both of the above classes and a fair division of their business in each branch could not be made, it was necessary to consolidate the reports of the two divisions. The total value of pressed and blown ware and bottles and jars in 1900 was 45.4 per cent in excess of that reported in 1890, the totals being $39,443,478 and $27,122,708, respectively. Of the total value of pressed and blown ware and bottles and jars in 1900, 55.9 per cent was the value of bottles and jars and 44.1 per cent that of pressed and blown ware, as shown in Table 14. Of the total value of all glass manufactured during the census year, the value of bottles and jars was 38.3 per cent and that of pressed and blown ware, 30.2 per cent.

Pennsylvania ranks first with 32.4 per cent of the total value of products in the manufacture of pressed and blown ware and bottles and jars in 1900. It was first also in 1890, with 39.7 per cent of the total value of products. Indiana, owing to its natural gas, ranked second in 1900, with 22.9 per cent, and sixth in 1890, with 4.3 per cent of the value of products. New Jersey was third in both 1900 and 1890, with 12.2 and 14.4 per cent of the value of products, respectively. Ohio was in fourth place in 1900, with 9.8 per cent of the value of products, but in 1890 was second, by reason of its gas fields, with 15 per cent of the total value of products. Illinois in 1900 retained the rank held in 1890, fifth place, while New York dropped from fourth place in 1890 to sixth place in 1900, on account of the western movement of the factories during the last decade. Reference to Table 14 shows that Pennsylvania leads in the production of pressed and blown ware, reporting 49.5 per cent of the total value of products, while Ohio and Indiana, the next two in rank, report 16 per cent and 15.8 per cent, respectively. West Virginia and New York report 8.1 per cent and 6.9 per cent, respectively. Indiana was the leading state in 1900 in the manufacture of bottles and jars, showing 29.2 per cent of the total value of products; New Jersey, 20.5 per cent; Pennsylvania, 19.2 per cent; Illinois, 12.4 per cent; New York, 5.5 per cent; and Ohio, 4.9 per cent.

The number of establishments reported in 1900 as engaged in the manufacture of pressed and blown lime and flint glassware and bottles and jars was 65.1 per cent of the total number of glass-manufacturing establishments of all kinds. In 1890 they were 66 per cent of the total number. The amount of capital invested in this branch of the industry in 1900 showed an increase of 53.9 per cent over 1890. The average number of wage-earners employed in 1900 was 24.3 per cent greater than in 1890, while the total amount of wages paid showed an increase of 31.5 per cent over 1890. There was an increase of 24.3 per cent in the average number of men employed and 27.5 per cent in their wages; the number of women increased 93 per cent and their wages 168 per cent. The increase in the number of women employed was due largely to the development of the manufacture of decorated ware during the last decade, giving employment to many young women. The average number of boys (practically all children in glass factories are boys) increased only 5.6 per cent and their wages 39.9 per cent. The small increase in the number of boys between 1890 and 1900 was due largely to the strict enforcement of the truant school laws in the principal glass-manufacturing states, which caused a great scarcity of boys, particularly in the bottle factories, and also largely accounted for the increase of 39.9 per cent in wages. The difficulty of obtaining boys is confined to establishments making pressed and blown ware and bottles and jars, practically none being employed in building-glass factories. Their chief duty is to carry the ware from the blower or presser to the annealing department and to attend to the molds, important items in the operation of the factory, so that their absence causes a general curtailment of production.

One result of this state of affairs was a general effort to invent means for dispensing with boy labor. One apparently practicable plan to this end is the use of a portable sheet-iron box or oven, capable of being kept at a satisfactory temperature, into which the ware is placed as it comes from the mold. When the "iron boy" is filled, two laborers carry it to the annealing department and unload the ware into the annealing ovens or lehrs. In this way, it is claimed, several laborers can handle the production of the factory with as much speed and at less cost than when boys are employed. As a result of a recent scarcity, the plan of employing young women or girls was agitated, but this aroused such a storm of indignant protest from all workers that it was never put into operation.

The total cost of materials used in 1900 in pressed and blown ware and bottle and jar manufacture was 60.3 per cent greater than in 1890. The total cost of fuel reported in 1900 is 54.4 per cent in excess of the total reported in 1890, the reported value of natural gas used being 82.2 per cent greater; however, a number of establishments owning their source of supply in 1890 and 1900 made practically no report of cost for gas fuel, but charged the expense against cost of maintenance. A remarkable increase in the use of oil as a fuel is shown, the number of gallons used being 659.1

per cent greater in 1900 than in 1890, while the cost increased 533.4 per cent. The average cost per gallon in 1900 was 3.2 cents, as compared with 3.9 cents in 1890. Ninety-four and three-tenths per cent of the quantity of fuel oil reported as used in glass manufacture in 1900 was used by the factories which manufactured pressed and blown ware and bottles and jars. A large number of small tanks operated with fuel oil, and a large quantity was used in the glory holes, the number of which in the entire industry in 1900 was 61.3 per cent in excess of the number reported in 1890. There was an increase of 57.3 per cent in the quantity of coal used and an increase of only 7.8 per cent in the cost. The average cost per ton in 1900 was $1.52, as compared with $2 22 per ton in 1890. The increased use of the tank furnace, with coal-gas producers using a cheap grade of slack coal, was the cause in a large measure of this decided decline in the average cost per ton.

The total number of furnaces in this branch of glass manufacture in 1900 shows an increase of 52.6 per cent over the number reported in 1890, and the total pot capacity increased 113.7 per cent; of this capacity, 54.8 per cent is contained in continuous and day or intermittent tank furnaces, which were of insignificant number prior to 1890. The use of the continuous tank in this branch of the industry is confined almost entirely to the bottle and jar trade, only 10 being reported in the pressed and blown ware establishments. Bottles of all kinds are being made from the continuous tank, and the bulk of the fruit jar and beer bottle production is made in this manner. Within the last few years flint glass for bottles and jars of such a fair quality has been made in the tank furnace that, taken in connection with the cheaper cost of production and the increased output, flint glass made in tanks for bottleware is rapidly superseding the pot-made flint glass. The adoption of the tank for manufacturing flint-glass bottles has been so general that at the close of the census year the flint-glass bottle blowers, numbering over 2,000, who since 1878 had been joined in a trades union with workmen in 13 other branches of the flint-glass trade, were preparing to leave that association and join with the green bottle blowers' union. This step was finally taken one year later by a large number.

A small decrease in the total number of annealing ovens in use in pressed and blown ware and bottle and jar manufacture was reported in 1900 as compared with 1890, and at the same time the number of annealing lehrs increased 71.1 per cent, showing that the annealing oven is being displaced by the faster and more economical lehr. The principle of the oven method of annealing is the gradual reduction of the heat, while the lehr method is based on the principle of gradually withdrawing the glass from the heat. The new method lends itself more readily to scientific exactness in securing results and, being continuous in operation, makes it possible to handle the increased output of the factory in much less time and at smaller cost.

The manufacture of bottles and jars is the oldest branch of the glass industry in this country, the first glass factory, at Jamestown, Va., in 1608, probably operating exclusively on bottles. It has always formed a prominent part of the industry and in the last decade has made greater progress than any other branch of glass manufacture. The tank furnace, machinery, and improved factory equipments and facilities have resulted in a large increase in the value of products.

Specialization is the prevailing characteristic. A few years ago it was customary for each establishment to manufacture a large variety of ware, and the workman as a rule was accustomed to make a little of everything; but it is now the tendency to restrict the output of the factory to a particular article, and the workman is an expert in one branch of his trade, the general workman having given way to the specialist capable of maintaining the highest speed. This specializing tendency is particularly marked in the manufacture of fruit jars and beer bottles. For years bottles were made in connection with window glass from the same furnace. A survival of this is present in the trade to-day with 5 establishments, manufacturing both window glass and bottles; separate furnaces are used, however.

In no branch of the glass industry has the use of machinery made so great a change as in bottle and jar manufacture during the last decade, and especially the last four years. This applies particularly to the manufacture of fruit jars and wide-mouth ware, such as vaseline jars, jam jars, etc. Prior to 1890 the manufacture of machine-made wide-mouth bottles or jars was largely experimental, and practically no fruit jars had been made by machinery. Since that date the enormous production of small wide-mouth articles, such as vaseline jars, of which one establishment in New York uses 10,000,000 yearly, has been made almost entirely by machines, while fully 90 per cent of the fruit jars are machine-made, and it is only a question of a very short time until the fruit jar will be made exclusively in this manner. The results so far attained indicate that in a few years the bulk of the entire wide-mouth bottle production will be made by machinery.

Prior to the use of machinery, the method of manufacture of wide-mouth ware was to gather the glass from the furnace on a blowpipe, forming it to a suitable preliminary shape in a block or on a marver, and then inserting the glass in a mold and blowing to the desired form. After separating the glass from the blowpipe, a ragged edge of superfluous glass remained attached to the neck of the article, which had to be chipped and ground off to make the product salable. The manufacture of the Mason fruit jar, which since it was patented, in 1858, has constituted 90 per cent of the fruit jar production, has been most completely revolutionized by machinery. Prior to 1896 the glass was gathered from the furnace upon a blowpipe, was then blocked or rolled in a hollow block to get a preliminary shape, then swung by the blower and blown up, rolled on a flat slab or marver, and again blown until it was just large enough to admit of being inserted in the blow mold. The mass of glass was then put into the mold and blown up, so as to completely fill the mold and form a collar of surplus glass extending above the top of the jar about an inch and a quarter. Above this collar was the remainder of a thin bubble into which the blower had formed the glass outside the mold so as to separate it from the blowpipe. This collar and bubble constituted the "blow-over," which had to be removed before the jar was marketable. After being annealed the jar was taken by a workman who, with a file, chipped off most of the "blow-over" and then filed it down as smooth as possible, leaving about one-sixteenth of an inch of the collar remaining, which was finally removed from the jar by the grinding machine. Then the jar had to receive a thorough washing by hand to remove all particles of broken glass and sand resulting from the chipping and grinding. After being carefully dried, the jar was at last ready to pack. The speed with which it was necessary to perform the operations of chipping, grinding, washing, and drying made the risk of breakage great, being estimated at the rate of from 8 to 20 per cent.

By the use of machinery the costly "blow-over" is avoided by first pressing the neck of the jar to finished form and then forming the body of the jar by blowing, so that when the jar leaves the blow mold to be annealed it is, so far as form is concerned, a marketable article. The process patented July 11, 1882, by Philip Arbogast, of Pittsburg, Pa., has been the basis for all machinery used in the manufacture of jars and wide-mouth bottles. He employed two separate molds, a press mold and a blow mold. Sufficient glass to make the desired article was taken from the furnace on a solid rod or punty and dropped into the press mold, the required quantity being separated from the mass on the punty by shears in the hands of a workman. A lever operated by the workman then brought down a plunger into the mold, pressing the mouth or neck of the article to finished form and pressing a wind cavity in the dependent mass of glass to aid in the blowing operation. The plunger being withdrawn, the mold was opened, and the ring inclosing the pressed neck with the dependent mass of glass was carried to the blow mold and inserted, after which the body of the article was blown up to the desired form. From 1884 to 1893 this process was followed in a small way on large candy and druggists' jars, wide-mouth bottles, vaseline and jam jars, milk jars, and tableware, such as bowls, pitchers, sugars, and creams, but the principal products were large drug and candy jars, which, after having the necks pressed to the finished form, were taken out of the press mold and greatly increased in size by manipulation of the blower before being placed in the blow mold. In 1893 the process began to be more extensively used on vaseline jars.

The idea of dispensing with the manual operation of transferring the glass from one mold to another was patented in England in 1886, both molds being combined into one by the use of sliding parts. About the same time the idea of placing a series of molds on a revolving table was also patented in that country, and patents were granted in the United States in 1889 on both devices, but they were never put into practical use. In 1896 an American combined the consolidated mold and rotary table. On a rotating table is placed a series of five separate, duplicate, double molds, each mold containing an outer blow section having a ring integral with it in which the neck of the article is pressed, and a telescopic press section rising within the blow section and receiving the glass, forming, with the neck of the blow section, a press mold. The glass is dropped into the combined mold when in this press mold position, and the table rotated, bringing the mold under the plunger, which enters it and presses the neck, and wind cavity into the dependent mass of glass. The plunger is withdrawn, and another rotation of the table brings the mold under the blow stem, the telescopic press section of the combined mold having dropped in the meantime, exposing the glass blank within the blow section. The bottom plate is inserted and the air admitted to expand the glass blank to the form of the blow mold. The next rotation of the table brings the mold to where it is opened by a boy, and the finished article is taken out and removed to the annealing oven.

All of the above operations are performed simultaneously, a finished article being produced at each rotation of the table. On such a machine the first commercially successful machine-made Mason fruit jar was manufactured in July, 1896, at the plant of the Atlas Glass Company at Washington, Pa. The numerous jar and wide-mouth bottle machines now in use have either separate blow and press molds arranged near together on a revolving table so that the shifting of the glass from one to the other is almost instantaneous, or have the molds combined in one. In all, the basic principle is the pressing of the finished neck and the subsequent blowing of the body. Compressed air for blowing and electricity for motive power have added much to the speed of the operation. The machine has a much greater productive capacity than is possible by the old hand method of blowing, and has reduced the cost of manufacture more than a third. Loss by breakage has been reduced to a minimum, while the finish of the ware is far superior to that of the handmade article.

So far, the manufacture of narrow neck bottle ware by machinery is not beyond the experimental stage in this country, although commercial success is claimed in Germany and Russia. The claim is made by the best authorities that the manufacture of narrow neck bottles by machinery will soon be perfected and become as general as the mechanical production of wide-mouth ware. The method employed at present in making narrow neck bottles is to gather a suitable amount of glass from the furnace on the blowpipe, to roll it on a marver or turn in a block, to swing and blow and again roll on the marver to give it the proper form for insertion in the mold, where it is blown, forming the body and neck of the bottle. The article is then taken from the mold and carried to the glory hole, where the top of the neck is reheated and the ring or lip of the bottle neck is formed by the workman with a finishing tool, after which the bottle is ready for annealing. The greatest advance made so far in the mechanical production of narrow neck ware has been in the finishing process, although the finishing machine, as yet, is used to but a limited extent.

The number of fruit jars reported in 1900 was 789,298 gross of different sizes—pints, quarts, and half gallons—valued at $2,935,036. It is estimated that about 90 per cent of these were the Mason patent jar, which has a screw threaded neck for a metallic cap which presses down a rubber band on the shoulder of the jar, making a perfect seal. The other jars manufactured were more expensive kinds with special sealing devices, of which that with an all-glass top was the favorite. There were 34 establishments engaged in the manufacture of fruit jars during the census year, 6 of which made that class of ware exclusively. The largest fruit jar plant in the world, with a daily capacity of 240,000 jars, all machine-made, is in Indiana. Comparison with the statistics of the last two censuses shows a great development in this branch of the industry, caused principally by the introduction of the continuous tank in the last decade and the adoption of machinery within the last four years. In 1890, 268,978 gross of fruit jars were reported, valued at $1,390,430. There was an increase of 193.4 per cent in the number manufactured in 1900 over 1890. The average value per gross in 1900 was $3.72 as compared with $5.17 in 1890, a decrease of 28 per cent in the value per gross.

The statistics of fruit jars manufactured at the census of 1880 are incomplete, yet the total of 148,271 gross reported for Pennsylvania, New York, and New Jersey probably comprised very nearly the production of the entire country. The increase in the quantity manufactured in 1900 over 1880 was 432.3 per cent. No fruit jars were reported in Indiana in 1880; but this state headed the list in 1890 with 83,270 gross, valued at $440,657, or 31 per cent of the total production, and also in 1900 with 559,549 gross, valued at $2,106,250, or 70.9 per cent of the total production. Pennsylvania, which was first in 1880 in the manufacture of fruit jars, 67,770 gross having been reported, was third in 1890, with a product of 47,250 gross, valued at $233,125, and second in 1900, with 115,000 gross, valued at $436,104. Ohio was second in the manufacture of fruit jars in 1890 by reason of the discovery of natural gas, 60,726 gross, valued at $296,065, having been reported, while in 1900 the number had dwindled to 2,000 gross of a special kind, valued at $8,000. In 1880 there were 51,749 gross reported as manufactured in New Jersey; in 1890, 33,406 gross, valued at $181,410; and in 1900 this state reached third place, with 61,871 gross, valued at $192,467. In New York there were 28,752 gross manufactured in 1880; in 1890 there were reported 9,500 gross, valued at $55,000; and 31,235 gross, valued at $128,965, in 1900, an increase in the number manufactured of 228.8 per cent over 1890. The statistics for Illinois show a large decrease in fruit jars manufactured since 1890, the number reported in 1900 being 1,500 gross, valued at $9,000, compared with 20,750 gross in 1890, valued at $103,798. In West Virginia, from which no fruit jars were reported in either 1880 or 1890, there were manufactured 14,643 gross, valued at $43,750, in 1900.

At the close of the census year large quantities of fruit jars, roughly estimated at 340,000 gross, were being held in stock and were controlled by a selling agency formed among the principal manufacturers. A large portion of this stock was held by one firm, which had thousands of jars stacked in an open field. This stock had accumulated for several years and was held in prospect of the approaching failure of the natural gas and the consequent advance in prices.

The manufacture of prescription bottles, vials, and druggists' ware was carried on by 77 establishments in 1900, several of the largest factories in the country being operated almost exclusively on this class of goods. The value of these products in 1900 was 21.5 per cent of the total value of all bottles and jars manufactured. The statistics reported in 1890 of bottles and jars manufactured are of no value for comparative purposes, as they were not complete. However, the total number of bottles reported in that year, exclusive of beer bottles, was 2,170,961 gross. The average value per gross of this class of ware in 1900 was $1.92, which was a considerable reduction from the value per gross in 1890. This was due to the increased quantity of ware produced from the continuous tank furnace. Of the total quantity of this class of ware manufactured in the United States in 1900, 30.2 per cent was made in New Jersey, constituting 28 per cent of the total value, the average value per gross for the state being $1.79. Indiana ranked second, with 25.7 per cent of the total quantity and 25.4 per cent of the total value of the products, the average value per gross for the state being $1.90. Pennsylvania, by reason of much of the product of that state being of higher grade, closely followed Indiana in the value of the products, producing 25.4 per cent of the total value and 22.7 per cent of the total quantity, the average value per gross being $2.12. In Illinois 11 per cent of the total quantity and 8.7 per cent of the total value was manufactured, the average value per gross for the state being $1.52. A large part of the southern trade was supplied by that state. The manufacture of homeopathic vials was carried on by 4 glass making establishments. These vials were also made during the census year in a large number of small shops where the tubing is bought and reworked. No account of these shops is taken in this report. The American prescription bottle has no superior in form and finish, and is far in advance of the ware manufactured abroad. Export shipments of this class of ware direct from factories in 1900 were reported to Canada, Australia, South and Central America, Cuba, Great Britain, France, Africa, East Indies, China, and Japan, of a total value of $93,094, which represented only a portion of the actual exportation, as the most of the trade was done through exporting houses.

The manufacture of beer, soda, and mineral water bottles in 1900 was reported by 75 establishments in 15 states, the total value of which was $5,075,068, or 23.4 per cent of the total value of all bottles and jars manufactured. Several establishments were employed almost exclusively in the manufacture of beer and soda bottles, the bulk of the trade being done by them. Plans were being prepared at the close of the census year for 6 new establishments to manufacture beer and soda bottles exclusively, while increases of capacity among established plants were general, nearly all being in the line of continuous tanks. Demand for ware in the census year was extraordinary, the home consumption being unusually large, while large quantities of bottles filled with beer were shipped to Cuba and the far East. The export trade in beer and soda bottles with Mexico reached its highest development during the census year, direct factory shipments aggregating 21,147 gross, valued at $66,333, being reported for that country. The manufacture of mineral water bottles largely increased during the decade and was unusually large during the census year. By far the largest part of the production in this branch of the industry was made from the continuous tank furnace.

The general use of the tank and better facilities for the maintenance of a high rate of speed by the workmen have resulted in a great increase in the average factory output within the last ten years, yet consumption at the close of the census year was demanding still greater capacity, and prices were at a high point. In 1890 a production of 204,948 gross of beer bottles was reported, the figures probably not being complete, but showing nearly all of the country's production in that year; this was exceeded in 1900 by Illinois alone, with 4 establishments reporting. As in 1890, Illinois in 1900 was first in the manufacture of beer, soda, and mineral water bottles, with 26.3 per cent of the total value and 30.1 per cent of the total quantity manufactured in the United States. Pennsylvania ranked second in value of products, with 17.8 per cent of the total, but the quantity manufactured was only 10.9 per cent of the total quantity. Establishments in Ohio reported 12.6 per cent of the total value and 16.2 per cent of the total number of gross, while the production in New York constituted 9.9 per cent of the total quantity and 9.3 per cent of the total value. A large percentage of the total value and quantity was reported under the head of "all other states," which came chiefly from Wisconsin and Missouri, each having a large establishment devoted to the exclusive manufacture of this class of ware. California, Colorado, Georgia, Michigan, and Virginia were the other states included under this head. New Jersey, with a production slightly less in quantity, led Indiana in the total value of beer, soda, and mineral water bottles manufactured. Following Indiana in this class of ware were Maryland, West Virginia, and Massachusetts, in the order named.

There were 81 establishments engaged in the manufacture of flasks and liquor bottles in 1900, the total value of the products being 11.1 per cent of the total value of bottles and jars manufactured, Indiana heading the list with 50.2 per cent of the total value and 61.4 per cent of the total quantity. There were several small establishments equipped with tank furnaces in this state operating exclusively on flasks with very cheap gas fuel, and cheap unorganized labor, that created considerable demoralization in prices and in the trade of the old establishments. To counteract this, the American Flint Glass Workers' Union, to which the organized flask workers belong, at the close of the census year was erecting a tank factory in Indiana to be operated exclusively on flasks, which were to be sold at prices to compete with these new firms, and thus to either force them out of the business or cause them to maintain prices and working conditions equal to those in force among organized manufacturers. This movement is unique in the history of trades unions, and is based on the principle that there is greater economy and efficiency in direct business competition than in the old method of taking men out on strike and supporting them on a relief roll. Pennsylvania was next to Indiana in the manufacture of flasks and liquor bottles, 14.5 per cent of the total quantity and 18.6 per cent of the total value being manufactured in that state. Liquor bottles and flasks were also manufactured in California, Georgia, Illinois, Maryland, Massachusetts, Michigan, New Jersey, New York, Ohio, Virginia, West Virginia, and Wisconsin.

The manufacture of milk jars or bottles is practically a development of the last decade. The demand has steadily increased, causing a corresponding increase in the furnace capacity used in the manufacture of this class of ware. The manufacture of milk jars was reported in 1900 by 31 establishments, 13 of which were located in Pennsylvania. The total value of milk jars of all sizes manufactured in 1900 was 3.4 per cent of the total value of all bottles and jars manufactured. The average value per gross for the United States was

$4.99. The mechanical production of milk jars is commercially possible, and it is probable that a large part of the product will be made by machinery during the present decade. The manufacture of milk jars was one of the most rapidly expanding branches of the glass trade at the close of the census year, the overwhelming merits of such a package for milk becoming more widely recognized and the demand steadily increasing. Pennsylvania led the productive list, with 55.1 per cent of the total quantity and 59.6 per cent of the total value. The percentages of the total quantity and total value of milk jars manufactured in the other states in 1900, are as follows: New Jersey, 13.5 per cent of the quantity and 14.7 per cent of the value; Indiana, 13.4 per cent of the quantity and 7.6 per cent of the value; Illinois, 5.1 per cent of both quantity and value; New York, 4.7 per cent of the quantity and 4.6 per cent of the value; Ohio, 4.1 per cent of both quantity and value; West Virginia, 3.1 per cent of the quantity and 3.2 per cent of the value.

The manufacture of bottles for patent and proprietary medicines is largely confined to the states of New Jersey, Illinois, and Indiana, although 47 establishments in 8 states were reported as engaged in the manufacture of such products. The value of bottles for patent and proprietary medicines manufactured in 1900 was 12 per cent of the value of bottles and jars of all kinds reported. The combined production of New Jersey, Illinois, and Indiana was 88.6 per cent of the total quantity for the United States. Bottles of this kind are made of a cheaper grade than prescription bottles and are used in steadily increasing quantities, a large quantity being exported filled. New Jersey for a long period has been first in the manufacture of this class of ware, and in 1900 there was reported from that state 46.4 per cent of the total quantity and 53.7 per cent of the total value for the United States. From Illinois was reported 23.4 per cent of the total quantity and 19 per cent of the total value; and from Indiana 18.9 per cent of the total quantity and 14.5 per cent of the total value. Bottles for patent and proprietary medicines were also manufactured in Pennsylvania, New York, Ohio, Maryland, and Georgia.

The manufacture of bottles and jars for the packing and preserving industries, exclusive of the enormous production of fruit jars, has steadily advanced during the past decade, owing to the remarkable growth of the above interests and the increasing recognition of glass as the ideal package. In this branch of the bottle and jar industry the value of the product in 1900 was 9.8 per cent of the total value of all bottles and jars manufactured, and 45 establishments in 10 states reported. The products covered a wide range of glass food packages, the average value being $2.70 per gross. The manufacture of machine-made ware in this line is increasing, although constituting as yet a very small proportion of the total. The 3 leading states in the manufacture of bottles and jars for packers and preservers were New Jersey, Indiana, and Pennsylvania. In New Jersey, 35.6 per cent of the quantity and 29.3 per cent of the value of these products was manufactured; in Indiana, 31.6 per cent of the quantity and 32.4 per cent of the value; and in Pennsylvania, 14.5 per cent of the quantity and 19.8 per cent of the value. Illinois followed, with 10.3 per cent of the quantity and 9.2 per cent of the value. This class of ware was also manufactured in Ohio, New York, California, West Virginia, Maryland, and Georgia; these states reporting in the order given as to quantity and value of product.

The number of demijohns and carboys manufactured in 1900 was 83,243 dozens, valued at $206,061. The average value per dozen for the several states varied with the proportion of the state's output of the more expensive carboy or the cheaper demijohn, the average value of the carboy being about twice that of the demijohn. New Jersey was first in the value of demijohns and carboys manufactured in 1900, with 42 per cent of the total value, followed by Illinois with 23.8 per cent of the total value, Pennsylvania with 17.9 per cent, and New York with 9.2 per cent. Under the head of "all other products," bottles and jars which were not specified, valued at $940,277, were reported. A large variety of ware was embraced under this head. During the census year the manufacture of large glass jars and retorts for laboratory use and for water coolers was successfully accomplished in this country, the process having been brought from France.

There was no such close organization of manufacturing interests in the bottle and jar industry during the census year as in the plate glass, window glass, and tableware industries. Eastern and western manufacturers of bottles have relied upon a common understanding to regulate prices, with varying success, particularly in some lines such as flasks and prescription bottles. The manufacture of beer bottles was controlled by a few firms, and very satisfactory results in keeping prices uniform were the rule. The prices of fruit jars were regulated by a selling agency agreement among controlling manufacturing interests. The workmen in both the green and flint bottle and jar trades were well organized and their rules as to duration of factory operation and a uniform scale of wages, which affected a large majority of the factories in all branches of glass manufacture, were the strongest factors in maintaining uniformity of prices. The green bottle blowers' organization, the Glass Bottle Blowers' Association, organized about 1877, is one of the best managed and most progressive trades unions in the United States, and had a membership of about 4,000 and about $100,000 in cash in the treasury at the close of the census year. The organization of flint or prescription bottle blowers numbered about 1,500, and formed a branch of the American Flint Glass Workers' Union, one of the largest trades unions in the country. The scale of wages and the duration of the summer stop of the factories are fixed each year at a meeting of a joint committee representing organized workers and manufacturers. The only company stores in the glass trade in 1900 were in the bottle and jar branch of the industry. There were 10 of these stores, but in only two instances were the glass workers compelled to trade with them, as had been customary a short time before, the blowers' union having conducted a successful strike chiefly against the company store system. In 1890, 20 company stores were reported, 11 in connection with factories making bottles and jars and glassware, 8 in window glass works, and 1 in the plate glass branch. In 1880 there were 27 reported, as follows: 13 in connection with factories making bottles and jars and glassware, 12 in window glass works, and 2 in the plate glass branch.

Table 9 is a statement, by states, of the number of bottles manufactured, classified by capacity.

TABLE 9.—NUMBER OF BOTTLES MANUFACTURED, CLASSIFIED BY CAPACITY, BY STATES: 1900.

STATES.	BOTTLES.		
	4-ounce and under, number of gross.	4 to 16-ounce, inclusive, number of gross.	Over 16-ounce, number of gross.
United States	2,462,694	3,055,204	1,228,719
California	4,600	22,486	25,187
Georgia	13,000	17,000	7,350
Illinois	428,077	430,636	239,285
Indiana	562,345	872,318	199,947
Maryland	113,898	48,960	8,969
Massachusetts	...	4,865	1,561
Michigan	3,876	10,425	1,670
Missouri	...	46,667	23,333
New Jersey	764,385	614,385	130,046
New York	57,321	196,790	254,074
Ohio	74,015	195,054	94,338
Pennsylvania	405,528	496,670	199,310
Virginia	34,000	22,000	9,000
West Virginia	1,649	34,948	6,649
Wisconsin	...	42,000	28,000

It is possible that the statistics presented in the above table are not strictly accurate, as several establishments were unable to furnish more than an estimate of the number of bottles of each size manufactured. The total number of the three classes of bottles exceeds the total number reported in Tables 12 and 14 as "prescriptions, vials, and druggists' ware," "beers, sodas, and minerals," "liquors and flasks," and "patent and proprietary." This is probably accounted for by the fact that a large number of bottles included in the statement were not reported under either of the foregoing classifications, but were reported on the schedule under "all other products."

Pressed and Blown Glassware.—Pressed and blown lead and lime glassware manufactured in the United States is characterized by purity of color, excellence of design and finish, and cheapness of cost. The United States has been preeminent in the manufacture of pressed glassware ever since the invention of the process, which occurred about 1827 at a little plant in Sandwich, Mass., as the result of a suggestion of a carpenter who knew nothing of glass manufacture. His idea that molten glass could be pressed into any desired shape was at first regarded as absurd by experienced glass manufacturers.[1] Prior to this all glassware was blown, either offhand or in a mold, which required much greater skill and more time than the pressing operation.

About 37 years after the first glass press was constructed another important discovery was made, which so improved the composition of the batch for lime glass that, in purity and brilliancy, lime glassware was made to rival the more expensive lead glassware. Lime glass had been used in Europe and England for centuries in the manufacture of window glass, bottles and jars, and common tableware, and from an early period it had been used in the United States in the manufacture of tableware. But it was so inferior in purity and luster that it could not compete with lead glass, and was restricted to the cheapest and lowest grade of ware.

In 1864, according to the authority noted above, William Leighton sr., a glass manufacturer of Wheeling, W. Va., by the substitution of bicarbonate of soda for soda ash, and a better proportion of the materials in the batch, manufactured a lime glass that equaled in beauty the finest lead glass. This placed lime glass on a basis of competition with lead glass at less than one-half the cost. The almost immediate effect was a complete revolution in the manufacture, the production of lime glass rapidly increasing, while that of lead glass for tableware was soon reduced to a comparatively small quantity. The lime glass was not only cheaper, but had to be worked quicker than the lead glass, resulting, in connection with the use of the press, in a largely increased output.

The quantity of pressed ware manufactured has been greatly increased in the last decade by the removal of the arbitrary limit placed on the number of pieces to be made in a "turn" by the worker, and by the improvement of the old-style press by adding a rotating table carrying a series of molds, and operated by steam, compressed air, or electricity. The effectiveness of these improvements has been further increased by elaborating on the old wind system for cooling molds and workers. This increase in the speed of the old press without changing its basic form, and in that of the fire polishing and finishing operation, have been the notable changes during the last twenty years.

The effort to increase rapidity of production, especially in the last decade, was the principal characteristic of the pressed-ware trade. So well has this succeeded by the use of the improved press and continuous tank, that it has resulted in a large increase in the quantity manufactured, of common tumblers and jelly glasses, cheap, unfinished tableware, common lamps, etc., and a

[1] Tenth Census of the United States, "Report on Glass Manufacture," by Joseph D. Weeks, special agent, page 58.

large reduction in cost, although the best grade of pressed ware is still made on the old hand press. For years American pressed tableware has been unrivaled in brilliancy and in its close imitation of the real cut glass, the fire-polish finish being the greatest factor in this success. In beauty and variety of design, pressed tableware has equaled if not surpassed the real cut ware, new designs being produced each year in great profusion and at large cost.

During the last decade great mechanical progress has been made in the blown glass branch of the industry, but not to such an extent as in the production of fruit jars. Since 1897 a large number of thin blown tumblers have been made by machinery, and the same machine has been successfully applied to the manufacture of lamp chimneys, although trade conditions have restricted its advantages and prevented its operation in the manufacture of the latter to the extent reached on tumblers. In the manufacture of both tumblers and lamp chimneys, the machine greatly increases the output and lessens the expense of skilled labor. The machine has a circular table revolving around a central column or standard, the table carrying a series of duplicate molds, usually six. After the ball of glass has been gathered from the furnace on the blowpipe to the size required for the desired article, it is placed in the mold, which is closed, and the blowpipe held in place perpendicularly over the mold by a clamping device at the top of the machine, which engages with the upper end of the blowpipe. Over the mouthpiece of the pipe is placed a rubber hose which leads to a supply of air, furnished either by a compressing pump, or, if light pressure is required, as with some tumblers, by a fan system. The mechanical rotation of the table admits the air into the pipe, which is kept revolving, and blows up the glass in the mold until it is ready to be turned out for the finishing process. Ingenious mechanism regulates the air pressure. The entire operation is performed with great rapidity and it is claimed that the output of the machine is limited only by the ability of the workmen to supply the glass. The mechanical finishing of ware is now engaging the special attention of manufacturers, and a completely mechanical process, requiring small labor cost to perform the entire operation of finishing the ware after its removal from the blowpipe or mold, is the object sought. Manufacturers generally are of the opinion that more real progress will result from improvements in the finishing process than from further improvements in the mechanical process of making the ware. While the high-speed machine is a success on ordinary ware, both pressed and blown, the manufacture of high-grade ware seems to require the sympathetic touch of the skilled workman.

The manufacture of pressed and blown ware in 1900 was done almost entirely in Pennsylvania, Ohio, Indiana, West Virginia, and New York, only 3.7 per cent of the total value of such products being reported in Massachusetts, Illinois, Maryland, New Jersey, and Colorado. Specialization in manufacture was carried far in many lines, particularly in the manufacture of chimneys, tumblers, and lamps. Competition in nearly all lines was very active, particularly during the latter part of the decade, creating a strong tendency toward concentration of capacity along special lines, so as to manufacture at the lowest possible cost. The more rapid and safer handling of the ware, economy of working space in the factory, and facilities and conveniences for adding to the efficiency of the working force were considerations that received the greatest attention. Competition was so intense at the opening of the census year that all previous agreements between manufacturers as to prices were useless, and consequently prices of pressed and blown ware were unusually low. This was the principal cause of the formation of two close consolidations and additional general associations for the regulation of prices. The result was a decided improvement in prices during the latter half of the year. In July, 1899, a consolidation was effected of 7 establishments which manufactured lamp chimneys exclusively, and on November 1, 1899, 19 large pressed and blown ware establishments, equipped with about one-half of the available capacity of the United States, making a general line of tableware, tumblers, and novelties, came under the control of one central company. In 1891 a similar consolidation of 13 tableware establishments, principally in the immediate neighborhood of Pittsburg, Pa., was formed, and the number of plants was increased later. During the census year this company operated only 6 factories, 3 of which were in Pittsburg.

In the early part of the census year nearly all the manufacturers of pressed and blown ware agreed in forming an association to effectively maintain prices, and so successful was this association that on many articles unusually low prices, caused by sharp competition, were succeeded by quite profitable prices, which were well maintained. The association in attaining this end enlisted the aid of the jobbers by the establishment of a liberal rebate system, similar in some respects to the plan adopted by the consolidation of window glass manufacturers in the same year, although the latter went to the extent of forming the jobbers into an incorporated body pledged to cooperate with the manufacturing interests. The several consolidated companies engaged in the manufacture of glass established their headquarters in Pittsburg, which city, although it had lost nearly all the glass factories that had made it famous as the center of American glass manufacture, controlled more completely than ever, at the close of the census year, the manufacture of glass in the United States. Pittsburg was also the headquarters of all the glass-workers' associations, except that of the green bottle blowers, which was at Philadelphia. A large majority of the skilled workmen in the pressed and blown ware industry were members of the American Flint Glass Workers' Union, which was organized in 1878, and embraced the workmen in 14 different branches of the trade. The membership was about 7,000 and the treasury contained about $100,000. By means of this organization the manufacture was carried on under a practically uniform wage scale and with concerted action as to factory operation.

The manufacture of tableware, which consists of pressed and blown articles in sets ranging from two or three pieces to over a hundred, of very great variety of form and size, was confined to the 4 states of Pennsylvania, Ohio, Indiana, and West Virginia, in the order named. Twenty-seven establishments reported products valued at $2,617,784, or 15.3 per cent of the total value of all ware made in the pressed and blown division of the industry, and numbering 65,514,100 separate pieces. There was a very great variety in the value of the different kinds of ware, but the average value per 100 pieces for the United States was $4.

In Pennsylvania 55.7 per cent of the total quantity, and 60.6 per cent of the total value, was manufactured, and the average value per 100 pieces in that state was $4.35. A large proportion of the product for the state was manufactured in the Pittsburg district. In Ohio 23 per cent of the total quantity, and 25.5 per cent of the total value, was reported, and the average value was $4.43 per 100 pieces. The great bulk of the product was manufactured in the valley of the Ohio River. By the substitution of glass of a cheap quality made in tanks for glass made in pots, and worked with the press at higher speed than customary, and by dispensing with the fire-polishing operation, a class of cheap unfinished tableware and other glassware was manufactured in Indiana during the closing years of the last decade. This largely accounts for the fact that only 11.1 per cent of the total value of tableware manufactured in the United States, compared with 19.3 per cent of the quantity, was made in that state. The average value per 100 pieces was $2.31. The manufacture of tableware in West Virginia was conducted entirely along the banks of the Ohio River, and 2 per cent of the total quantity, and 2.8 per cent of the total value, was manufactured there, at an average value of $5.48 per 100 pieces. A considerable proportion of the product was blown ware.

Considerable rivalry exists among the manufacturers of pressed tableware in the production of attractive designs and decorations. Most of the ware is in imitation of cut ware, and so highly has the art been developed that a careful examination is frequently required to detect the difference. It is the custom with a majority of the establishments to offer new designs at the opening of each year, a large amount of money being expended to secure these designs and to prepare the required molds. The profitable life of a design, unless it is unusually popular, is limited to one season, its place being taken by some new idea expected to better catch the popular fancy. A popular design will, in one season, prove extremely profitable, while the losses on unpopular designs are so great as to make the expression of the public's favor an exceedingly interesting matter to the manufacturers. Popular favor has changed in the last decade from imitation cut ware to plain ware, and from that to highly decorated ware, but the imitation cut ware has been in most constant demand, although within the last few years colored ware and plain crystal with gold decorations have been strongly favored. Within the last half of the decade the manufacture of colored ware, to compete with the influx of imported Bohemian ware, has been assuming shape, and it seems probable that this profitable field will not much longer be left wholly undisputed to the foreign manufacturer.

Tableware has long formed a large proportion of the exports of glass from the United States, by reason of its superiority of color and design. The export branch of the business received special attention in 1900, traveling representatives having been sent through South America, Australia, and the United Kingdom, and a number of permanent agencies were established by the larger interests. For a long period large quantities of American tableware have been used in Canada, and a field of large proportions is being opened in Australia, one glass manufacturing establishment during the census year, having made a single direct shipment to that country of 10 cars, or about 1,500,000 pieces, a small part of which was common lamps. Thirteen establishments reported exports direct from factory of a total value exceeding $100,000, to Canada, Australia, Mexico, South America, Cuba, Hawaii, England, and Germany. This represented only a small part of the total exports of tableware during the census year, as the bulk of the trade was done through exporting houses. A growing tendency has been noted on the part of the manufacturers to export direct from the factories, and foreign needs are being closely studied with a view to the increase of the export trade in the future.

Jelly glasses and pressed tumblers and goblets, 102,528,600 pieces in number, valued at $2,007,386, were manufactured by 28 establishments in 5 states in 1900. The value of such ware was 11.8 per cent of the total value of all pressed and blown ware manufactured in the United States. The average value was 23 cents per dozen.

In Pennsylvania 36.4 per cent of the total quantity and 39.5 per cent of the total value was manufactured, and the average value for the state was 25.5 cents per dozen. The proportion manufactured in Indiana was 31.4 per cent of the total value and 35.7 per cent of the total quantity, at an average value of 21 cents per dozen. From Ohio was reported 9.6 per cent of the total value and 19.7 per cent of the total quantity, at an average value of 23 cents per dozen. The remaining 9.5 per cent of total value and 8.2 per cent of total quantity was manufactured about equally in Maryland and West Virginia, at an average value of 27 cents per dozen. At the close of the census year two large establishments, intended solely for the manufacture of jelly glasses and tumblers, were being built in West Virginia, and a large establishment was being erected in Ohio for the manufacture of the same class of ware by machinery and methods that were expected to still further reduce the cost and increase the possible output.

At the censuses of 1880 and 1890 incomplete returns were made of the manufacture of tumblers and goblets. In 1880, 46,415 dozen "tumblers" were reported from Massachusetts, 409,713 dozen from Ohio, and 2,500,000 dozen from Pennsylvania. In 1890, 5,438,700 dozen "tumblers and goblets," valued at $555,273, were reported as manufactured in Ohio; and 2,481,600 dozen, valued at $780,059, in Pennsylvania. The use of jelly glasses and tumblers in the packing trade is steadily increasing and there has been a steady growth in the exports.

Lamps manufactured in 1900 numbered 807,765 dozens, valued at $1,498,675, or $1.86 per dozen. They were in many varieties, from the most common pressed lamps to those ornately fashioned, and their value was 8.8 per cent of the total value of all pressed and blown ware. By far the largest proportion consisted of the commonest pressed grades. The manufacture was confined to 6 states and 27 establishments, several of which made a specialty of highly decorated lamps. The largest factory in the world making decorated lamps exclusively was located in Pennsylvania. Great progress was made during the last decade in the manufacture of decorated lamps of a medium grade, and this branch of the industry is receiving increased attention.

In Pennsylvania 65.6 per cent of the total value and 56.4 per cent of the total quantity was manufactured, at an average value of $2.16 per dozen. The largest proportion of Ohio's total product was common lamps; the quantity manufactured was 23.7 per cent of the total quantity, and the value 12.4 per cent of the total value, with an average value of 97 cents per dozen. In West Virginia, with the bulk of the production of decorated lamps, 18.4 per cent of the total value and 7.6 per cent of the total quantity was manufactured at an average value per dozen of $4.47. The lamps manufactured in Indiana were largely of a cheap grade; the quantity manufactured was 10.1 per cent of the total quantity, and the value 2.9 per cent of the total value, at an average value of 53 cents per dozen. Lamps were manufactured also in New York and Massachusetts, the product of the former state being largely common lamps, and that of the latter a better grade of ware.

The use of the tank in lamp manufacture has made possible a considerable reduction in cost from that of the old pot-melting method which was in general use in 1890. The manufacture of pressed lamps has been steadily increasing, resulting in a large reduction in the cost of the common article.

The value of lamp chimneys manufactured in 1900 was $2,719,583, the greatest in value of any single product reported under the pressed and blown glass branch of the industry, and was 15.9 per cent of the value of all pressed and blown glassware. The manufacture was reported in 6 states, but 90.4 per cent of the total value of products was manufactured in Indiana, Pennsylvania, and Ohio. The average value per dozen for the United States was 39 cents. Indiana led, with a product constituting 45.1 per cent of the total quantity and 44 per cent of the total value, the average value being 38 cents per dozen. Pennsylvania was second with 26.6 per cent of the total quantity and 23.5 per cent of the total value, at an average value of 35 cents per dozen. The quantity of lamp chimneys manufactured in Ohio was 21.9 per cent of the total, and the value 22.9 per cent; the average value per dozen was 42 cents. The remaining states in which lamp chimneys were manufactured were Illinois, New York, and Massachusetts. There were 27 establishments engaged in the manufacture.

A comparison of the statistics for 1900 with the incomplete statistics for 1890 and 1880 shows how the manufacture of chimneys has moved westward, following the natural gas and cheap fuel, and also gives some idea of the extent the production has been curtailed by the increased use of gas and electric light. The total number reported in 1890 was 7,534,473 dozens, valued at $1,816,016, and distributed as follows: Ohio, 4,025,120 dozens, valued at $541,836; Pennsylvania, 2,885,841 dozens, valued at $1,017,639; New York, 623,512 dozens, valued at $256,541. In 1880 the total number reported for the United States, no value being given, was 4,463,140 dozens, distributed as follows: Pennsylvania, 2,719,649 dozens; New York, 888,639 dozens; Ohio, 743,140 dozens; and Massachusetts, 111,712 dozens. No lamp chimneys were reported as manufactured in Indiana in either 1880 or 1890; this state was first, however, in 1900 in this branch of the industry, and succeeded Ohio, which was the leading state in 1890. This change in the relative positions of these two states was coincident with a similar change in the supply of natural gas. A decrease of 8.4 per cent in the total quantity manufactured in the United States is shown from 1890 to 1900, while the total value in 1900 exceeds that of 1890 by 49.8 per cent; this was due largely to the extremely low value reported for the product of Ohio in 1890, which was more than one-half of the total quantity reported at that time.

During the last decade the improvement in the manufacture of lamp chimneys was shown by better quality and a greater variety of design. There has been a large increase in the use of higher grade chimneys of special design. Special attention has been given to the package for fine grade ware, and a large number of such chimneys have, within the last few years, been packed in separate cartons, resulting in a decided improvement in appearance and in safety of shipment.

The manufacture of lamp chimneys by the blowing machine was limited to two factories in 1900, and in only one of these plants was it carried on extensively, being confined largely to a cheap class of goods. Machine-blown lamp chimneys will probably represent a large proportion of the production in the near future, although it is questioned if the higher grades of chimneys will not require hand work. During 1900 the lamp chimney market was fairly well regulated by an agreement between the largest manufacturing interests, but a number of small establishments in Indiana were causing demoralization in lime glass chimneys, or the cheap grade of goods. During the census year the tank furnace became a factor in the manufacture of the common lime glass chimneys, 4 tanks being reported. Great strides had also been taken toward improved factory equipment for handling the ware; lehrs operated by electricity, electric conveyors to take the ware from the lehr to the packer and then to the stock room or car, were among the improvements made, together with a great increase in the rapidity of the finishing operation. A good export trade has been developed in this branch of the industry. Large shipments have been made for many years by export houses, but during the census year the manufacturers renewed attempts to reach the export trade direct, and a special effort to introduce the American lamp chimney into England was successful, 66,667 dozen chimneys being reported as sent direct from factory to England during the year. The remainder of the exports that were shipped direct from the factories were sent to South America and Mexico.

Lantern globes were manufactured during the census year in 6 states by 27 establishments, and the number reported was 1,044,816 dozens, valued at $497,021, or 2.9 per cent of the total value of all pressed and blown ware manufactured. The average value per dozen was 48 cents, the average value by states ranging from 25 cents to $1.17 per dozen, depending upon the quality of the ware. There were two establishments employed exclusively in the manufacture of lantern globes, one in Indiana and one in West Virginia. The percentages of the product manufactured in the leading states, of the total for the United States, are as follows: Indiana, 52.4 per cent of the quantity and 35.4 per cent of the value, with an average value per dozen of 32 cents; New York, 15.5 per cent of the quantity and 38.2 per cent of the value, with an average value per dozen of $1.17; Ohio, 13.7 per cent of the quantity and 14 per cent of the value, with an average value per dozen of 49 cents; West Virginia, 12.6 per cent of the quantity and 6.6 per cent of the value, with an average value per dozen of 25 cents; Pennsylvania, 5.6 per cent of the quantity and 5.4 per cent of the value, with an average value per dozen of 46 cents. A small proportion was manufactured also in Massachusetts. Indiana and West Virginia supplied the great bulk of the output of cheap lantern globes, while New York led in the manufacture of ware of a higher grade. There were no statistics of the manufacture published at the census of 1890, but a great increase has been made during the decade. During the census year very active competition on the cheaper grades of lantern globes was developed. More than 10,000 dozen lantern globes were reported in 1900 as exported direct from the factories to Mexico and Central America; this represented but a small part of the total exportation.

The manufacture of pressed and blown shades, globes, electric bulbs, and glassware for gas and electric lighting ranked third in value of products in the pressed and blown ware branch of the industry in 1900, being 14.6 per cent of the total. The shades and globes ranged in quality from the plain pressed Welsbach gas article to the most costly and artistic products in fine plain and colored glass, richly decorated, engraved, or etched. The manufacture of glassware for the Welsbach gas light had developed to a very large extent. Electric glassware, such as incandescent bulbs and arc globes, formed a large item, although foreign competition in that line was quite active. The manufacture of gas and electric glassware has been largely a development of the last decade, and it is now one of the specialized lines of the industry. Although the increased use of gas and electricity has curtailed the use of the oil lamp in some quarters, yet a tendency has been shown toward the use of fancy lamps with highly decorated or ornamented shades and globes, more for decorative effect, probably, than real use, and this has greatly stimulated the production of globes and shades of a much higher quality in general than was ever before manufactured. The total production of shades, globes, and gas and electric goods in 1900 was manufactured in 7 states, from 3 of which, Pennsylvania, New York, and Ohio, 94.9 per cent of the total value was reported. There were 30 establishments engaged in the manufacture of these goods on a more or less extensive scale. The average value per dozen for the United States was 93 cents, the average value by states varying as the bulk of the output was cheap gas and electric ware or decorated shades and globes.

From Pennsylvania was reported 32 per cent of the total quantity and 58.1 per cent of the total value, the average value per dozen being $1.70. Large quantities of medium-priced globes and shades, cheap gas goods, and a valuable production of globes and shades of the finest quality were manufactured in that state. In New York a large quantity of high-grade shades and globes, and a large output of electric bulbs were manufactured. The quantity of articles of this class manufactured was 11.7 per cent of the total, and the value 20.8 per cent, with an average value per dozen of $1.66. A large number of electric bulbs was manufactured in Ohio, which was third in rank as to value of products, but was far in the lead as to quantity, with 52.3 per cent of the total quantity reported and 16 per cent of the total value, the average value per dozen for the state being 28 cents. Shades, globes, and gas and electric goods were manufactured also in West Virginia, Massachusetts, Indiana, and New Jersey. Decorated shades and globes constituted the larger part of the product in West Virginia, and the product in Indiana was electric and gas ware, at an average value of 13 cents a dozen. Shades and globes were manufactured in Massachusetts, and in New Jersey the product was entirely electric bulbs. Great improvements have been made in the last few years in the package for shades and globes, nearly all the better grade being packed in separate cartons. The export trade has had a steady growth, but complete statistics were not obtained from the factories. A total of 44,200 dozen articles in this branch of the industry, mostly electric ware, was reported in 1900 as shipped direct from the factories to Canada, the West Indies, South America, and Australia. By far the largest proportion was exported to Canada.

Blown tumblers, stemware, and bar glasses, 6,127,367 dozen in number, were reported in 1900 by 17 establishments in 4 states. These products constituted 9.4 per cent of the value of all pressed and blown ware manufactured. The average value per dozen for the United States was 26 cents. The manufacture of this class of ware has become greatly concentrated, 94.3 per cent of the total value of products being reported from Pennsylvania and West Virginia. The percentages of the total quantity and total value manufactured in the two leading states are as follows: Pennsylvania, 57.3 per cent of the quantity and 69.3 per cent of the value, with an average value of 31 cents per dozen; West Virginia, 37.4 per cent of the quantity and 25 per cent of the value, with an average value of 17 cents per dozen. The remainder of the product was manufactured in Ohio and Indiana, the average value per dozen in Ohio being 25 cents, and in Indiana, 34 cents. The returns do not embrace the total production of blown tumblers, as many were reported under "cut glass," having received light cutting. A large proportion of the lower grade of blown tumblers manufactured in Pennsylvania was made on the blowing machine, but practically all the finer grades were made by hand. Great improvements in the finishing of this class of ware have been made in the last few years, and much of the "cracking-off" is done by a machine on which a gas jet is used in place of a wire, one machine, operated by a boy, having a capacity of 9,000 tumblers a day. Improvements in grinding machinery have made it possible for two girls with one machine to grind 22,500 dozen tumblers in a week. For a long period blown tumblers, stemware, and bar goods have formed a large item in glass exports, being shipped to the principal countries of the world in steadily increasing quantities.

Decorated opal or porcelain glassware was very much in favor with the public during the closing years of the last decade. It was made into small-piece sets, in an endless variety of novelties and toilet articles. In 1900 the manufacture of 3,750,443 dozen pieces was reported, representing 9.3 per cent of the total value of pressed and blown glassware manufactured. In large part the decorations were of the cheapest kind, the average price per dozen for the United States being 42 cents. Twenty-six establishments in 6 states reported its manufacture, and 90.7 per cent of the total value of the products was made in Pennsylvania and West Virginia. Establishments in Pennsylvania made 78 per cent of the total quantity and 76.8 per cent of the total value, and in West Virginia 12.8 per cent of the total quantity and 13.9 per cent of the total value. Establishments in Indiana, Ohio, Massachusetts, and New York were engaged also in manufacturing this class of ware. The great demand for decorated opal or porcelain glassware developed within the last half of the decade, and in 1900 its manufacture formed a prominent part in the operations of some of the largest pressed ware establishments in the country, leading to a large increase in the decorating facilities of those plants. The craze for opal ware was decreasing at the close of the census year and the production gave evidence of soon returning to normal proportions.

Cut glassware, 134,726 dozen pieces in number, valued at $672,463, an average of $4.99 a dozen, was reported by 12 establishments in 1900. This report does not cover the numerous glass-cutting establishments in which the basic material used is the glass blank and in which the manufacture consists merely in reworking the glass. A large portion of the cut glass reported from Pennsylvania and West Virginia was light-cut articles, such as tumblers, although there was 1 establishment in Pennsylvania engaged largely in the manufacture of cut ware of the highest grade. The percentages of the total quantity and total value manufactured in the several states are as follows: Pennsylvania, 42.2 per cent of the total quantity and 46.3 per cent of the total value, at an average value of $5.48 per dozen pieces; Massachusetts, only 2.5 per cent of the total quantity but 21.8 per cent of the total value, the average value of $44 per dozen indicating the manufacture of the richest cut ware; the same is true of Ohio, with only 2.2 per cent of the total quantity and 18.7 per cent of the total value, an average value per dozen of $43.45. In West Virginia, with its large production of blown ware, practically all light cutting was done, the product averaging $1.23 per dozen in value; the product of that state was 23 per cent of the total quantity, but only 13.1 per cent of the total value.

West Virginia was first in the number of pieces manufactured, although its product was practically all of the cheapest kind. A small product was also reported from Indiana. The largest part of the cut glass manufactured was made in establishments in which the glass was reworked only, and is not included in this report. A list of such establishments, published at the close of the census year, giving the number in each state, was as follows: New York, 21; Pennsylvania, 13; Illinois, 4; Connecticut, 2; and Massachusetts, Rhode Island, New Jersey, West Virginia, and Michigan, 1 each. The industry has had a large growth in the last decade, particularly during the latter part of it, the number of establishments having doubled and the number of frames operated more than trebled. The demand has steadily increased and the market widened as prices have been lowered by competition. The popularity of pressed ware in imitation of cut ware shows the widespread desire for the real cut article. An improvement that will probably be made in the industry is the manufacture of the blank by pressing, increasing the speed of manufacture fourfold over the blowing process. It was for a long time the practice to import the blanks from France for most of the finest grade of ware cut in this country, but the domestic blank is now conceded by competent judges to be equal, if not superior, and is steadily supplanting the imported article. The superiority of American rich cut glass is generally acknowledged at home and abroad.

The amount reported as the value of all other pressed and blown ware products, $1,384,945, includes a large variety of articles for different purposes. One item that has come into prominence during the last few years is the manufacture of prismatic glass for increasing the diffusion of sunlight in buildings. The product of the only establishment manufacturing glass play marbles in the United States, located in Ohio, is included in this total.

The value of all products other than glass reported by establishments manufacturing pressed and blown ware and bottles and jars was $690,562, a large item being packages, particularly for lamp chimneys. According to some manufacturers, the profit in certain lines of chimneys lies entirely in the sale of the package.

MATERIALS.

Table 10 is a comparative summary of the quantity and cost of the materials used, with percentages of in crease, for 1890 and 1900.

TABLE 10.—QUANTITY AND COST OF MATERIALS USED, 1890 AND 1900, WITH PER CENT OF INCREASE.

	1900	1890	Increase.	Per cent of increase.
Total cost	$16,731,009	$12,140,985	$4,590,024	37.8
Glass sand, tons	581,720	369,328	212,392	57.5
Cost	$846,822	$899,998	[1]$53,176	[1]5.9
Soda ash, tons	157,779	96,777	61,002	63.0
Cost	$2,259,939	$3,108,233	[1]$848,294	[1]27.3
Salt cake, tons	53,257	38,092	15,165	39.8
Cost	$518,590	$604,179	[1]$85,589	[1]14.2
Nitrate of soda, ons	10,770	7,031	3,739	53.2
Cost	$320,937	$278,291	$42,646	15.3

[1] Decrease.

TABLE 10.—QUANTITY AND COST OF MATERIALS USED, 1890 AND 1900, WITH PER CENT OF INCREASE—Con.

	1900	1890	Increase.	Per cent of increase.
Limestone, tons	91,015	45,482	45,533	100.1
Cost	$181,717	$136,450	$45,267	33.2
Lime, hundredweights	794,679	743,765	50,914	6.8
Cost	$147,901	$150,092	[1]$2,191	[1]1.5
Arsenic, pounds	2,349,261	1,823,007	526,254	28.9
Cost	$112,630	$61,575	$51,055	82.9
Manganese, pounds	1,493,538	610,915	882,623	144.5
Cost	$57,493	$31,080	$26,413	85.0
Litharge, pounds	8,386,106	5,501,559	2,884,547	52.4
Cost	$490,200	$300,096	$190,104	63.3
Potash or pearlash, pounds	4,406,211	2,544,978	1,861,233	73.1
Cost	$186,847	$135,047	$51,800	38.4
Grinding sand, tons	265,438	227,416	38,022	16.7
Cost	$166,040	$151,995	$14,045	9.2
Fire clay or pot clay, pounds	32,151,017	37,066,652	[1]4,915,635	[1]13.3
Cost	$221,183	$328,903	[1]$107,720	[1]32.8
Pots, not including those m de at works, number	8,941	8,006	935	11.7
Cost	$381,147	$393,875	[1]$12,728	[1]3.2
Fuel, cost	$3,203,146	$2,340,912	$862,234	36.8
Packages and packing materials, cost	$4,913,544	$1,853,462	$3,060,082	165.1
All other materials, cost	$2,722,873	$1,366,797	$1,356,076	99.2

[1] Decrease.

The cost of materials used in the combined industry of glass manufacture in 1900 was 37.8 per cent greater than in 1890. In nearly all the principal materials, a comparison of returns for 1900 with those for 1890 shows a large increase in the quantity used and a decided decrease in the average cost per unit, notwithstanding the fact that in 1900 the prices of practically all glass-making materials were sharply advanced. An increase of 57.5 per cent is shown in the total number of tons of glass-melting sand reported used in 1900 over 1890, 581,720 tons being reported in 1900 and 369,328 in 1890. On the other hand, a decrease of 5.9 per cent in total cost is shown in 1900 from 1890, the total cost in 1890 being $899,998, while in 1900 the total cost was $846,822. The average cost per ton in 1900 was $1.46 compared with $2.44 in 1890. Glass sand of very fine quality in practically inexhaustible supplies, is found in many parts of the country, although the chief sources of supply are still, as they have been for many years, the Juniata Valley in Pennsylvania; Hancock county, West Virginia; the Fox River district in Illinois; and St. Charles, St. Louis, and Jefferson counties in Missouri. By far the largest proportion of the glass sand used comes from these deposits, although southern New Jersey still furnishes sand for a number of factories in the East, and sand of the finest quality still comes from Berkshire, Mass. The cost of transportation and the fine quality of more available deposits have considerably restricted the output from the latter locality. During the census year a considerable quantity of good glass sand came from Westmoreland county, Pennsylvania.

The preparation of sand for the glass factories became a highly specialized business during the last decade, about a score of establishments being exclusively engaged in the industry, with elaborately equipped plants representing large investments. The active competition which developed among these establishments is principally accountable for the large decrease in price in 1900 compared with 1890. Eight establishments in the Juniata Valley were merged under one head during the census year and prices on all grades of sand were sharply raised. Many glass manufacturers, however, had contracted for their supply for the season during the period of low prices, and, in addition, two of the largest manufacturing interests were mining and preparing their own sand to a large extent, making it cost them considerably below the average. Competition has led to the greatest care and attention in the preparation of the glass sand and the maintenance of a high quality.

The supply of soda ash for glass manufacture formerly came almost entirely from England; but during the last decade, through the development of the Solvay process, practically all soda ash used in glass making was of domestic manufacture, coming mainly from Syracuse, N. Y., and near Detroit, Mich. A large plant was projected during the census year at Barberton, Ohio, by glass manufacturing interests. One of the greatest advances in the domestic manufacture of soda ash was the establishment during the decade of large works at Wyandotte, Mich., by glass manufacturers to directly supply their wants. The number of tons of soda ash reported in 1900 was 157,779, compared with 96,777 tons in 1890, an increase of 63 per cent, while the total cost in 1900 was $2,259,939, compared with $3,108,233 in 1890, a decrease of 27.3 per cent. The average cost per ton in 1900 was $14.32, compared with $32.12 in 1890. The demand for soda ash in 1900 was unusually large, exhausting the domestic supply and greatly increasing importations. This abnormal demand came from outside the glass industry, the textile industry using a large quantity, and is shown by the large increase of importations in 1900 over 1899. As reported by the Bureau of Statistics of the Treasury Department, imports entered for consumption were 80,118,967 pounds, valued at $665,104, in 1900, compared with 41,844,101 pounds, valued at $304,549, in 1899.

The salt cake used in glass making twenty years ago was nearly all imported, but the greater portion of the amount consumed in the census year was of domestic manufacture, many large chemical manufacturers furnishing it, to the almost total exclusion of the foreign product. Competition has lowered the average cost per ton 38.6 per cent from 1890 to 1900, the average cost per ton for the respective years being $15.86 and $9.74. The number of tons used in 1890 was 38,092, costing $604,179, compared with 53,257 tons in 1900, costing $518,590, an increase in quantity of 39.8 per cent and a decrease in cost of 14.2 per cent.

Practically the entire supply of nitrate of soda used in glass manufacture in the United States comes from South America. The number of tons used in 1890 was 7,031, costing $278,291, compared with 10,770 tons in 1900, costing $320,937, an increase in quantity of 53.2 per cent and in cost of 15.3 per cent. In 1890 the average price per ton was $39.58, compared with $29.80 in 1900.

The number of tons of limestone used in glass manufacture in 1900 was 91,015, costing $181,717, or an average of $2 per ton, compared with 45,482 tons in 1890, costing $136,450, or an average cost of $3 per ton. The increase in the quantity used in 1900 over 1890 was 100.1 per cent, and in cost 33.2 per cent. Ohio and Indiana were the principal sources of supply.

The quantity of lime used in 1900 was 794,679 hundredweight, costing $147,901, compared with 743,765 hundredweight in 1890, costing $150,092, an increase in 1900 over 1890 of 6.8 per cent in quantity and 1.5 per cent in cost. The average cost per hundredweight in 1890 was 20.2 cents, and in 1900 was 18.5 cents. Much of the lime is wood-burned and ground and bolted, the industry being highly developed in Seneca county, Ohio, and vicinity.

England has been the chief source of the supply of arsenic used in glass manufacture. Recently, however, the imports from that country have been greatly reduced by the supply from the gold fields of British Columbia. At the close of the census year, movements were in progress which promised to result in the development of the manufacture in this country, and it is confidently asserted that in a few years the glass industry will be supplied entirely by arsenic of domestic manufacture. In 1890, 1,823,007 pounds were reported, costing $61,575, and in 1900, 2,349,261 pounds, costing $112,630, an increase of 28.9 per cent in the quantity and 82.9 per cent in the cost.

Manganese, which comes largely from Saxony, was used in 1890 in glass making to the extent of 610,915 pounds, costing $31,080, compared with 1,493,538 pounds in 1900, costing $57,493, an increase in quantity of 144.5 per cent and in cost of 85 per cent. The average price per pound was 5.1 cents in 1890 and 3.2 cents in 1900.

The proportion of litharge manufactured in the United States for use in glass manufacture is steadily increasing, but a large proportion is still imported from England. The quantity used in 1890 was 5,501,559 pounds, costing $300,096, compared with 8,386,106 in 1900, costing $490,200, an increase in quantity of 52.4 per cent and in cost of 63.3 per cent. The average cost per pound in 1890 was 5.5 cents and in 1900 was 5.8 cents.

There were 2,544,978 pounds of potash or pearlash, which was supplied principally from Germany, used in 1890, costing $135,047, compared with 4,406,211 pounds in 1900, costing $186,847, an increase in quantity of 73.1 per cent and in cost of 38.4 per cent. The average cost per pound in 1890 was 5.3 cents and in 1900 was 4.2 cents.

A notable increase is shown in the consumption of packages and packing materials in 1900 over 1890. The cost of such materials in 1890 was $1,853,462 compared with $4,913,544 in 1900, an increase of 165.1 per cent. The neatness of the package received special attention during the latter part of the decade, and great improvement has resulted, compared with the practice followed formerly.

IMPORTS AND EXPORTS OF GLASS.

Table 11 presents the value of the different kinds of glass imported and exported from 1869 to 1900, inclusive.

TABLE 11.—VALUE OF GLASS IMPORTED AND EXPORTED: 1869 TO 1900.[1]

YEAR.	IMPORTS.										EXPORTS.		
	Total value.	Bottles, vials, carboys, etc.[2]	Cylinder and common window glass, unpolished.	Cylinder and crown glass, polished.		Plate glass.			Glass plates or disks for optical instruments.[4]	All other.	Total value.	Window glass.[5]	All other.
				Unsilvered.	Silvered.[3]	Fluted, rolled, or rough.	Cast, polished, unsilvered.	Cast, polished, silvered.					
1900	$5,037,931	$464,483	$1,555,924	$539,082	$286	$7,915	$226,295	$12,413	$125,449	$2,106,084	$1,936,119	$36,218	$1,899,901
1899	4,303,660	371,394	1,275,184	521,957	622	9,528	233,190	419	119,832	1,771,534	1,503,651	32,690	1,470,961
1898	3,782,617	338,861	953,116	569,380	66,768	9,880	161,637	562	107,572	1,574,841	1,211,084	23,480	1,187,604
1897	5,603,868	600,308	1,181,696	301,412	772,296	18,245	285,485	21,870	94,242	2,328,314	1,208,187	13,369	1,194,818
1896	7,528,420	382,101	1,067,999	190,704	1,158,321	23,486	773,250	34,119	92,628	3,805,812	1,062,225	14,994	1,047,231
1895	6,627,473	531,904	835,730	61,212	782,778	23,990	684,131	16,740	85,794	3,605,194	946,381	11,140	935,241
1894	5,288,697	506,183	1,067,787	22,314	786,004	38,121	449,086	75,106	71,881	2,272,215	922,072	19,311	902,761
1893	8,082,639	739,037	1,496,326	91,559	1,679,185	70,493	829,596	154,404	60,898	2,961,141	973,827	10,229	963,598
1892	8,828,952	827,761	1,674,679	158,464	1,549,968	56,162	887,626	119,201	69,988	3,485,103	942,302	10,238	932,064
1891	8,463,935	926,010	1,475,338	91,248	1,912,391	78,030	1,351,808	183,015	99,623	2,346,472	868,374	11,244	857,130
1890	7,411,343	912,704	1,461,736	74,546	1,529,401	84,715	931,323	249,819	58,830	2,108,269	882,677	8,910	873,767
1889	7,724,662	825,411	1,444,982	91,105	756,577	130,172	983,316	1,243,455	10,741	2,238,903	894,200	16,864	877,336
1888	7,867,263	815,564	1,397,898	95,147	59,208	131,224	1,258,736	1,801,514	12,538	2,295,434	881,628	10,733	870,895
1887	7,336,771	739,240	1,420,159	85,500	1,262	90,899	1,191,134	1,647,154	16,876	2,144,547	883,504	15,955	867,549
1886	6,358,085	609,435	1,360,955	27,807	....	107,057	907,267	1,528,379	19,988	1,797,197	773,878	8,246	765,632
1885	6,256,194	590,160	1,630,844	18,287	189	118,693	900,461	1,192,147	....	1,805,413	783,915	10,055	773,860
1884	7,552,498	521,787	2,431,068	28,695	....	101,777	959,817	1,387,728	....	2,121,626	839,756	18,665	821,091
1883	7,762,543	....	1,736,700	62,630	....	62,898	1,145,709	1,226,432	....	3,528,174	998,857	....	998,857
1882	6,634,371	....	1,387,257	27,117	....	56,407	1,183,482	943,706	....	3,036,402	864,235	....	864,235
1881	5,878,025	....	1,414,709	57,754	....	32,422	979,452	833,385	....	2,560,303	756,022	....	766,022
1880	5,221,511	....	1,439,447	15,601	....	22,799	835,496	911,144	....	1,997,024	749,866	....	749,866
1879	3,222,479	....	595,070	11,110	....	6,527	699,459	575,549	....	1,334,764	768,644	....	768,644
1878	3,345,149	....	812,612	7,168	....	5,685	885,823	572,066	....	1,061,795	869,682	....	869,682
1877	3,936,786	....	1,006,456	8,482	....	14,405	1,263,864	552,899	....	1,090,680	658,061	....	658,061
1876	4,806,948	....	1,292,020	5,448	....	29,069	1,358,881	773,423	....	1,348,107	628,121	....	628,121
1875	5,805,115	....	1,656,040	21,166	....	47,265	1,620,032	887,847	....	1,572,765	691,310	....	691,310
1874	6,257,964	....	1,881,368	14,933	....	34,237	1,655,909	961,512	....	1,710,005	631,827	....	631,827
1873	7,420,044	....	2,759,728	21,217	....	34,180	1,550,857	823,076	....	2,230,986	627,562	....	627,562
1872	5,834,712	....	2,103,827	23,931	....	17,697	1,063,810	803,487	....	1,821,960	547,112	....	547,112
1871	4,269,620	....	1,447,292	16,738	....	26,191	919,435	651,487	....	1,208,477	466,447	....	466,447
1870	4,157,634	....	1,459,067	18,501	....	24,684	820,252	615,347	....	1,219,783	530,654	....	530,654
1869	3,895,739	....	1,466,138	25,885	....	22,173	717,952	625,338	....	1,038,253	580,718	....	580,718

1 Reports of United States Treasury, Bureau of Statistics.
2 Included in "all other" glass and glassware imported previous to 1884.
3 Included in "unsilvered cylinder and crown glass, polished" previous to 1885.
4 Not separately reported previous to 1886.
5 Included in "all other" glass and glassware exported previous to 1884.

The import figures presented in Table 11 for "cylinder and crown glass, polished," and plate glass, silvered and unsilvered, show the great victory the American manufacturers of polished plate glass have gained in superseding the foreign article, particularly the foreign mirror plate, by glass of domestic manufacture. The silvered, polished crown glass is styled German looking-glass plate, while the silvered polished plate glass is what is commonly known as French mirror plate. The German plate is lighter and inferior to the French plate and is nearly all imported under 5 square feet in dimensions, while the French plate is of larger sizes. From 1869 to 1889, inclusive, the value of importations of French mirror plate was nearly equal to the imports of polished plate glass unsilvered, the aggregate value of the French mirror plate during the twenty-one years being $20,557,075 while the value of the unsilvered polished plate was $22,901,144. Previous to 1885 the importations of the German mirror plate are included in the table with the unsilvered polished cylinder and crown glass, the larger part of the polished cylinder and crown imported to that date being employed for car windows and similar uses where a glass thinner than ordinary plate and of better quality than common window glass was desired. The importations of silvered German mirror plate previous to 1889 were inconsiderable, but in that year their value increased from $59,208 in 1888 to $756,577, or 1,177.8 per cent.

The year 1889 marked the beginning of the decline of the importations of French mirror plate and the growth of the importations of German plate. The value of imported French silvered plate in 1890 was only $249,819, a decrease of 79.9 per cent from the previous year; this was due in part to the introduction of American plate, but more to the remarkable increase in importations of the cheaper German plate.

The value of the German silvered plate imported in the same year increased $772,824, or 102.2 per cent over 1889. For the next seven years, German silvered plate importations exceeded in value the combined value of silvered and unsilvered polished or French plate. The plate glass manufacturers of the United States during this time were directing their competition against the more profitable field filled by the French silvered and unsilvered plate, so that the German plate had nearly a clear field. However, an increase of plate glass productive capacity in the United States in 1894 produced a period of low prices that caused large reductions in the value and number of square feet of all foreign plate imports, reducing the value of imported French mirror plate 51.4 per cent from 1893 to 1894; German silvered plate 53.2 per cent; polished plate and rough plate, each 45.4 per cent; and unsilvered polished cylinder and crown glass 75.6 per cent. From this period of low prices a better organization of the American plate glass manufacture developed, a consolidation of individual companies controlling a large percentage of the capacity being formed; and the fight against foreign glass was carried on so successfully that from 1894 French mirror imports have dwindled to insignificant proportions, being, in 1900, 83.5 per cent less than in 1894 and 95 per cent less than in 1890. During 1895 and 1896 imports of polished plate, unsilvered, increased to some extent, caused largely by the sale in the United States at low prices of surplus foreign stock. After 1896, however, the American manufacturing interests lined up more closely against the foreign trade, and since then the value of imported polished plate has been gratifyingly small, showing in 1900 a decrease of 70.4 per cent from 1896 and 79.8 per cent under the total value of 1890.

While German mirror import values received a decided check in 1894 and 1895, the next two years witnessed a revival and a change in the form of importation, an increased quantity being imported unsilvered, to be silvered by American mirror makers. Table 11 shows a marked decrease in the value of silvered German plate imports in 1897 and a considerable increase in the unsilvered imports. American competition has made it advantageous to have the silvering done in this country. With French mirror plate practically excluded, the plate-glass manufacturers of the United States took up the German mirror plate problem, and by selling superior polished plate to the mirror trade at cost, or less, reduced the value of German plate imports, unsilvered and silvered, nearly one-half in 1897, and at present have stopped the importation of the German silvered plate even more completely than they have the French product. In 1900 practically all the German plate was imported unsilvered, and was much less than the total quantity, silvered and unsilvered, annually imported from 1890 to 1897.

A portion of the imported polished cylinder and crown glass comes in competition with domestic window glass for car windows, but the expected development of the manufacture of thin polished plate glass in this country may probably supplant the foreign article for high-quality and light-weight glazing purposes. Ninety-five and five-tenths per cent of the total quantity of unsilvered polished cylinder and crown glass imported in 1900 was shipped from Germany, the remainder being divided among Austria-Hungary, Belgium, France, Netherlands, and the United Kingdom. Of the total quantity of fluted, rolled, and rough plate imported in 1900, the United Kingdom supplied 91.3 per cent and France, Belgium, and Germany, the remainder. The importation of polished plate glass is controlled by an European syndicate, and is apportioned among the various producing countries; Belgium furnishing, in 1900, 80.2 per cent of the total quantity; Germany, 8.1 per cent; and the United Kingdom and France, practically all the remainder. The extent of the importation is determined largely by trade conditions abroad, this market being used for the disposal of surplus products, with slight regard to price. New York is the principal port of entry for plate glass.

The value of importations of fluted, rolled, and rough plate has steadily decreased, being, in 1900, 90.7 per cent less than in 1890. The total value of such imports in 1900 was nearly equaled by the direct export shipments of one American skylight factory.

Window glass importation values have maintained comparative regularity during the last thirty years. The total value of window glass imported during the decade ending with 1880 was $14,993,860; from 1880 to 1890, $15,686,308; and from 1890 to 1900 the value was $12,583,779. While the total value of window glass imported during the last decade was less than that of each of the two preceding decades, the value in 1900 exceeded that in 1890 by 6.4 per cent; 1880 by 8.1 per cent; and 1870, by 6.6 per cent. The number of pounds imported in 1900, as reported by the United States Treasury Bureau of Statistics, was 51,343,339, which, estimating 70 pounds to the 50-foot box, 25 per cent double strength, equals 733,476 boxes, or 16.9 per cent of the quantity manufactured in the United States in that year. The number of pounds imported during each of the preceding ten years was as follows: 1899, 47,202,267; 1898, 38,908,992; 1897, 55,961,813; 1896, 53,182,301; 1895, 40,786,279; 1894, 52,437,068; 1893, 63,715,989; 1892, 72,682,127; 1891, 58,932,738; 1890, 73,112,550. The imports, 92.7 per cent of which come from Belgium and the remainder from the United Kingdom, Germany, and France, are regulated largely, as in plate glass, by the condition of the foreign market. The Continental and far Eastern markets are the most profitable fields for Belgian window glass, and if the demand in these markets is weak and a surplus stock accumulates in Belgium, increased shipments to the United States follow. Belgian glass, the product of cheaper labor, constantly acts as a check on window-glass prices in the United States, for unless the demand abroad is unusually strong, the first announcement of high prices in this country results in an increase of exports. The foreign window glass, as in the case of plate glass, was for a long time credited with superior quality, especially as to finish, but in both cases that claim has been disproven in the progress of the American plate and window glass manufacture during the last decade. In 1900 Boston, Mass., was the principal entry port for foreign window glass, followed by New York, N. Y. The entry ports for the South are St. Louis, Mo.; Baltimore, Md.; Newport News, Va.; and New Orleans, La. Previous to 1901 most of the window glass used on the Pacific coast was of foreign manufacture, entering principally at San Francisco. The cheapness of ballast freight rates of wheat-carrying ships returning to the Pacific coast, compared with the expensive overland freight rates from the domestic window-glass factories, gave the foreign glass a great advantage, but American manufacturers, by a decided differential in price and systematic distributing arrangements, have succeeded lately in steadily reducing the importations to that section of the country.

The value of imports of bottles, vials, carboys, etc., has shown an almost constant decrease from year to year during the last ten years. The total value in 1900 was $464,483, or 49.1 per cent less than in 1890. About one-half of the total importation consists of bottles filled with liquors, mineral waters, etc., and the principal exporting countries are Germany, France, Austria-Hungary, and the United Kingdom, in the order named. The importation of empty bottles, therefore, is very small in comparison with the domestic output. New York and Baltimore are the chief entry ports, but many unfilled bottles enter at San Francisco, coming over at cheap rates in returning wheat-carrying ships. Boston, New Orleans, and Philadelphia, also have large receipts.

The importation of optical glass has steadily increased, the development of the photographic camera being a strong stimulant. A large portion of the total importation enters in the New York camera district at Rochester, N. Y. Germany furnished 43.7 per cent of the total value in 1900; the United Kingdom, 33.7 per cent; and France, 22.6 per cent. Attempts have been made in this country to make optical glass, but the manufacture has never passed beyond the experimental stage, and at present even experimenting has ceased. The time and care required and the uncertainty as to results attending every melt, in face of the free entry of these products from countries long skilled in the art, make the manufacture of optical glass an unattractive proposition to glass manufacturers in the United States.

A large proportion of the $2,106,084 reported as the value of "all other" glass imports in 1900, was that of fancy decorated Bohemian glassware, much of it made to sell at low prices. The fancy colored and decorated ware, of the Bohemian order, is as yet but a small item in glass manufacture in the United States, although a large quantity is purchased. Increased attention is being given to it, and such success was achieved in its manufacture during the census year by at least one firm, that it will very likely have a vigorous growth during the next few years. Decorated opal or porcelain glass has met with great favor in this country for several years, and in addition to the large quantity of home manufacture, a considerable quantity has been imported, mostly from Germany. Germany has a large trade in chemical glassware for laboratory use, and, with England and France, is finding a rich and almost undisputed field here for that class of ware. The manufacture of chemical ware has been carried on in the United States in a small way, but a recent movement among American chemists in favor of home manufacture has caused more or less agitation among glass manufacturers, and gives promise of leading to a determined attempt on the part of one or two firms, to establish the industry on a larger scale in this country.

Great progress has been made in recent years in the manufacture of expensive "art glass" of the highest order. One of the exhibits which attracted considerable attention from glass men of all countries at the Paris Exposition was a new art glass manufactured by a firm in New York city. High-grade lamps, unsurpassed by any manufactured, have been produced in this country. Watch crystals, which are not manufactured in the United States, although it was attempted recently in West Virginia, are imported in large numbers of small aggregate value. The process of manufacture is simple, and it will in time probably form a part of the American industry. A thin round ball or bubble of glass is blown, and from this, with diamond-pointed compasses, the circular disks are cut, which are then placed on properly shaped blocks and bent to the required shape by reheating. Of the total value of "all other" glass imports, 33 per cent comes from Germany, 28.1 per cent from Austria-Hungary, 23.1 per cent from France, 7.8 per cent from the United Kingdom, and 6.3 per cent from Belgium.

Table 11 presents, in addition to the value of imported glass, the value of glass of domestic manufacture exported annually, from 1869 to 1900, inclusive.

The exportation of all other than window glass has almost constantly increased from year to year since 1869, gaining 227.2 per cent in value during that period, and 117.4 per cent during the last decade. The gain in the ten years ending with 1890 over the ten preceding years was $1,830,612, and between 1890 and 1900 over the ten preceding years, $2,922,065. American glassware is exported to nearly every civilized country, 68 countries being reported by the Bureau of Statistics of the Treasury Department in 1900. Canada received 30 per cent of the total value in 1900; Mexico, 14.6 per cent; Australia, 12.8 per cent; Cuba, 8.2 per cent;

and the United Kingdom, 7.3 per cent. An inquiry as to exports was incorporated in the schedule used for the purpose of eliciting complete information as to the articles exported and their destinations; but as the largest part of the exporting is done through regular exporting houses, a very small portion goes direct from the factory with its destination known. The returns from factories, therefore, are very meager, but as far as they go, furnish an idea of the comprehensive scope of the glass export business. Beer and soda bottles, and plain and lettered prescription bottles, pressed tableware, lamp chimneys, and lantern globes constitute the bulk of the exports reported direct from factories. Bottles to the value of $161,300 were reported as exported during the census year by 12 firms, $66,333 of which was the value of beer and soda-water bottles exported to Mexico, where a fair trade has been developed recently in that line of ware. Plain and lettered prescription bottles are a large item in the exports, and 6 firms reported direct shipments to Canada, South and Central America, Mexico, West Indies, Great Britain, France, East Indies, Australia, China, and Japan. The bottle trade with the Philippines and Cuba is very large, principally in the form of bottles filled with beer and liquor. Direct tableware exports were reported by 16 establishments, amounting to $137,982.

American pressed tableware is unexcelled in the markets of the world for color, workmanship, and finish, which make it the closest imitation of real cut ware, at such prices as, quality considered, place it in a class by itself. Export trade is receiving special consideration from some of the largest manufacturers of pressed ware, and the American sample room and traveling agent for pressed glassware are becoming more general abroad. The largest part of the lamp chimney exportation is done by jobbing houses, yet 4 factories reported direct shipments valued at $111,560. About four-fifths of the quantity reported went to South America, where lamp chimneys made in the United States are in high favor. As a result of a recent systematic introduction of the American lamp chimney in England and some of the continental countries, the exports in that direction are steadily increasing and have already reached a very satisfactory figure. American lantern globes are largely used in Central and South America. Canada, South America, and Australia are steadily increasing their consumption of American gas and electric glassware, such as globes and shades. Cathedral or opalescent glass valued at $13,432 was reported as shipped direct from factory to Canada, Germany, England, and France, where, by reason of its superior colors and texture, it is preferred in the construction of art windows.

Exports of window glass show some increase during the last few years, but the lower cost of production in Belgium will, no doubt, continue to restrict, as in the past, the foreign trade of the United States in this commodity. The exports are confined largely to Mexico, British America, and the West Indies. A plan has been discussed to operate the American window factories an extra time during the year at reduced wages to manufacture glass for export exclusively, but it has not met with favor from the workmen and from some of the manufacturers.

FURNACE IMPROVEMENT.

The greatest advance made in the American glass industry in the past decade has been in the improvement of the melting furnace in the direction of greater economy and rapidity in operation. The great feature of this development has been the widespread substitution of the tank for the pot furnace, 48.8 per cent of the total melting capacity of active plants reported during the census year being contained in tank furnaces. In the United States the tank is practically a creation of the last ten years, its standing prior to that time being experimental, though it had been used successfully abroad for a much longer period. So far Germany and Belgium have set the pace for American glass furnace construction.

The glass-melting furnace is a modification of the reverberatory furnace, the materials to be melted being exposed to the action of the flame, but not to the contact of the burning fuel. While numerous modifications exist, the furnaces generally used are of two styles, the pot furnace and the tank furnace. The former is adapted either for the use of open pots or for covered pots, and the latter is either a day tank, intermittent in its melting action, or a continuous tank in which the melting is continuous. The pot furnace contains a number of melting pots, large clay crucibles, each holding, on an average, a ton of molten glass. These pots are arranged immediately inside the breast wall of the furnace with room in the center of the furnace for combustion space. The batch, or mixture of the raw materials, is filled into these pots through an opening in the side of the furnace opposite each pot, and after the melting process is completed, the glass is gathered from the pots through these openings. The pot furnace used in the manufacture of plate glass is an exception in this respect, as the pots are removed bodily from the furnace by a crane and their contents poured on the casting table. In the tank furnace, pots are entirely dispensed with, the glass being melted and held on the hearth of the furnace itself, the flame sweeping across its surface. In the continuous tank there is a supply of molten glass at all times, the batch being filled in at one end and the glass worked out continuously at the other end. The day tank requires a night or day to melt the glass, when it is worked out and the tank again filled with the batch, the operation being similar to the working of a pot furnace. The pot furnaces used in the manufacture of window glass, plate glass, and bottles and jars are either square or oblong in form, and those for flint glass, tableware, etc., are round or oval.

The open-pot furnace for window glass and bottles and jars varies in length according to the number of pots used, its width being about three times the diameter of the pot. The pots vary in number from 4 to 12, generally being 6 or 10, placed in the furnace in 2 rows. Openings at the ends of the furnace permit the removal and replacement of broken pots. The crown of the furnace, forming the top of the combustion chamber, is preferably rather flat, but set high enough to allow adequate flame development and good distribution of the heat between and above the pots. In the direct-fired furnace, the fuel is on a grate set in the space between the 2 rows of pots, somewhat below the level of the bench on which the pots are placed. An arched passage—the cave—runs beneath the furnace for the admission of air to the grate, and there are frequently 2 caves crossing at right angles, so as to admit air from all directions. Neither flues nor regenerators are used when the fuel is fired direct, the draft being regulated by the height of the stack of the furnace, which varies with different fuels employed. In the regenerative gas-fired furnace, the regenerators are so placed that in the event of a pot breaking, the molten glass can not reach them and obstruct the draft. The hot escaping gases from combustion pass from the combustion chamber through the checkerwork of bricks, which take up their heat and soon become very hot. The direction of the flame is reversed and the air for combustion enters through the hot regenerator, while the waste gases pass out through another regenerator. By a reversal of the direction of the flame every twenty or thirty minutes, the hot outgoing waste gases are constantly giving off their heat to the regenerators and the incoming air is constantly returning it to the furnace. In what is styled a recuperative gas-fired furnace, no reversal of the current occurs. The waste gases pass out through a series of thin-walled flues, while the incoming air is admitted through a second series of thin-walled flues, and coming in contact with the first series of flues, absorbs the waste heat. In the gas-fired furnace the air and gas flues rise vertically at either end and terminate in ports at or below the hearth level. The flame traverses the furnace from one end to the other, describing the arc of a circle, or by lessening the draft, it can be made to completely fill the furnace. The open-pot furnace for plate glass is longer than that for window or bottle glass, as it usually holds 20 large pots. There is an opening in the wall of the furnace opposite each pot to allow its removal, bodily, for casting purposes. All plate-glass furnaces are gas fired, the air and gas flues ascending and terminating vertically or coming up vertically and turning so as to enter the furnace horizontally. With the use of the lehr in plate-glass manufacture, the tendency is now toward smaller pots, which increases the number that may be placed in the furnace.

The covered pot furnace for flint glass is generally circular in form. The pots have a hood-like top, which projects to the opening in the breast wall of the furnace and through which the batch is filled in and the glass worked out. This hooded top entirely shields the contents of the pot from the flame. When old or broken pots are to be replaced, the wall of the furnace is removed enough to allow for the passage of the pot. The average life of the covered pot is several months, while that of the open pot is about six weeks; the length of time, however, in each case, may be more or less. It is possible to melt a much better quality of glass in the covered pot than in the open pot, as the hooded top excludes many impurities caused by combustion. The number of covered pots in a furnace is from 8 to 16. In firing the open-pot furnace the aim is to develop in the combustion space between the pots and above them a solid flame, but with the covered pots, the flame must be divided so as to play close around each pot. To this end the flame is drawn from the center of the furnace to a series of flues at the breast wall, a flue being placed between each pot and the adjoining pot. The crown of the furnace comes just above the pots and the stack widens at the base sufficiently to take in the entire diameter of the furnace. The draft flues empty into the stack through the breast wall or through the crown. These furnaces are adapted for recuperative gas firing or direct coal firing. In the oval covered pot furnace the stack is at one side, as with the regenerative tank; greater economy of space in setting the pots is secured as well as better heating results. One method of treatment of the waste heat in a furnace of this kind is to convey it by a series of flues so as to heat the water system that heats the entire factory plant.

The first successful gas-fired glass-melting pot furnace was developed abroad in 1861, the solid fuel being converted into gas in a producer outside of the furnace. Several years were required to introduce this improvement into glass manufacture in this country. This application of gas is one of the chief improvements in modern glass making, making possible a saving in the cost of fuel of fully 50 per cent over the cost with the direct-fired furnace, greatly reducing the time of melt, improving the quality of the glass, and lengthening the life of the pot. However, the disadvantages attending the pot system of melting created a demand for a system to melt and blow the glass continuously; these disadvantages were the time lost with the pot system (fully one-half the time being spent in cooling and settling the metal, working out the glass, and reheating the furnace), and the constant loss incurred by breaking pots, one broken pot so disturbing the rest of the furnace that the full capacity is frequently unavailable for a considerable time. This led to the development of the tank furnace, which was used in Europe in 1861 and improved in 1872. However, the general introduction of the tank into glass manufacture in the United States did not occur until 1888, the successful operation of the continuous tank for window glass at Jeannette, Pa., in that year probably marking its actual introduction into the glass industry of this country. The chief advantages of the tank over the pot furnace are increased production, economy in operation, durability of furnace, regularity of working, and intensity of heat.

The day or intermittent tank is practically a pot furnace with one large open pot comprising the entire hearth, which is a square or oblong box built up of fire clay blocks and well ventilated on the bottom to prevent excessive wear and leakage occurring when the glass gets too hot or soft on the bottom. The air and gas are brought up through flues at one end and the products of combustion are discharged through flues at the other end. Either the regenerative or recuperative system can be used. There were 130 day tanks reported in operation during the census year, 117 of which were in establishments manufacturing bottles and jars and flint ware of all varieties, the average capacity of the tank in such establishments being 6 tons, equal to 6 pots; and 13 in establishments manufacturing skylight glass, glass tiling, rolled glass, and window glass. The greatest obstacle to the successful use of the day tank on flint glass has been the maintenance of color caused by the glass melting principally from the top, leaving the glass at the bottom of the tank less fluid and more refractory, but during the past decade this tank has been so improved that, at present, a very fair grade of so-called flint glass is in many cases being produced, at a great saving in cost over the pot-melting method. With these small tanks the use of gas for fuel probably produces the best results, but oil is being introduced for this purpose with a marked degree of success.[1]

The glass melting capacity of continuous tanks reported active in 1900 was 42.4 per cent of the total for the United States; pot furnaces with a total capacity of 4,300 pots were reported, day tanks of a capacity equivalent to 818 pots, and continuous tanks of a capacity equivalent to 3,775 pots, 2,476 of which were operated on bottles and jars and pressed and blown ware, and 1,299 on building glass. The continuous tank is confined largely to the manufacture of bottles and jars and window glass, 2 shifts being worked in the bottle trade and 3 in the window. The continuous regenerative melting tank contains an immense quantity of molten glass and is always full or nearly so. The window tank is oblong, four or five times as long as the width, with a capacity varying from 6 to 20 rings, each ring being equivalent to a capacity of 3 pots. The bottle tank is much shorter and wider than the window tank, and has an average of about 10 rings, each ring being equivalent to a capacity of 2 pots. The average window tank has 8 rings, or a capacity of 24 blowers or pots. Inside it is 14 feet wide, 70 feet long, and 5 feet deep, and will contain about 425 tons of molten metal. The batch is filled in continuously at one end and drawn, melting as it goes, to the working holes at the other end, where it is worked out. Near the working end of the tank is a floating bridge of prepared clay, extending down about one-fourth of the depth of the tank, which breaks the surface of the mass of glass and acts as a purifier, the completely melted glass passing beneath the floater into the working end of the tank, while the impure glass, which rises to the top, is held in check until properly melted. The wall of the working end of the tank is pierced by working holes through which the glass is gathered, in front of each hole being a deep clay ring stationed in the glass, the refined metal coming into this ring through the bottom and being gathered from the ring by the workman. The bottom and sides of the tank are well ventilated, to lessen the strain on the structure. The regenerators are at either side of the tank foundations, and the flues lead to ports in the side walls or to ports that open through the crown, the flame entering the furnace above the surface of the glass and just beneath the crown. All arrangements are made with a view to developing a nearly continuous sheet of flame.

A modification of the continuous tank for window glass, styled the blow-over tank, was introduced into this country in 1900, though in use abroad for a number of years. There were three or four such plants erected. By the use of the blow-over tank the blow furnace for "warming in" the roller of glass during the blowing operation is dispensed with, as the roller is "warmed in" directly over the mass of molten glass in the tank, the heat of the tank accomplishing this purpose, which effects a saving in fuel of about 50 per cent, for as much fuel is often required for the blow furnaces as for the melting tank. This improvement is made by lengthening the working end of the tank to permit a series of warming-in holes on each side between the floaters and the gathering holes. The results so far obtained with the blow-over tank will probably lead to its general introduction, as, in addition to the great saving in fuel cost, the heat is much more constant and uniform than with the blow furnace.

The use of oil as a fuel for glass melting has greatly increased during the last ten years. One of the most successful methods of oil firing is the use of the cheap, heavy oil of 34 to 40 specific gravity, practically a refinery by-product, with an air pressure of from 2 to 7 ounces per square inch. The air meets the flow of oil at the end of the burner and completely atomizes it in a spray, furnishing just enough oxygen to perfect combustion. Oil is advantageous as a clean fuel of high calorific value and perfect safety, but the cost restricts its general use. Benzine is largely used in certain

[1] Elements of Glass and Glass Making, Biser, 1900, page 62.

branches of the glass industry as fuel, being especially well adapted for fuel for glory holes, particularly in the manufacture of bottles, producing an intense uniform heat and requiring but little attention.

DETAILED STATISTICS OF GLASS MANUFACTURE.

The detailed statistics for the industry as reported are shown in Tables 12, 13, and 14; Table 12 presenting statistics of the entire industry; Table 13, of the manufacture of building glass; and Table 14, of the manufacture of pressed and blown glass, and bottles and jars. These tables present separate totals for each state in which there were 3 or more establishments, and group the statistics for other states, so as not to disclose the operations of individual establishments. The establishments are classified according to the character of the ownership, which shows that in the building glass branch of the industry, 6 were owned by individuals, 11 by partnerships, 102 by corporations, and 5 were of a miscellaneous character; and in the manufacture of pressed and blown glass, and bottles and jars, 23 were owned by individuals, 49 by partnerships, 157 by corporations, and 2 were of a miscellaneous character. The employees are classified so as to show for salaried officials, clerks, etc., and for wage-earners separately the number and salaries or wages of men, women, and children, respectively, and also the average number of wage-earners employed during each month of the year. Separate totals are shown for the different materials, presenting the quantity and cost of each; and the quantity and value of the several products manufactured, and the value of all other products, are given. The number of engines, water wheels, electric motors, and other forms of power in use, with their horsepower, are shown. The establishments are grouped in the tables according to the number of employees in each.

TABLE 12.—GLASS MANUFACTURE, BY STATES: 1900.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	Missouri.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Number of establishments	355	6	110	7	5	3	26	27	28	119	16	8
Character of organization:												
Individual	29	....	7	1	....	....	4	3	3	10	1	....
Firm and limited partnership	60	1	5	2	1	....	4	6	4	31	3	3
Incorporated company	259	5	93	4	4	3	18	17	21	77	12	5
Miscellaneous	7	....	5	....	....	....	....	1	....	1	....	....
Capital:												
Total	$61,423,903	$2,181,801	$12,775,389	$581,086	$258,949	$2,198,316	$5,397,662	$2,242,834	$5,451,513	$28,287,187	$1,338,084	$711,082
Land	$4,771,476	$66,657	$626,095	$49,618	$33,000	$251,081	$330,136	$242,675	$440,375	$2,589,897	$75,142	$66,800
Buildings	$16,954,293	$524,764	$4,132,329	$144,576	$50,047	$668,346	$1,164,071	$397,004	$1,310,859	$8,021,796	$397,301	$143,200
Machinery, tools, and implements	$14,247,283	$118,289	$2,936,890	$66,559	$35,150	$878,589	$353,600	$300,232	$1,491,631	$7,683,311	$234,532	$148,500
Cash and sundries	$25,450,851	$1,472,091	$5,080,075	$320,333	$140,752	$400,300	$3,549,855	$1,302,923	$2,208,648	$9,992,183	$631,109	$352,582
Proprietors and firm members	170	1	24	4	2	....	18	17	9	81	6	8
Salaried officials, clerks, etc.:												
Total number	2,268	75	509	31	39	26	317	117	199	842	85	28
Total salaries	$2,792,376	$110,100	$649,227	$38,976	$28,060	$47,448	$284,960	$139,698	$249,029	$1,110,383	$97,551	$36,944
Officers of corporations—												
Number	389	12	119	6	8	4	51	29	30	107	19	4
Salaries	$936,835	$36,260	$271,147	$9,710	$9,869	$17,400	$83,540	$56,054	$68,639	$345,816	$31,100	$7,300
General superintendents, managers, clerks, etc.—												
Total number	1,879	63	390	25	31	22	266	88	169	735	66	24
Total salaries	$1,855,541	$73,840	$378,080	$29,266	$18,191	$30,048	$201,420	$83,644	$180,390	$764,567	$66,451	$29,644
Men—												
Number	1,647	59	342	23	22	19	234	81	139	651	53	24
Salaries	$1,745,140	$71,320	$353,093	$27,944	$15,326	$28,538	$188,740	$80,082	$167,888	$722,108	$60,457	$29,644
Women—												
Number	232	4	48	2	9	3	32	7	30	84	13	....
Salaries	$110,401	$2,520	$24,987	$1,322	$2,865	$1,510	$12,680	$3,562	$12,502	$42,459	$5,994	....
Wage-earners, including pieceworkers, and total wages:												
Greatest number employed at any one time during the year	71,713	3,904	18,523	990	534	1,051	7,421	3,499	6,233	26,043	2,375	1,140
Least number employed at any one time during the year	53,660	3,654	14,669	751	373	720	4,637	2,373	4,307	19,154	2,000	1,022
Average number	52,818	3,304	13,015	742	387	650	5,383	2,556	4,546	19,420	1,949	866
Total wages	$27,084,710	$1,621,286	$7,226,047	$339,518	$188,674	$341,375	$2,462,745	$1,305,264	$2,067,384	$10,287,491	$789,422	$455,504
Men, 16 years and over—												
Average number	42,173	2,607	10,910	562	343	648	4,366	2,201	3,505	15,136	1,319	576
Wages	$24,901,233	$1,496,891	$6,808,042	$313,920	$179,236	$340,825	$2,278,306	$1,239,971	$1,844,958	$9,338,261	$657,984	$402,839
Women, 16 years and over—												
Average number	3,529	148	634	54	19	....	170	73	405	1,546	468	12
Wages	$840,001	$28,456	$129,808	$8,673	$4,392	....	$32,726	$17,831	$96,017	$414,250	$103,748	$4,100
Children, under 16 years—												
Average number	7,116	549	1,471	126	25	2	847	282	636	2,738	162	278
Wages	$1,343,476	$95,939	$288,197	$16,925	$5,046	$550	$151,713	$47,462	$126,409	$534,980	$27,690	$48,565
Average number of wage-earners, including pieceworkers, employed during each month:												
Men, 16 years and over—												
January	51,282	3,023	13,956	636	390	526	5,344	2,488	4,132	18,680	1,407	700
February	51,730	3,020	14,140	648	368	518	5,384	2,393	4,169	18,928	1,462	700
March	52,146	3,015	13,847	699	330	516	5,410	2,607	4,488	19,033	1,467	734
April	52,044	2,995	14,017	713	303	716	4,848	2,720	4,527	19,023	1,462	720
May	50,662	2,954	13,728	710	323	969	5,014	2,671	4,290	17,972	1,414	617
June	45,847	2,806	12,687	668	310	964	4,641	2,348	3,244	16,483	1,150	546
July	17,829	662	3,921	193	222	649	1,419	968	1,209	7,874	507	205
August	20,468	665	4,183	225	239	693	969	1,033	1,632	9,410	1,214	205
September	35,245	3,040	8,165	481	344	538	3,931	1,841	3,262	11,773	1,377	493
October	40,878	3,035	10,306	573	373	558	4,765	2,244	3,531	13,502	1,431	560
November	43,042	3,051	10,861	564	449	555	5,316	2,501	3,541	14,042	1,448	714
December	44,903	3,018	11,112	634	465	578	5,352	2,593	4.032	14,914	1,487	718

[1] Includes establishments distributed as follows: California, 1; Colorado, 1, Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1.

TABLE 12.—GLASS MANUFACTURE, BY STATES: 1900—Continued.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	Missouri.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Average number of wage-earners, including pieceworkers, employed during each month—Continued.												
Women, 16 years and over—												
January	3,820	179	792	53	15	....	153	71	431	1,665	448	13
February	3,879	177	758	58	19	....	159	67	439	1,731	458	13
March	3,984	177	810	62	19	....	166	83	487	1,704	463	13
April	3,890	177	806	57	20	....	160	90	479	1,625	463	13
May	3,486	167	625	58	20	....	181	98	427	1,469	433	13
June	3,343	152	623	54	18	....	182	84	402	1,384	428	16
July	1,850	24	197	25	8	....	147	44	193	1,020	176	16
August	2,530	24	253	50	14	....	93	60	261	1,262	508	15
September	3,428	172	442	59	21	....	135	56	414	1,572	557	....
October	3,907	171	715	61	20	....	175	67	447	1,694	557	....
November	4,135	177	801	61	24	....	261	80	451	1,699	565	16
December	4,096	177	782	56	24	....	223	79	445	1,733	561	16
Children, under 16 years—												
January	8,301	667	1,813	132	34	....	996	300	829	3,040	160	330
February	8,463	659	1,878	136	35	....	993	286	840	3,139	167	330
March	8,537	669	1,884	188	24	....	983	300	832	3,142	176	349
April	8,644	661	1,911	197	24	....	965	334	819	3,210	176	347
May	7,341	646	1,306	186	25	6	986	350	549	2,749	171	367
June	7,082	646	1,196	199	25	6	963	333	585	2,663	169	297
July	2,397	....	524	5	6	8	169	116	82	1,325	77	85
August	3,350	....	694	5	6	6	157	141	246	1,871	139	85
September	6,146	650	1,101	60	24	....	789	239	464	2,393	182	244
October	8,091	660	1,748	137	30	....	969	292	789	3,042	180	244
November	8,496	671	1,802	128	32	....	1,124	329	797	3,107	177	329
December	8,544	667	1,800	136	35	....	1,071	366	796	3,169	173	331
Miscellaneous expenses—												
Total	$3,588,641	$210,588	$690,165	$26,065	$14,243	$98,119	$241,665	$145,505	$165,512	$1,867,879	$112,791	$26,119
Rent of works	$29,195	....	$780	....	$500	$154	$683	$8,945	$68	$12,465	$400	$5,200
Taxes, not including internal revenue	$236,338	$9,556	$59,550	$2,040	$3,155	$6,242	$21,663	$8,122	$17,260	$100,838	$4,804	$3,108
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$3,264,149	$201,032	$625,835	$24,025	$10,588	$91,723	$212,900	$115,369	$138,184	$1,723,445	$105,637	$15,411
Contract work	$58,959	....	$4,000	....	....	....	$6,409	$13,069	....	$31,131	$1,950	$2,400
Materials used:												
Aggregate cost	$16,731,009	$674,008	$4,582,141	$151,500	$137,186	$231,615	$1,488,700	$899,590	$1,253,164	$6,435,463	$593,251	$284,492
Glass sand, tons	581,720	32,978	179,367	3,493	1,622	10,366	81,260	22,820	37,707	191,859	10,025	10,223
Cost	$846,822	$33,381	$241,075	$6,166	$6,355	$8,613	$78,521	$46,117	$67,035	$329,465	$14,203	$15,891
Soda ash (carbonate of soda), tons	157,779	12,017	48,629	1,601	194	3,048	20,630	7,508	11,072	46,398	2,847	3,835
Cost	$2,259,939	$164,827	$686,471	$23,276	$5,342	$47,654	$310,641	$113,586	$156,797	$639,152	$43,724	$68,569
Salt cake (sulphate of soda), tons	53,257	....	14,371	....	125	226	697	1,453	1,751	34,297	337	....
Cost	$518,590	....	$183,232	....	$1,625	$2,311	$7,478	$13,606	$18,428	$287,311	$4,600	....
Nitrate of soda, tons	10,770	440	2,329	149	24	....	1,314	548	1,259	4,330	307	70
Cost	$320,937	$13,720	$75,243	$5,000	$830	....	$21,166	$19,174	$39,634	$132,389	$10,982	$2,800
Limestone, tons	91,015	4,815	27,993	185	100	4,112	8,577	2,462	3,356	38,309	450	656
Cost	$181,717	$9,912	$47,882	$578	$225	$8,566	$25,471	$6,826	$6,536	$71,110	$825	$3,786
Lime, hundredweight	794,679	46,387	230,148	15,128	659	610	198,923	32,819	75,638	147,975	15,728	31,764
Cost	$147,901	$10,175	$37,599	$1,492	$112	$140	$26,873	$8,885	$14,712	$37,946	$4,057	$5,910
Arsenic, pounds	2,349,261	45,607	837,487	4,621	7,789	24,233	102,490	101,570	228,587	896,074	80,503	20,300
Cost	$112,630	$2,173	$40,848	$207	$370	$1,217	$4,912	$4,942	$11,751	$41,295	$3,837	$1,078
Carbon, tons	4,155	90	1,883	....	15	18	20	61	133	1,926	13	6
Cost	$17,000	$1,018	$6,657	....	$100	$540	$406	$544	$660	$6,950	$155	$70
Manganese, pounds	1,493,538	59,838	521,980	11,167	8,101	33,000	143,465	90,721	76,117	457,581	58,944	32,624
Cost	$57,493	$1,960	$19,655	$566	$207	$825	$5,674	$3,800	$3,672	$17,474	$2,239	$1,421
Litharge (red lead), pounds	8,386,106	115,600	1,482,887	36,982	364,448	....	72,049	822,130	2,063,000	3,143,727	285,283	....
Cost	$490,200	$6,242	$76,215	$1,857	$24,497	....	$3,918	$48,137	$117,035	$191,716	$20,583	....
Potash or pearlash, pounds	4,406,211	....	453,481	75,000	207,967	....	60,270	469,186	850,171	1,938,334	351,802	....
Cost	$186,847	....	$18,564	$3,000	$8,994	....	$2,866	$20,503	$34,129	$82,234	$16,557	....
Grinding sand, tons	265,438	....	71,152	....	....	4,743	433	50	6,897	182,117	46	....
Cost	$166,040	....	$37,533	....	....	$1,897	$519	$120	$2,520	$123,186	$265	....
Rouge, pounds	837,536	....	267,345	....	....	20,980	1,300	....	14,987	532,624	400	....
Cost	$24,747	....	$9,061	....	....	$693	$41	....	$897	$13,971	$84	....
Plaster of paris, tons	23,066	....	7,660	....	....	696	....	10	611	14,184	4	1
Cost	$108,531	....	$35,104	....	....	$3,799	....	$71	$1,311	$68,171	$57	$18
Fire clay, or pot clay, pounds	32,151,017	642,000	8,624,298	245,900	66,158	426,520	2,108,845	1,033,200	2,549,910	15,926,246	154,940	373,000
Cost	$221,183	$5,687	$64,394	$1,390	$720	$2,795	$13,875	$8,373	$7,055	$113,822	$1,587	$1,485
Pots, not including those made at works, number	8,941	309	2,429	164	110	58	366	475	1,199	3,461	350	20
Cost	$381,147	$17,680	$101,884	$7,286	$5,175	$2,030	$12,517	$17,520	$61,971	$135,765	$17,999	$1,320
Flattening stones, number	272	....	79	....	4	....	14	1	24	146	4	....
Cost	$16,344	....	$5,010	....	$200	....	$316	$60	$1,550	$9,049	$160	....
Fuel—												
Total cost	$3,203,146	$155,400	$355,300	$47,980	$33,047	$75,689	$445,828	$227,158	$249,405	$1,421,710	$88,905	$102,724
Natural gas	$1,575,278	....	$351,553	....	....	....	....	$9,190	$110,616	$1,016,903	$87,016	....
Oil, gallons	12,690,856	1,663,301	624	293,107	371,867	60,000	5,098,181	1,347,692	1,250,750	1,116,129	18,650	1,480,555
Cost	$409,158	$41,084	$115	$10,051	$15,619	$2,000	$159,327	$48,345	$31,899	$50,227	$585	$49,906
Coal, tons	755,463	114,676	952	17,395	4,136	46,293	104,926	68,959	77,409	300,484	1,271	19,963
Cost	$1,074,074	$95,312	$2,616	$32,804	$14,942	$71,719	$219,362	$158,752	$102,461	$326,369	$1,304	$48,433
All other fuel	$144,636	$19,004	$1,016	$5,125	$2,486	$1,970	$67,139	$10,871	$4,429	$28,211	....	$4,385
Rent of power and heat	$62	....	....	....	....	....	....	....	....	$62	....	....
Lumber, casks, barrels, boxes, and nails	$2,778,025	$104,589	$941,834	$15,868	$12,191	$17,840	$193,850	$127,827	$211,651	$1,026,513	$197,050	$18,812
Cartons, wrapping paper, straw, and hay	$612,602	$22,571	$290,525	$3,026	$4,193	$2,773	$22,390	$22,305	$49,770	$161,012	$32,562	$1,475
Caps, metal trimmings, and rubber supplies	$1,622,917	$31,073	$747,574	$10,494	$6,816	....	$79,359	$67,111	$61,212	$405,045	$101,983	$12,250
Supplies used in repairs on tanks and furnaces	$531,916	$36,659	$145,667	$2,107	$2,803	$14,073	$47,089	$30,524	$19,174	$205,665	$16,422	$11,733
Mill supplies	$138,434	$1,126	$56,846	$2,667	$692	$1,938	$3,707	$3,528	$9,064	$49,169	$8,690	$1,107
All other materials	$991,751	$31,672	$137,133	$12,463	$20,679	$30,906	$109,335	$78,950	$43,746	$458,507	$63,628	$4,732
Freight	$894,088	$24,143	$220,935	$6,177	$2,012	$7,316	$71,950	$29,924	$63,449	$406,774	$32,097	$29,311

[1] Includes establishments distributed as follows: California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1.

TABLE 12.—GLASS MANUFACTURE, BY STATES: 1900—Continued.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	Missouri.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Products:												
Aggregate value	$56,539,712	$2,834,398	$14,757,883	$557,895	$418,458	$765,564	$5,093,822	$2,756,978	$4,547,083	$22,011,130	$1,871,795	$924,706
Building glass—												
Total value	$17,096,234	$24,000	$5,711,948	$103,262	$16,200	$505,564	$274,011	$346,790	$671,422	$9,213,545	$101,242	$128,250
Window glass, 50-foot boxes	4,341,282	4,000	1,701,729	49,669	6,000	...	124,541	89,522	200,854	2,068,340	40,144	56,483
Value	$10,879,355	$24,000	$4,176,587	$103,262	$15,000	...	$267,611	$243,085	$519,187	$5,301,131	$101,242	$128,250
Plate glass—												
Total cast, square feet	34,758,994	...	8,553,838	...	...	5,628,860	...	543,282	486,340	19,546,674	...	...
Rough sold, square feet	628,684	...	31,917	...	...	16,862	...	...	...	579,905	...	...
Value	$75,887	...	$4,780	...	...	$3,075	...	...	...	$68,032	...	...
Polished plate made, square feet	16,883,578	...	5,177,160	...	...	455,222	...	...	373,946	10,877,250	...	...
Value	$5,158,598	...	$1,415,224	...	...	$152,062	...	...	$149,578	$3,441,734	...	...
Cathedral, square feet	8,846,361	...	2,000,000	...	...	5,103,079	...	543,282	...	1,200,000	...	...
Value	$567,252	...	$100,000	...	...	$349,558	...	$46,694	...	$71,000	...	...
Skylight, square feet	3,679,694	...	5,616	...	...	10,976	...	...	26,566	3,636,536	...	...
Value	$165,086	...	$357	...	...	$869	...	...	$2,657	$161,203	...	...
Wire, square feet	1,295,504	...	...	...	...	...	...	...	...	1,295,504	...	...
Value	$129,051	...	...	...	...	...	...	...	...	$129,051	...	...
All other building glass	$121,005	...	$15,000	...	$1,200	...	$6,400	$57,011	...	$41,394	...	...
Pressed and blown glass—												
Total value	$17,076,125	$131,618	$2,691,787	$100,000	$382,091	...	$21,300	$1,173,784	$2,738,289	$8,453,550	$1,379,706	$4,000
Tableware, 100 pieces	655,141	...	126,162	...	...	...	...	...	150,992	364,770	13,217	...
Value	$2,617,784	...	$291,060	...	...	...	...	...	$668,469	$1,585,870	$72,385	...
Jellies, tumblers, and goblets, dozens	8,544,050	...	3,050,595	340,000	...	...	...	...	1,681,584	3,112,588	359,283	...
Value	$2,007,386	...	$630,485	$100,000	...	...	...	...	$392,612	$793,902	$90,387	...
Lamps, dozens	807,765	...	81,972	...	2,020	...	...	15,599	191,084	455,543	61,547	...
Value	$1,498,675	...	$43,116	...	$4,000	...	...	$7,447	$185,297	$983,452	$275,363	...
Chimneys, dozens	6,901,192	173,931	3,113,228	...	84,000	...	...	186,800	1,508,114	1,835,119	...	...
Value	$2,719,583	$131,618	$1,196,996	...	$33,000	...	...	$96,707	$622,721	$638,541	...	...
Lantern globes, dozens	1,044,816	...	547,971	...	2,000	...	...	162,038	142,800	58,275	131,732	...
Value	$497,021	...	$176,150	...	$1,800	...	...	$189,629	$69,589	$26,920	$32,933	...
Shades, globes, gas and electric goods, dozens	2,673,854	...	15,052	...	23,300	...	41,666	312,500	1,397,824	856,125	27,387	...
Value	$2,497,885	...	$19,044	...	$40,000	...	$6,500	$520,000	$398,420	$1,452,248	$61,673	...
Blown tumblers, stemware, and bar goods, dozens	6,127,367	...	112,163	...	...	...	...	...	214,072	3,512,552	2,288,580	...
Value	$1,598,652	...	$37,701	...	...	...	...	...	$53,368	$1,107,489	$400,094	...
Opal ware, dozens	3,750,443	...	244,873	...	3,000	...	...	1,000	96,597	2,925,545	479,428	...
Value	$1,581,731	...	$90,322	...	$4,000	...	...	$1,500	$51,656	$1,214,472	$219,781	...
Cut glass, dozens	134,726	...	325	...	3,332	...	...	...	2,900	56,800	71,369	...
Value	$672,463	...	$600	...	$146,613	...	...	...	$126,000	$311,189	$88,061	...
All other pressed and blown glass	$1,384,945	...	$206,313	...	$152,678	...	$14,800	$358,501	$170,157	$339,467	$139,029	$4,000
Bottles and jars—												
Total value	$21,676,791	$2,678,780	$6,327,468	$346,633	$20,167	$260,000	$4,452,219	$1,195,276	$1,058,955	$4,162,990	$381,847	$792,456
Prescription vials and druggists' wares, gross	2,423,932	265,918	624,128	20,000	...	...	731,107	81,803	76,409	551,236	4,004	69,327
Value	$4,665,697	$404,799	$1,184,397	$94,633	...	...	$1,306,316	$203,734	$155,377	$1,170,061	$8,889	$137,491
Beers, sodas, and minerals, gross	1,351,118	406,037	109,194	13,004	128	70,000	108,247	134,364	219,422	147,145	25,000	118,577
Value	$5,075,068	$1,332,842	$347,836	$120,212	$626	$260,000	$408,661	$495,398	$637,428	$01,129	$92,000	$478,936
Liquors and flasks, gross	985,374	31,168	604,798	5,000	6,298	...	64,140	44,171	16,400	142,518	43,058	27,823
Value	$2,403,447	$131,869	$1,207,519	$20,000	$19,541	...	$153,165	$110,221	$67,350	$448,182	$169,852	$85,748
Milk jars, gross	146,142	7,500	19,561	...	...	...	19,798	6,938	6,000	80,485	4,600	1,260
Value	$729,008	$37,500	$55,344	...	...	...	$107,431	$33,863	$30,000	$434,310	$23,000	$7,560
Fruit jars, gross	789,298	1,500	559,549	...	...	...	61,871	31,235	2,000	115,000	14,643	3,500
Value	$2,935,036	$9,000	$2,106,250	...	...	...	$192,467	$128,965	$8,000	$436,104	$43,750	$10,500
Patent and proprietary, gross	1,296,131	302,708	244,343	500	...	...	601,276	57,224	20,000	55,080	...	15,000
Value	$2,602,976	$495,597	$378,301	$1,500	...	...	$1,399,042	$120,543	$35,800	$142,193	...	$30,000
Packers and preservers, gross	784,588	80,739	247,731	5,007	...	...	278,960	11,430	25,000	113,546	10,242	11,933
Value	$2,119,221	$195,691	$686,092	$15,021	...	...	$620,869	$33,706	$100,000	$419,947	$20,356	$27,539
Demijohns and carboys, dozens	83,243	29,136	...	...	...	...	18,689	10,929	...	17,815	...	6,674
Value	$206,061	$48,984	...	...	...	...	$86,645	$18,896	...	$36,854	...	$14,682
All other bottles and jars	$940,277	$22,498	$361,729	$95,267	...	...	$177,623	$49,950	$35,000	$174,210	$24,000	...
Value of all other products	$690,562	...	$26,680	$8,000	...	...	$346,292	$41,128	$78,417	$181,045	$9,000	...
Comparison of products:												
Number of establishments reporting for both years	252	6	63	7	3	3	23	23	21	88	10	5
Value for census year	$47,184,649	$2,834,398	$11,157,894	$557,895	$382,091	$765,564	$4,927,447	$2,638,902	$4,138,150	$17,347,849	$1,628,027	$806,432
Value for preceding business year	$41,959,668	$2,297,679	$10,056,153	$532,723	$430,549	$1,034,253	$4,539,963	$2,350,494	$3,316,665	$15,384,075	$1,371,352	$646,762
Equipment and characteristics of works:												
Pot furnaces—												
Operated, number	391	9	116	10	4	4	27	24	37	143	14	3
Pots, number	4,300	117	1,220	91	38	60	200	200	444	1,758	144	28
Idle, number	60	1	9	2	3	3	6	5	5	25	1	...
Pots, number	807	12	134	16	27	50	55	47	95	359	12	...
Tanks—												
Continuous—												
Operated, number	192	11	71	...	...	3	31	14	12	43	...	7
Rings, number	1,671	133	564	...	...	20	293	115	95	404	...	47
Pot capacity, number	3,775	266	1,307	...	...	43	610	230	212	1,013	...	94
Idle, number	14	...	4	...	...	2	6	...	...	1	...	1
Rings, number	79	...	12	...	...	15	40	...	...	8	...	4
Pot capacity, number	158	...	24	...	...	30	80	...	...	16	...	8

[1] Includes establishments distributed as follows: California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1.

TABLE 12.—GLASS MANUFACTURE, BY STATES: 1900—Continued.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	Missouri.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Equipment and characteristics of works—Continued.												
Intermittent or day—												
Operated, number	130	7	33	1	1		12	7	3	44	19	3
Tons capacity, number	818	40	208	6	90		72	49	13	232	85	23
Pot capacity, number	818	40	208	6	90		72	49	13	232	85	23
Idle, number	17		4				2	1	3	5	1	1
Tons capacity, number	83		12				7	3	12	42	5	2
Pot capacity, number	83		12				7	3	12	42	5	2
Building glass—												
Flattening ovens, number	285	1	116	2	1		6	5	12	138	2	2
Monkey ovens, number	2	2										
Blow furnaces, number	259		135		1			10	15	94	4	
Casting tables, number	100	4	17			14		5	3	57		
Annealing ovens, number	869		258			98		5	23	485		
Bending ovens, number	9		5							4		
Lehrs, number	302		115	2	1	2	5	12	13	147	3	2
Clay grinding mills, number	63		22	2	1	1	3	6	3	23	1	1
Grinding machines, number	227		61	1		21		3	12	129		
Polishing machines, number	294		86			24			10	174		
Sand-blast machines, number	5		1					1		3		
Glassware and bottles—												
Shops, number	3,978	427	1,397	67	38	26	718	312	613	144	158	78
Glory holes, number	1,419	146	351	24	16	6	301	66	93	351	28	37
Annealing ovens, number	1,540	289	161	21	15	32	266	126	121	395	18	96
Lehrs, number	1,025	31	321	18	12		95	55	102	323	59	9
Decorating kilns, number	105		6	1	8			1	27	55	7	
Decorating lehrs, number	23		1						4	15	3	
Presses, hand, number	915	13	197	7	9		55	49	125	402	57	1
Presses, mechanical, number	49		4							42	3	
Blowing machines, number	169	1	80				4	1	18	65		
Finishing machines, number	140	2	33				1	2	59	42	1	
Crimping machines, number	494	1	169		5			32	35	252		
Mechanical polishers, number	16				1		1	1	1	12		
Sand-blast machines, number	68	1	8		3		1	9	10	27	9	
Grinding machines for fruit-jar tops, number	137	3	29	4			22	9	5	54	10	1
Clay-grinding mills, number	8		1				1		2	4		
Mechanical stokers, number	79						3	14	8	52		2
Horses and mules, number	409	23	21	13	8	9	98	49	18	134	6	30
Wagons, carts, and drays, number	407	24	23	17	9	7	111	47	18	126	6	19
Power:												
Number of establishments reporting	330	6	99	7	4	3	25	25	27	112	14	8
Total horsepower	58,929	700	11,386	240	199	3,592	1,756	1,127	7,326	30,956	958	689
Owned—												
Engines—												
Steam, number	753	14	187	9	4	17	69	33	38	353	17	12
Horsepower	49,791	700	10,333	230	100	3,110	1,681	1,017	3,426	27,732	773	689
Gas, or gasoline, number	84		23		1		1	1	13	41	4	
Horsepower	2,364		585		7		5	50	235	1,322	160	
Water wheels, number	2				1					1		
Horsepower	27				12					15		
Electric motors, number	178		18	1	1	15			45	97	1	
Horsepower	5,986		468	10	40	482			3,605	1,361	20	
Other power, number	25						4	4	6	10	1	
Horsepower	705						70	60	60	510	5	
Rented—												
Electric, horsepower	44				40					4		
Other kind, horsepower	12									12		
Furnished to other establishments, horsepower	10							10				
Establishments classified by number of persons employed, not including proprietors and firm members:												
Total number of establishments	355	6	110	7	5	3	26	27	28	119	16	8
Under 5	1										1	
5 to 20	5	1	2						1	1		
21 to 50	33		7		1		3	9	2	8	3	
51 to 100	93		39	3	2		5	7	3	24	5	5
101 to 250	139	1	43	3	2	1	11	7	12	55	3	1
251 to 500	58	2	14	1		2	3	4	8	18	4	2
501 to 1,000	21		4				3		2	12		
Over 1,000	5	2	1				1			1		

[1] Includes establishments distributed as follows: California, 1; Colorado, 1; Delaware, 1; Georgia, 1; Michigan, 1; Virginia, 2; Wisconsin, 1.

TABLE 13.—BUILDING GLASS, BY STATES: 1900.

	United States.	Indiana.	New Jersey.	New York	Ohio.	Pennsylvania.	All other states.[1]
Number of establishments	124	51	4	7	7	46	9
Character of organization:							
Individual	6	2	1	...	2	...	1
Firm and limited partnership	11	...	1	1	...	7	2
Incorporated company	102	45	2	6	5	38	6
Miscellaneous	5	4	...	...	...	1	...
Capital:							
Total	$26,617,122	$7,080,415	$218,990	$334,035	$2,039,134	$14,661,120	$2,283,428
Land	$2,170,678	$385,283	$28,000	$16,450	$212,194	$1,275,513	$253,238
Buildings	$9,020,800	$2,810,636	$81,000	$71,500	$486,931	$4,831,176	$739,657
Machinery, tools, and implements	$9,523,538	$2,162,680	$14,500	$38,150	$991,209	$5,425,846	$891,153
Cash and sundries	$5,902,106	$1,721,816	$95,490	$207,935	$348,800	$3,128,585	$399,480
Proprietors and firm members	25	2	4	6	2	8	3
Salaried officials, clerks, etc.:							
Total number	615	224	8	11	25	307	40
Total salaries	$811,983	$274,105	$6,326	$15,160	$22,570	$435,015	$58,807
Officers of corporations—							
Number	87	32	1	2	5	41	6
Salaries	$311,672	$105,898	$1,200	$4,700	$7,825	$173,449	$18,600
General superintendents, managers, clerks, etc.—							
Total number	528	192	7	9	20	266	34
Total salaries	$500,311	$168,207	$5,126	$10,460	$14,745	$261,566	$40,207
Men—							
Number	485	178	6	8	18	245	30
Salaries	$476,169	$159,904	$4,970	$10,096	$14,295	$248,707	$38,197
Women—							
Number	43	14	1	1	2	21	4
Salaries	$24,142	$8,303	$156	$364	$450	$12,859	$2,010
Wage-earners, including pieceworkers, and total wages:							
Greatest number employed at any one time during the year	19,343	6,512	389	313	1,021	10,031	1,077
Least number employed at any one time during the year	16,059	5,519	242	263	912	8,379	744
Average number	11,902	3,912	230	228	477	6,459	696
Total wages	$9,029,673	$3,251,819	$163,245	$164,291	$376,006	$4,706,720	$367,592
Men, 16 years and over—							
Average number	11,801	3,908	230	226	477	6,368	592
Wages	$8,999,613	$3,250,119	$163,245	$163,979	$376,006	$4,679,801	$366,463
Women, 16 years and over—							
Average number	20	...	...	...	...	20	...
Wages	$4,901	...	...	...	...	$4,901	...
Children, under 16 years—							
Average number	81	4	...	2	...	71	4
Wages	$25,159	$1,700	...	$312	...	$22,018	$1,129
Average number of wage-earners, including pieceworkers, employed during each month:							
Men, 16 years and over—							
January	16,693	5,865	357	297	787	8,840	647
February	16,919	6,012	357	293	780	8,985	492
March	16,743	5,461	357	305	955	9,175	490
April	16,987	5,457	373	292	951	9,224	690
May	17,162	5,806	384	284	932	8,803	943
June	14,408	5,370	249	91	4	7,846	848
July	6,584	1,558	37	59	4	3,243	683
August	5,717	1,545	23	45	10	3,367	727
September	5,761	1,922	18	169	192	3,218	242
October	7,578	2,447	105	285	229	4,086	426
November	8,241	2,605	240	296	229	4,402	469
December	9,823	2,845	260	297	649	5,227	545
Women, 16 years and over—							
January	26	...	...	...	...	25	...
February	24	...	...	...	...	24	...
March	27	...	...	...	...	27	...
April	22	...	...	...	...	22	...
May	18	...	...	...	...	18	...
June	18	...	...	...	...	18	...
July	13	...	...	...	...	13	...
August	15	...	...	...	...	16	...
September	17	...	...	...	...	17	...
October	21	...	...	...	...	21	...
November	18	...	...	...	...	18	...
December	24	...	...	...	...	24	...
Children, under 16 years—							
January	91	3	...	2	...	82	4
February	94	5	...	2	...	83	4
March	91	4	...	2	...	81	4
April	93	5	...	2	...	82	4
May	92	5	...	2	...	75	10
June	91	6	...	2	...	73	10
July	76	4	...	...	...	64	8
August	80	4	...	2	...	68	6
September	58	4	...	2	...	52	...
October	62	3	...	2	...	57	...
November	69	3	...	2	...	64	...
December	77	4	...	2	...	71	...
Miscellaneous expenses:							
Total	$1,365,865	$348,665	$12,141	$14,569	$19,505	$867,168	$103,817
Rent of works	$6,314	...	...	$1,200	...	$4,460	$654
Taxes, not including internal revenue	$104,969	$32,387	$841	$810	$2,291	$61,989	$6,651
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$1,243,457	$316,278	$11,300	$11,882	$17,214	$790,271	$96,512
Contract work	$11,125	...	...	$677	...	$10,448	...
Materials used:							
Aggregate cost	$4,679,084	$1,319,675	$86,720	$120,748	$158,526	$2,697,041	$296,374
Glass sand, tons	177,966	59,746	2,763	2,977	5,851	95,176	11,453
Cost	$298,879	$102,019	$2,833	$3,773	$7,836	$172,003	$10,415
Soda ash (carbonate of soda), tons	25,500	8,037	615	59	666	13,206	2,917
Cost	$338,534	$106,833	$11,396	$1,433	$9,669	$168,022	$41,181
Salt cake (sulphate of soda), tons	52,789	14,158	500	1,453	1,751	34,239	688
Cost	$512,835	$180,018	$5,700	$13,605	$18,428	$286,548	$8,536
Nitrate of soda, tons	614	50	...	23	...	541	...
Cost	$9,262	$1,875	...	$1,056	...	$6,331	...
Limestone, tons	60,274	18,911	350	917	1,982	34,910	3,204
Cost	$106,540	$31,987	$850	$1,621	$3,102	$62,380	$6,603
Lime, hundredweights	125,030	12,060	72,922	...	3,150	20,185	16,713
Cost	$12,315	$1,745	$2,373	...	$482	$3,919	$3,796

[1] Includes establishments distributed as follows: Illinois, 1; Maryland, 2; Massachusetts, 1; Missouri, 2; West Virginia, 2; Delaware, 1.

TABLE 13.—BUILDING GLASS, BY STATES: 1900—Continued.

	United States.	Indiana.	New Jersey.	New York.	Ohio.	Pennsylvania.	All other states.[1]
Materials used—Continued.							
Aggregate cost—Continued.							
Arsenic, pounds	1,321,130	517,839	5,085	40,552	105,243	610,807	41,604
Cost	$63,067	$25,867	$280	$2,066	$4,875	$27,923	$2,056
Carbon, tons	3,973	1,847		47	133	1,912	34
Cost	$14,499	$6,135		$310	$660	$6,749	$645
Manganese, pounds	68,600	13,000		1,200		20,400	34,000
Cost	$2,316	$735		$63		$643	$875
Litharge (red lead), pounds	36,521	1,000		31,221		2,700	600
Cost	$2,273	$60		$2,023		$148	$42
Potash or pearlash, pounds	70,383	10,000		64,748		5,635	
Cost	$3,704	$510		$2,951		$243	
Grinding sand, tons	263,933	70,853			6,800	181,537	4,743
Cost	$160,305	$36,811			$2,040	$119,657	$1,897
Rouge, pounds	835,749	267,345			14,900	532,524	20,980
Cost	$24,448	$9,061			$723	$13,971	$693
Plaster of paris, tons	22,980	7,626			600	14,157	597
Cost	$107,434	$34,610			$1,200	$67,807	$3,817
Fire clay or pot clay, pounds	23,510,700	7,282,228	196,840	288,750	1,603,910	13,365,852	773,120
Cost	$170,522	$57,310	$2,148	$2,438	$4,749	$97,832	$6,045
Pots (not including those made at works), number	3,830	1,482	65	332	336	1,366	249
Cost	$101,061	$45,035	$1,300	$10,395	$9,110	$25,641	$9,580
Flattening stones, number	272	79	14	1	24	146	8
Cost	$16,344	$5,010	$315	$60	$1,550	$9,049	$360
Fuel—							
Total cost	$1,119,022	$195,376	$30,343	$42,741	$35,772	$710,416	$104,375
Natural gas	$751,354	$193,590			$11,212	$535,070	$11,482
Oil, gallons	723,654	489	133,414	54,171	113	177,256	358,211
Cost	$23,161	$78	$4,070	$2,742	$25	$5,679	$10,567
Coal, tons	269,611	432	12,406	20,769	28,593	161,368	46,043
Cost	$335,856	$1,138	$24,905	$37,450	$24,323	$166,866	$81,174
All other fuel	$8,651	$570	$1,368	$2,549	$212	$2,800	$1,152
Lumber, casks, barrels, boxes, and nails	$727,663	$257,905	$11,340	$14,546	$33,227	$378,557	$32,088
Cartons, wrapping paper, straw, and hay	$43,897	$13,252	$785	$876	$1,247	$23,890	$3,847
Supplies used in repairs on tanks and furnaces	$247,538	$72,010	$2,650	$2,531	$7,666	$152,213	$10,468
Mill supplies	$65,616	$37,290	$240	$550	$1,460	$24,315	$1,761
All other materials	$296,155	$56,922	$4,788	$9,417	$4,995	$184,680	$35,353
Freight	$234,855	$41,299	$9,379	$8,293	$9,735	$154,205	$11,944
Products:[2]							
Total value	$17,096,234	$5,711,948	$274,011	$346,790	$671,422	$9,213,545	$878,518
Building glass—							
Window, 50-foot boxes	4,341,282	1,701,729	124,541	89,522	200,854	2,068,340	166,296
Value	$10,879,356	$4,176,587	$267,611	$243,085	$519,187	$5,301,131	$371,754
Plate—							
Total cast, square feet	34,758,994	8,553,838				19,546,674	6,658,482
Rough sold, square feet	628,684	31,917				579,905	16,862
Value	$75,887	$4,780				$68,032	$3,075
Polished plate made, square feet	16,883,678	6,177,160				10,877,250	829,168
Value	$5,158,598	$1,415,224				$3,441,734	$301,640
Cathedral, square feet	8,846,361						8,846,361
Value	$567,252						$567,252
Skylight, square feet	3,679,694					3,636,536	43,158
Value	$165,086					$161,203	$3,883
Wire, square feet	1,295,504					1,295,504	
Value	$129,051					$129,051	
Value of all other products	$121,005	$15,000	$6,400	$67,011		$41,394	$1,200
Comparison of products:							
Number of establishments reporting for both years	59	20	3	5	6	20	6
Value for census year	$9,574,171	$3,088,863	$204,011	$251,714	$478,017	$4,790,490	$761,076
Value for preceding business year	$9,668,452	$2,908,757	$215,388	$177,837	$368,431	$4,949,146	$1,048,893
Equipment and characteristics of works:							
Pot furnaces—							
Operated, number	164	77	3	8	9	62	15
Pots, number	1,825	735	24	60	82	780	144
Idle, number	29	6		1	4	14	6
Pots, number	471	90		5	80	234	62
Tanks—							
Continuous—							
Operated, number	34	12	3		2	16	1
Rings, number	433	179	24		22	205	3
Pot capacity, number	1,299	637	72		66	615	9
Intermittent, or day—							
Operated, number	13	1				12	
Tons capacity, number	124	16				109	
Pot capacity, number	124	15				109	
Idle, number	1					1	
Tons capacity, number	7					7	
Pot capacity, number	7					7	
Flattening ovens, number	285	116	6	6	12	138	8
Monkey ovens, number	2						2
Blow furnaces, number	259	136		10	15	94	5
Casting tables, number	100	17		5	3	57	18
Annealing ovens, number	869	258		5	23	485	98
Bending ovens, number	9	6				4	
Lehrs, number	302	115	5	12	13	147	10
Clay-grinding mills, number	63	22	3	6	3	23	6
Grinding machines, number	227	61		3	12	129	22
Polishing machines, number	294	86			10	174	24
Sand-blast machines, number	5	1		1		3	
Mechanical stokers, number	62			2	8	52	
Horses and mules, number	92	14	6	5	3	47	17
Wagons, carts, and drays, number	93	13	7	3	2	52	16
Power:							
Number of establishments reporting	111	45	4	7	6	41	8
Total horsepower	43,939	8,741	90	155	5,799	25,616	3,638
Owned—							
Engines—							
Steam, number	442	127	4	8	8	274	21
Horsepower	37,161	8,230	90	165	2,250	23,292	3,144
Gas or gasoline, number	26	7			3	16	
Horsepower	685	143			29	513	

[1] Includes establishments distributed as follows: Illinois, 1; Maryland, 2; Massachusetts, 1; Missouri, 2; West Virginia, 2; Delaware, 1.

[2] While the aggregate value for the respective states is the aggregate value of products reported for building glass manufacture, this total can not be obtained by adding the amounts given, as the report of certain products has been suppressed to avoid disclosing the operations of individual establishments.

TABLE 13.—BUILDING GLASS, BY STATES: 1900—Continued.

	United States.	Indiana.	New Jersey.	New York.	Ohio.	Pennsylvania.	All other states.[1]
Power—Continued.							
Total horsepower—Continued.							
Owned—Continued.							
Water wheels, number	1						1
Horsepower	12						12
Electric motors, number	134	14			39	66	15
Horsepower	5,628	368			3,520	1,258	482
Other power, number	6					6	
Horsepower	440					440	
Rented—							
Electric, horsepower	1					1	
Other, horsepower	12					12	
Establishments classified by number of persons employed, not including proprietors and firm members:							
Total number of establishments	124	51	4	7	7	46	9
5 to 20	3	2					1
21 to 50	16	4	1	5	2	2	2
51 to 100	43	24	1	2		12	4
101 to 250	41	15	2		4	19	1
251 to 500	13	4			1	7	1
501 to 1,000	8	2				6	

[1] Includes establishments distributed as follows: Illinois, 1; Maryland, 2; Massachusetts, 1; Missouri, 2; West Virginia, 2; Delaware, 1.

TABLE 14.—PRESSED AND BLOWN GLASS AND BOTTLES AND JARS, BY STATES: 1900.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Number of establishments	231	5	59	5	4	22	20	21	73	14	8
Character of organization:											
Individual	23		5			3	3	1	10	1	
Firm and limited partnership	49		6	1	1	3	4	4	24	3	3
Incorporated company	157	5	47	4	3	16	12	16	39	10	5
Miscellaneous	2		1				1				
Capital:											
Total	$34,806,781	$2,143,658	$5,694,974	$479,534	$255,949	$5,178,672	$1,908,799	$3,412,379	$13,626,067	$1,265,624	$841,125
Land	$2,600,798	$65,157	$240,812	$32,061	$33,000	$302,136	$226,225	$228,181	$1,314,384	$72,042	$86,800
Buildings	$7,933,493	$520,764	$1,321,693	$104,365	$50,047	$1,083,071	$325,504	$823,928	$3,190,620	$348,301	$165,200
Machinery, tools, and implements	$4,723,745	$108,289	$774,210	$61,495	$34,150	$339,100	$262,082	$500,422	$2,257,465	$230,532	$156,000
Cash and sundries	$19,548,745	$1,449,448	$3,358,259	$281,613	$138,752	$3,454,365	$1,094,988	$1,859,848	$6,863,598	$614,749	$433,125
Proprietors and firm members	145		22	2	2	14	11	7	73	6	8
Salaried officials, clerks, etc.:											
Total number	1,653	71	285	28	38	309	106	174	535	80	27
Total salaries	$1,980,393	$106,600	$375,122	$36,576	$27,660	$278,634	$124,538	$226,459	$675,368	$93,016	$36,420
Officers of corporations—											
Number	302	12	87	6	7	50	27	25	66	17	5
Salaries	$625,163	$36,260	$165,249	$9,710	$9,469	$82,340	$51,354	$60,814	$172,367	$27,900	$9,700
General superintendents, managers, clerks, etc.—											
Total number	1,351	59	198	22	31	259	79	149	469	63	22
Total salaries	$1,355,230	$70,340	$209,873	$26,866	$18,191	$196,294	$73,184	$165,645	$503,001	$65,116	$26,720
Men—											
Number	1,162	56	164	20	22	228	73	121	406	50	22
Salaries	$1,268,971	$68,320	$193,189	$25,544	$15,326	$183,770	$69,986	$153,593	$473,401	$59,122	$26,720
Women—											
Number	189	3	34	2	9	31	6	28	63	13	
Salaries	$86,259	$2,020	$16,684	$1,322	$2,865	$12,524	$3,198	$12,052	$29,600	$5,994	
Wage-earners, including pieceworkers, and total wages:											
Greatest number employed at any one time during the year	52,370	3,889	12,011	870	486	7,032	[illegible],186	5,212	16,012	2,266	1,406
Least number employed at any one time during the year	37,601	3,639	9,150	631	327	4,395	2,110	3,395	10,775	1,891	1,288
Average number	40,916	3,291	9,103	657	375	5,153	2,328	4,069	12,961	1,886	1,093
Total wages	$18,055,037	$1,615,786	$3,974,228	$275,354	$179,329	$2,299,500	$1,140,973	$1,691,378	$5,580,771	$734,676	$563,042
Men, 16 years and over—											
Average number	30,372	2,594	7,002	477	331	4,136	1,975	3,028	8,768	1,258	803
Wages	$15,901,620	$1,491,391	$3,557,923	$249,756	$169,891	$2,115,061	$1,075,992	$1,468,952	$4,658,460	$603,817	$510,377
Women, 16 years and over—											
Average number	3,509	148	634	54	19	170	73	405	1,526	468	12
Wages	$835,100	$28,456	$129,808	$8,673	$4,392	$32,726	$17,831	$96,017	$409,349	$103,748	$4,100
Children, under 16 years—											
Average number	7,035	549	1,467	126	25	847	280	636	2,667	160	278
Wages	$1,318,317	$95,939	$286,497	$16,925	$5,046	$151,713	$47,150	$126,409	$512,962	$27,111	$48,565
Average number of wage-earners, including pieceworkers, employed during each month:											
Men, 16 years and over—											
January	34,589	3,008	8,091	516	343	4,987	2,191	3,345	9,840	1,302	966
February	34,811	3,005	8,128	528	368	5,027	2,100	3,389	9,943	1,357	966
March	35,403	3,000	8,386	579	330	5,053	2,302	3,533	9,858	1,362	1,000
April	35,057	2,980	8,560	593	303	4,475	2,428	3,576	9,799	1,357	986
May	33,510	2,939	7,922	590	323	4,630	2,387	3,358	9,169	1,309	883
June	31,439	2,791	7,317	588	310	4,392	2,257	3,240	8,637	1,095	812
July	12,245	657	2,363	164	222	1,382	909	1,205	4,631	507	205
August	14,751	660	2,638	196	239	946	988	1,622	6,043	1,214	205
September	29,484	3,025	6,243	457	344	3,913	1,672	3,070	8,555	1,377	828
October	33,300	3,020	7,859	504	373	4,660	1,959	3,302	9,416	1,381	826
November	34,801	3,036	8,256	495	403	5,076	2,205	3,312	9,641	1,397	980
December	35,080	3,003	8,267	514	417	5,092	2,296	3,383	9,687	1,437	984
Women, 16 years and over—											
January	3,795	179	792	53	15	153	71	431	1,640	448	13
February	3,855	177	758	58	19	159	67	439	1,707	458	13
March	3,957	177	810	62	19	166	83	487	1,677	463	13
April	3,868	177	806	57	20	160	90	479	1,603	463	13

[1] Includes establishments distributed as follows: California, 1; Colorado, 1; Georgia, 1; Michigan, 1; Missouri, 1; Virginia, 2; Wisconsin, 1.

TABLE 14.—PRESSED AND BLOWN GLASS AND BOTTLES AND JARS, BY STATES: 1900—Continued.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Average number of wage-earners, including pieceworkers, employed during each month—Continued.											
Women, 16 years and over—Con.											
May	3,468	167	625	58	20	181	93	427	1,451	433	13
June	3,325	152	623	54	18	182	84	402	1,366	428	16
July	1,837	24	197	25	8	147	44	193	1,007	176	16
August	2,515	24	253	50	14	93	60	251	1,247	608	15
September	3,411	172	442	59	21	135	56	414	1,555	557	....
October	3,886	171	715	61	20	175	67	447	1,673	557	....
November	4,117	177	801	61	24	261	80	451	1,681	565	16
December	4,072	177	782	56	24	223	79	445	1,709	561	16
Children, under 16 years—											
January	8,210	667	1,810	132	34	996	298	829	2,958	156	330
February	8,369	659	1,873	136	36	993	284	840	3,056	163	330
March	8,446	669	1,880	188	24	983	298	832	3,061	172	349
April	8,551	661	1,906	197	24	965	332	819	3,128	172	347
May	7,249	646	1,301	186	25	986	348	649	2,674	167	367
June	6,991	646	1,190	199	25	963	331	585	2,590	165	297
July	2,321	....	520	6	6	169	116	82	1,261	77	85
August	3,270	....	690	5	6	157	139	246	1,803	139	85
September	6,088	650	1,097	60	24	789	237	464	2,341	182	244
October	8,029	660	1,746	137	30	969	290	789	2,985	180	244
November	8,427	671	1,799	128	32	1,124	327	797	3,043	177	329
December	8,467	667	1,796	136	35	1,071	364	796	3,098	173	331
Miscellaneous expenses:											
Total	$2,222,776	$210,329	$341,500	$22,313	$13,483	$229,514	$130,936	$136,007	$1,000,711	$109,904	$28,079
Rent of works	$22,881	....	$780	....	....	$683	$7,745	$68	$8,005	$400	$5,200
Taxes, not including internal revenue	$131,369	$9,426	$27,163	$1,480	$2,915	$20,822	$7,312	$14,969	$38,849	$4,622	$3,811
Rent of offices, insurance, interest, and all sundry expenses not hitherto included	$2,020,692	$200,903	$309,557	$20,833	$10,568	$201,600	$103,487	$120,970	$933,174	$102,932	$16,668
Contract work	$47,834	....	$4,000	....	....	$6,409	$12,392	....	$20,683	$1,950	$2,400
Materials used:											
Aggregate cost	$12,051,925	$664,858	$3,262,466	$120,759	$130,095	$1,401,980	$778,842	$1,094,638	$3,738,422	$557,368	$302,497
Glass sand, tons	403,754	32,778	119,621	2,076	1,322	78,497	19,843	31,856	96,683	9,205	11,873
Cost	$547,943	$33,231	$139,056	$3,929	$6,265	$75,688	$42,344	$59,199	$157,462	$12,958	$17,811
Soda ash (carbonate of soda), tons	132,279	11,942	40,592	1,263	189	20,015	7,449	10,406	33,192	2,796	4,435
Cost	$1,921,405	$163,694	$579,638	$19,080	$5,217	$299,245	$112,153	$147,128	$471,130	$42,751	$81,369
Salt cake (sulphate of soda), tons	468	....	213	....	....	197	....	....	58	....	....
Cost	$5,755	....	$3,214	....	....	$1,778	....	....	$763	....	....
Nitrate of soda, tons	10,156	440	2,279	149	24	1,314	525	1,259	3,789	307	70
Cost	$311,675	$13,720	$73,368	$5,000	$830	$21,165	$18,118	$39,634	$126,058	$10,982	$2,800
Limestone, tons	30,741	4,815	9,082	118	....	8,227	1,545	1,374	3,399	325	1,856
Cost	$75,177	$9,912	$15,895	$319	....	$24,621	$5,206	$3,434	$8,730	$575	$6,486
Lime, hundredweights	669,649	45,387	218,088	14,725	659	126,001	32,819	72,488	127,790	11,228	20,564
Cost	$135,586	$10,175	$35,854	$1,233	$112	$24,500	$8,885	$14,230	$34,027	$2,820	$3,750
Arsenic, pounds	1,028,131	45,207	319,648	1,650	6,789	97,405	61,018	123,344	285,267	69,303	18,500
Cost	$49,563	$2,153	$14,981	$83	$330	$4,632	$2,876	$6,876	$13,372	$3,295	$965
Carbon, tons	182	90	36	....	....	20	4	....	14	12	6
Cost	$2,501	$1,018	$422	....	....	$406	$234	....	$201	$150	$78
Manganese, pounds	1,424,938	58,838	508,980	11,167	8,101	143,465	89,521	76,117	437,181	58,944	32,624
Cost	$55,177	$1,910	$18,920	$566	$207	$5,674	$3,737	$3,672	$16,831	$2,239	$1,421
Litharge (red lead), pounds	8,350,585	115,000	1,481,887	36,982	364,448	72,049	790,909	2,063,000	3,141,027	285,283	....
Cost	$487,927	$6,200	$76,155	$1,857	$24,497	$3,918	$46,114	$117,035	$191,568	$20,583	....
Potash or pearlash, pounds	4,335,828	....	443,481	76,000	207,967	60,270	414,438	850,171	1,932,699	351,802	....
Cost	$183,143	....	$18,054	$3,000	$8,994	$2,866	$17,552	$34,129	$81,991	$16,657	....
Grinding sand, tons	1,505	....	299	....	....	433	60	97	580	46	....
Cost	$5,735	....	$722	....	....	$519	$120	$480	$3,629	$265	....
Rouge, pounds	1,787	....	....	....	....	1,300	....	87	....	400	....
Cost	$299	....	....	....	....	$41	....	$174	....	$84	....
Plaster of Paris, tons	86	....	34	....	....	....	10	11	27	4	....
Cost	$1,097	....	$494	....	....	....	$71	$111	$364	$57	....
Fire clay or pot clay, pounds	8,640,317	662,000	1,342,070	141,300	26,158	1,912,005	744,450	946,000	2,560,394	134,940	271,000
Cost	$50,661	$4,960	$7,084	$717	$120	$11,727	$5,935	$2,306	$15,990	$1,437	$385
Pots, not including those made at works, number	5,111	284	947	164	110	301	143	863	2,095	184	20
Cost	$280,086	$16,930	$56,849	$7,286	$5,175	$11,217	$7,125	$52,861	$110,124	$11,199	$1,320
Fuel—											
Total cost	$2,084,124	$154,020	$159,924	$33,416	$30,287	$416,485	$184,417	$213,633	$711,295	$77,423	$104,224
Natural gas	$823,924	....	$157,963	....	....	....	$9,190	$99,404	$481,833	$75,534	....
Oil, gallons	11,967,202	1,663,301	135	148,396	371,867	4,964,767	1,293,521	1,250,637	938,873	18,650	1,317,055
Cost	$385,997	$41,084	$37	$6,234	$15,619	$155,267	$45,603	$31,874	$44,548	$585	$45,156
Coal, tons	486,852	113,475	520	12,316	3,416	92,520	48,190	48,816	139,116	1,271	26,213
Cost	$738,218	$94,232	$1,478	$22,089	$12,782	$194,467	$121,302	$78,138	$159,503	$1,304	$52,933
All other fuel	$135,985	$18,704	$446	$5,093	$1,886	$65,771	$8,322	$4,217	$25,411	....	$6,135
Rent of power and heat	$62	....	....	....	....	....	....	....	$62	....	....
Lumber, casks, barrels, boxes, and nails	$2,050,362	$103,089	$683,929	$12,239	$11,851	$182,510	$113,281	$178,424	$647,956	$100,424	$16,659
Cartons, wrapping paper, straw, and hay	$568,705	$22,571	$277,273	$2,326	$4,193	$21,665	$21,429	$48,523	$137,122	$32,513	$1,150
Caps, metal trimmings, and rubber supplies	$1,522,917	$31,073	$747,574	$10,494	$6,816	$79,359	$67,111	$61,212	$405,045	$101,983	$12,250
Supplies used in repairs on tanks or furnaces	$284,378	$35,559	$73,657	$2,107	$2,723	$44,439	$27,993	$11,508	$53,452	$16,140	$16,800
Mill supplies	$72,818	$1,076	$19,556	$2,486	$687	$3,467	$2,978	$7,604	$24,854	$8,680	$1,430
All other materials	$695,596	$30,672	$80,211	$8,444	$20,679	$104,547	$69,533	$38,751	$273,827	$63,626	$5,307
Freight	$659,233	$22,895	$179,636	$6,177	$1,112	$62,571	$21,631	$53,714	$252,569	$30,628	$28,300
Products:											
Aggregate value	$39,443,478	$2,810,398	$9,045,935	$454,633	$402,258	$4,819,811	$2,410,188	$3,875,661	$12,797,585	$1,770,553	$1,056,456
Pressed and blown glass—											
Total value	$17,076,125	$131,618	$2,691,787	$100,000	$382,091	$21,300	$1,17[illegible],784	$2,738,289	$8,463,550	$1,379,706	$4,000
Tableware, 100 pieces	655,141	....	126,162	....	....	....	....	150,992	364,770	13,217	....
Value	$2,617,784	....	$291,060	....	....	....	....	$668,469	$1,585,870	$72,385	....
Jellies, tumblers, and goblets, dozens	8,544,050	....	3,050,595	340,000	....	....	....	1,681,584	3,112,588	359,283	....
Value	$2,007,386	....	$630,485	$100,000	....	....	....	$392,612	$793,902	$90,387	....
Lamps, dozens	807,765	....	81,972	....	2,020	....	15,599	191,084	455,543	61,547	....
Value	$1,498,675	....	$43,116	....	$4,000	....	$7,447	$185,297	$983,452	$276,363	....
Chimneys, dozens	6,901,192	173,931	3,113,228	....	84,000	....	186,800	1,608,114	1,835,119	....	....
Value	$2,719,583	$131,618	$1,196,996	....	$33,000	....	$96,707	$622,721	$638,541	....	....
Lantern globes, dozens	1,044,816	....	547,971	....	2,000	....	162,038	142,800	58,276	131,732	....
Value	$497,021	....	$176,150	....	$1,800	....	$189,629	$69,589	$26,920	$32,933	....

[1] Includes establishments distributed as follows: California, 1; Colorado, 1; Georgia, 1; Michigan, 1; Missouri, 1; Virginia, 2; Wisconsin, 1.

TABLE 14.—PRESSED AND BLOWN GLASS AND BOTTLES AND JARS, BY STATES: 1900—Continued.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Products—Continued.											
Pressed and blown glass—Con.											
Shades, globes, and gas and electric goods, dozens	2,673,854	....	15,052	....	23,300	41,666	312,500	1,397,824	856,125	27,387	....
Value	$2,497,885	....	$19,044	....	$40,000	$6,500	$520,000	$398,420	$1,452,248	$61,673	....
Blown tumblers, stemware, and bar goods, dozens	6,127,367	....	112,163	....	....	....	....	214,072	3,512,552	2,288,580	....
Value	$1,598,652	....	$37,701	....	....	....	....	$53,368	$1,107,489	$400,094	....
Opal ware, dozens	3,750,443	....	244,873	....	3,000	....	1,000	96,597	2,925,545	479,428	....
Value	$1,581,731	....	$90,322	....	$4,000	....	$1,500	$51,656	$1,214,472	$219,781	....
Cut glass, dozens	134,726	....	325	....	3,332	....	....	2,900	56,800	71,369	....
Value	$672,463	....	$600	....	$146,613	....	....	$126,000	$311,189	$88,061	....
All other products for this group	$1,384,945	....	$206,313	....	$152,678	$14,800	$358,501	$170,157	$339,467	$139,029	$4,000
Bottles and jars—											
Total value	$21,676,791	$2,678,780	$6,327,468	$346,633	$20,167	$4,452,219	$1,195,276	$1,058,955	$4,162,990	$381,847	$1,052,456
Prescription vials, and druggists' ware, gross	2,423,932	265,918	624,128	20,000	....	731,107	81,803	76,409	551,236	4,004	69,327
Value	$4,665,697	$404,799	$1,184,397	$94,633	....	$1,306,316	$203,734	$155,377	$1,170,061	$8,889	$137,491
Beers, sodas, and minerals, gross	1,351,118	406,037	109,194	13,004	128	108,247	134,364	219,422	147,145	25,000	188,577
Value	$5,075,068	$1,332,842	$347,836	$120,212	$626	$408,661	$495,398	$637,428	$901,129	$92,000	$738,936
Liquors and flasks, gross	985,374	31,168	604,798	5,000	6,298	64,140	44,171	16,400	142,518	43,058	27,823
Value	$2,403,447	$131,869	$1,207,519	$20,000	$19,541	$153,165	$110,221	$57,350	$448,182	$169,852	$85,748
Milk jars, gross	146,142	7,500	19,561	....	....	19,798	6,938	6,000	80,485	4,600	1,260
Value	$729,008	$37,500	$55,344	....	....	$107,431	$33,863	$30,000	$434,310	$23,000	$7,560
Fruit jars, gross	789,298	1,500	559,549	....	....	61,871	31,235	2,000	115,000	14,643	3,500
Value	$2,935,036	$9,000	$2,106,250	....	....	$192,467	$128,965	$8,000	$436,104	$43,750	$10,500
Patent and proprietary, gross	1,296,131	302,708	244,343	500	....	601,276	57,224	20,000	55,080	....	15,000
Value	$2,602,976	$495,597	$378,301	$1,500	....	$1,399,042	$120,543	$35,800	$142,193	....	$30,000
Packers and preservers', gross	784,588	80,739	247,731	5,007	....	278,960	11,430	25,000	113,546	10,242	11,933
Value	$2,119,221	$195,691	$686,092	$15,021	....	$620,869	$33,706	$100,000	$419,947	$20,356	$27,539
Demijohns and carboys, dozens	83,243	29,136	....	....	....	18,689	10,929	....	17,815	....	6,674
Value	$206,061	$48,984	....	....	....	$86,645	$18,896	....	$36,854	....	$14,682
All other products for this group	$940,277	$22,498	$361,729	$95,267	....	$177,623	$49,950	$35,000	$174,210	$24,000	....
Value of all other products	$690,562	....	$26,680	$8,000	....	$346,292	$41,128	$78,417	$181,045	$9,000	....
Comparison of products:											
Number of establishments reporting for both years	193	5	43	5	3	20	18	16	68	10	5
Value for census year	$37,610,478	$2,810,398	$8,069,031	$454,633	$382,091	$4,723,436	$2,387,188	$3,660,133	$12,557,359	$1,628,027	$938,182
Value for preceding business year	$32,291,216	$2,278,679	$7,147,396	$430,845	$430,549	$4,324,575	$2.172,657	$2,948,234	$10,434,929	$1,371,352	$752,000
Equipment and characteristics of works:											
Pot furnaces—											
Operated, number	227	8	39	6	3	24	16	28	91	11	1
Pots, number	2,475	105	485	67	28	176	140	362	978	122	12
Idle, number	31	1	4	1	2	6	4	1	11	1	....
Pots, number	336	12	44	12	19	55	42	15	125	12	....
Tanks—											
Continuous—											
Operated, number	158	11	59	....	....	28	14	10	27	....	9
Rings, number	1,238	133	385	....	....	269	115	73	199	....	64
Pot capacity, number	2,476	266	770	....	....	538	230	146	398	....	128
Idle, number	14	....	4	....	....	6	....	....	1	....	3
Rings, number	79	....	12	....	....	40	....	....	8	....	19
Pot capacity, number	158	....	24	....	....	80	....	....	16	....	38
Intermittent or day—											
Operated, number	117	7	32	1	1	12	7	3	32	19	3
Tons capacity, number	694	40	193	6	90	72	49	13	123	85	23
Pot capacity, number	694	40	193	6	90	72	49	13	123	85	23
Idle, number	16	....	4	....	....	2	1	3	4	1	1
Tons capacity, number	76	....	12	....	....	7	3	12	35	5	2
Pot capacity, number	76	....	12	....	....	7	3	12	35	5	2
Shops, number	3,978	427	1,397	67	38	718	312	613	144	158	104
Glory holes, number	1,419	146	351	24	16	301	66	93	351	28	43
Annealing ovens, number	1,540	289	161	21	15	266	126	121	395	18	128
Lehrs, number	1,025	31	321	18	12	95	55	102	323	59	9
Decorating kilns, number	105	....	6	1	8	....	1	27	55	7	....
Decorating lehrs, number	23	....	1	....	....	....	....	4	15	3	....
Presses, hand, number	915	13	197	7	9	55	49	125	402	57	1
Presses, mechanical, number	49	....	4	....	....	....	....	....	42	3	....
Blowing machines, number	169	1	80	....	....	4	1	18	65	....	....
Finishing machines, number	140	2	33	....	....	1	2	59	42	1	....
Crimping machines, number	494	1	169	....	5	....	32	35	252	....	....
Mechanical polishers, number	16	....	....	....	1	1	1	1	12	....	....
Sand blast machines, number	68	1	8	....	3	1	9	10	27	9	....
Grinding machines for fruit jar tops, number	137	3	29	4	....	22	9	5	54	10	1
Clay grinding mills, number	8	....	1	....	....	1	....	2	4	....	....
Mechanical stokers, number	17	....	....	....	....	3	12	....	....	....	....
Horses and mules, number	317	23	7	8	7	92	44	15	87	5	29
Wagons, carts, and drays, number	314	24	20	11	8	104	44	6	74	5	18
Power:											
Number of establishments reporting	219	5	54	5	3	21	18	21	71	13	8
Total horsepower	14,990	675	2,645	207	187	1,666	972	1,527	5,440	952	719
Owned—											
Engines—											
Steam, number	311	13	60	7	4	65	25	30	79	16	12
Horsepower	12,630	675	2,103	197	100	1,591	862	1,176	4,440	767	719
Gas or gasoline, number	59	....	16	....	1	1	1	10	26	4	....
Horsepower	1,679	....	442	....	7	5	50	206	809	160	....
Water wheels, number	1	....	....	....	....	....	....	....	1	....	....
Horsepower	15	....	....	....	....	....	....	....	15	....	....
Electric motors, number	44	....	4	1	1	....	....	6	31	1	....
Horsepower	358	....	100	10	40	....	....	85	103	20	....
Other power, number	19	....	....	....	....	4	4	6	4	1	....
Horsepower	265	....	....	....	....	70	60	60	70	5	....
Rented—											
Electric, horsepower	43	....	....	....	40	....	....	....	3	....	....
Furnished to other establishments	10	....	....	....	....	....	10	....	....	....	....

[1] Includes establishments distributed as follows: California, 1; Colorado, 1; Georgia, 1; Michigan, 1; Missouri, 1; Virginia, 2; Wisconsin, 1.

TABLE 14.—PRESSED AND BLOWN GLASS AND BOTTLES AND JARS, BY STATES: 1900—Continued.

	United States.	Illinois.	Indiana.	Maryland.	Massachusetts.	New Jersey.	New York.	Ohio.	Pennsylvania.	West Virginia.	All other states.[1]
Establishments classified by number of persons employed, not including proprietors and firm members:											
Total number of establishments	231	5	59	5	4	22	20	21	73	14	8
Under 5	1	....	....	....	....	....	....	....	....	1	....
5 to 20	2	....	....	....	....	....	....	1	1	....	....
21 to 50	17	....	3	....	....	2	4	....	6	2	....
51 to 100	50	....	15	1	2	4	5	3	12	4	4
101 to 250	98	1	28	3	2	9	7	8	36	3	1
251 to 500	45	2	10	1	....	3	4	7	11	4	3
501 to 1,000	13	....	2	....	....	3	....	2	6	....	....
Over 1,000	5	2	1	....	....	1	....	....	1	....	....

[1] Includes establishments distributed as follows: California, 1; Colorado, 1; Georgia, 1; Michigan, 1; Missouri, 1; Virginia, 2; Wisconsin, 1.

O

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 229. WASHINGTON, D. C. July 3, 1902.

AGRICULTURE.

TEXAS.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Texas, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Texas, June 1, 1900, numbered 352,190, and were valued at $691,773,613. Of this amount, $100,222,811, or 14.5 per cent, represents the value of buildings, and $591,550,802, or 85.5 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $30,125,705, and of live stock, $240,576,955. These values, added to that of farms, give $962,476,273, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of all such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $239,823,244, of which amount $72,852,533, or 30.4 per cent, represents the value of animal products, and $166,970,711, or 69.6 per cent, the value of crops, including forest products cut or produced on farms. The "total value of farm products" for 1899 exceeds that for 1889 by $128,123,814, or 114.7 per cent, but a part of this gain is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting the value of the products fed to live stock on the farms of the producers from the total value of farm products. In 1899 the reported value of products fed was $30,476,810, leaving $209,346,434 as the gross farm income for that year. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Texas in 1899 it was 21.8 per cent.

As no reports for expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

Special reports as to the dimensions and cost of the leading irrigation ditches and canals, the area of land under them, methods for the artificial application of water to the growing crops, and other facts relating to irrigation were obtained by correspondence with farmers, engineers, and others. This correspondence was under the joint direction of Mr. F. H. Newell, chief hydrographer of the Geological Survey, acting as expert special agent for the division of agriculture, and Mr. Clarence J. Blanchard.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Texas.

Very respectfully,

L. G. Powers.
Chief Statistician for Agriculture.

AGRICULTURE IN TEXAS.

GENERAL STATISTICS.

Texas has a total land area of 262,290 square miles, or 167,865,600 acres, of which 125,807,017 acres, or 74.9 per cent, are included in farms.

The surface of Texas is greatly diversified. From the low, sandy Gulf coast rises a terrace of rich, rolling land, called the "prairie belt." Then comes a series of gradual elevations reaching to the plateau and mountains of the west and north, where some of the peaks attain an elevation of 5,000 feet.

There are a great many varieties of soil, nearly all excellently adapted to grazing. The prairies have in general a sandy loam, the interior, a heavier brown and black loam, while in the northern part of the state are great areas of red lands. In the waste portions are cacti and thorny mesquite chaparrals.

The Gulf of Mexico receives the drainage from the southern and central parts, while the Red and Arkansas rivers convey the waters of the northern part of the state to the Mississippi. In the south and east the rainfall is ample, but for the remainder of the state it is unreliable.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the per cent of farm land improved:

TABLE 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	352,190	125,807,017	19,576,076	106,230,941	357.2	15.6
1890	228,126	51,406,937	20,746,215	30,660,722	225.3	40.4
1880	174,184	36,292,219	12,650,314	23,641,905	208.4	34.9
1870	61,125	18,396,523	2,964,836	15,431,687	301.0	16.1
1860	42,891	25,344,028	2,650,781	22,693,247	590.9	10.5
1850	12,198	11,496,339	643,976	10,852,363	942.5	5.6

The number of farms reported in 1900 was nearly thirty times as great as the number in 1850, and 54.4 per cent greater than in 1890. The total acreage of farm land has increased rapidly, being twice as great in 1900 as in 1890. The improved acreage shows a decrease of 5.6 per cent for the last decade, owing to the use of a more strict definition of the term "improved land" in 1900 than in 1890. The decrease in the percentage of farm land improved is due also to the acquisition of vast areas of new unimproved land for grazing purposes, resulting in a marked increase in the average size of farms. The increased acreages in crops indicate that there has been no actual loss of improved area.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$962,476,273	$691,773,613	$30,125,705	$240,576,955	$239,823,244
1890	516,977,333	399,971,289	13,746,541	[3]103,259,503	111,699,430
1880	239,828,364	170,468,886	9,051,491	[3]60,307,987	65,204,329
1870[2]	100,971,937	60,149,950	3,396,793	37,425,194	[4]49,185,170
1860	137,186,219	88,101,320	6,259,452	42,825,447	....
1850	29,114,639	16,550,008	2,151,704	10,412,927	....

[1] For year preceding tbat designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Exclusive of live stock on ranges.
[4] Includes betterments and additions to live stock.

Every census year except the one following the Civil War shows a great growth in agriculture. The gain in the last decade in the total value of farm property was $445,498,940, or 86.2 per cent. The increase in the value of land, improvements, and buildings was $291,802,324, or 73.0 per cent; in that of live stock it was $137,317,452, or 133.0 per cent; and in that of implements and machinery, $16,379,164, or 119.2 per cent. The value of farm products in 1899 was more than twice as great as the value reported for 1889. A portion of this increase and of that shown for implements and machinery is doubtless the result of a more detailed enumeration in 1900 than in previous census years.

COUNTY STATISTICS.

Table 3 gives a statement of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	352,190	332,810	125,807,017	19,576,076	$591,550,802	$100,222,811	$30,125,705	$240,576,955	$209,346,434	$12,331,905	$124,716
Anderson	3,261	3,082	368,136	157,431	1,519,130	643,600	159,360	818,650	1,429,007	46,530	1,170
Andrews	12	12	921,626	70	600,600	4,800	4,220	981,304	181,275	17,840	....
Angelina	1,403	1,345	141,139	43,782	550,310	230,920	75,760	889,081	485,459	12,200	280
Aransas	47	44	12,899	5,636	305,410	14,500	2,690	52,606	16,554	1,210	70
Archer[1]	356	346	658,483	155,402	2,415,550	165,200	75,990	1,447,733	189,997	40,010	730
Armstrong[1]	172	169	1,060,291	22,486	1,959,790	91,380	26,070	1,477,658	332,268	34,480	....
Atascosa[1]	895	864	791,749	51,605	2,021,630	241,700	69,850	1,298,830	559,327	42,630	1,720
Austin	3,064	2,845	326,423	133,077	4,790,220	1,300,110	291,810	1,151,560	1,819,042	58,960	500
Bailey	5	4	306,666	275	252,700	16,300	700	378,210	22,685	6,120	....
Bandera	712	671	371,847	27,842	967,380	169,000	55,400	626,432	238,110	17,670	400
Bastrop	3,509	3,292	389,154	168,004	3,770,550	807,700	190,330	954,434	2,170,871	52,270	290
Baylor	327	313	608,495	47,032	1,605,120	126,740	47,090	971,711	269,813	16,820	....
Bee[1]	628	575	566,892	52,776	2,342,650	269,770	59,250	1,091,015	373,928	35,800	350
Bell	5,059	4,712	563,120	323,864	9,673,440	1,717,180	542,270	1,976,509	3,591,575	153,480	2,270
Bexar	2,342	2,315	649,850	122,629	6,767,360	1,023,720	296,760	1,290,611	1,211,544	125,010	1,650
Blanco	702	694	441,470	31,452	1,387,940	286,110	72,170	797,550	367,966	13,780	50
Borden[1]	129	126	1,150,134	3,542	1,480,360	71,800	18,460	1,062,614	271,288	30,920	....
Bosque	2,268	2,150	677,407	164,806	4,709,182	783,498	288,150	1,500,884	1,357,440	69,890	1,830
Bowie	3,369	3,246	277,625	118,143	1,206,580	468,040	144,670	669,588	1,202,036	18,160	4,210
Brazoria	1,721	1,549	277,160	73,558	2,749,710	620,320	250,400	782,985	637,008	78,870	1,210
Brazos	2,613	2,451	255,101	134,546	2,182,490	513,690	156,000	714,602	1,133,661	90,460	4,610
Brewster	77	59	1,644,855	743	1,364,990	68,810	12,640	1,803,485	268,629	35,170	....
Briscoe	170	165	260,014	9,434	275,880	41,610	17,960	445,709	82,039	4,570	....
Brown	2,044	1,950	489,695	113,860	2,758,580	507,440	203,850	1,073,078	1,040,040	27,690	550
Burleson	2,423	2,339	310,432	123,961	3,059,990	531,620	191,060	696,809	1,247,804	88,020	430
Burnet	1,416	1,323	512,885	75,030	3,175,310	502,800	168,980	1,080,070	748,828	21,180	1,290
Caldwell	2,594	2,412	288,411	130,129	4,253,090	754,440	218,310	782,620	1,957,323	164,030	870
Calhoun	226	217	260,425	9,364	1,207,660	95,190	18,580	593,463	166,363	8,060	....
Callahan	1,176	1,113	529,552	66,165	2,292,556	379,050	131,810	1,141,878	762,541	25,930	380
Cameron[1]	600	493	1,459,070	20,497	6,608,550	166,690	40,270	2,972,023	617,337	87,450	....
Camp	1,339	1,256	93,081	57,065	509,420	190,280	55,200	199,833	535,516	38,080	840
Carson	57	56	362,196	4,663	493,000	24,080	7,970	430,798	36,473	8,870	....
Cass	3,271	3,131	368,279	164,728	1,187,290	573,260	131,870	677,066	1,162,697	52,890	2,880
Castro	76	72	191,362	12,131	261,090	37,520	7,680	312,645	48,963	5,200	....
Chambers	327	317	366,436	11,681	790,410	140,240	24,500	1,274,713	434,590	22,080	670
Cherokee	3,683	3,460	340,814	148,970	1,644,550	673,021	142,890	756,104	1,364,544	45,870	1,660
Childress[1]	262	256	486,983	27,544	944,470	95,610	29,700	942,365	177,641	21,400	250
Clay	1,223	1,153	637,201	191,671	4,462,460	613,160	204,340	2,414,593	1,111,636	89,140	250
Cochran	1	1	1,900	....	5,600	300	50	21,050	117,034	100	....
Coke[1]	480	471	605,842	21,274	1,428,150	141,030	67,750	962,933	415,562	25,540	70
Coleman	1,369	1,282	807,872	89,031	3,577,714	444,480	151,610	1,798,014	821,102	84,650	....
Collin	6,651	6,300	609,419	377,594	14,994,460	2,386,660	831,030	2,593,802	5,468,012	311,730	1,990
Collingsworth[1]	218	213	684,692	21,494	995,660	54,600	27,020	1,035,682	171,822	19,920	....
Colorado	2,992	2,861	473,241	183,555	5,079,950	974,470	254,260	1,128,990	1,803,664	116,750	....
Comal	747	719	317,099	41,992	2,330,960	588,340	134,810	600,281	593,477	43,450	....
Comanche	3,548	3,212	622,273	167,423	3,600,400	726,000	278,660	1,285,073	1,567,165	35,170	....
Concho[1]	119	102	646,088	6,184	1,435,950	98,030	82,140	1,063,944	160,619	5,270	....
Cooke	3,307	3,199	470,818	225,179	6,656,620	1,137,810	420,240	1,964,823	2,276,939	121,740	310
Coryell	3,102	2,930	560,280	206,655	4,878,840	895,220	330,970	1,331,301	1,504,631	50,810	....
Cottle	122	119	435,661	7,758	926,690	47,890	14,970	931,231	222,590	18,590	....
Crane[1]	12	9	758,980	....	565,552	2,010	2,530	354,740	199,739	1,470	....
Crockett	85	67	1,706,005	110	1,953,480	48,800	23,980	2,370,685	372,496	69,020	....
Crosby	116	109	351,256	6,985	661,300	47,870	11,795	677,990	122,894	10,900	....
Dallam	4	4	26,090	1,280	59,500	3,600	1,620	368,890	651,274	37,920	....
Dallas[1]	4,909	4,699	455,529	294,382	11,698,912	2,229,300	632,730	2,533,393	3,985,392	284,520	2,900
Dawson[1]	6	3	825,772	35	412,980	3,800	2,220	678,197	90,321	9,340	....
Deaf Smith	97	93	317,961	11,041	511,450	110,650	17,120	548,682	86,250	12,630	....
Delta	2,354	2,220	145,151	106,213	2,293,490	591,520	163,310	670,567	1,236,128	51,350	740
Denton	3,699	3,491	528,468	286,189	8,997,450	1,470,220	553,930	1,978,767	2,680,983	168,420	300
Dewitt	2,187	2,063	532,515	126,956	6,804,660	776,620	164,680	1,558,118	1,561,853	108,260	180
Dickens[1]	197	188	732,972	40,842	1,301,180	46,290	18,720	1,485,109	273,322	32,860	....
Dimmit[1]	105	100	904,496	3,081	1,601,350	70,130	18,010	1,399,863	148,922	36,460	....
Donley	188	184	358,074	14,504	533,900	103,060	27,380	987,156	286,462	36,430	....
Duval	363	329	728,911	15,090	1,186,860	78,480	22,430	583,314	234,319	18,130	140
Eastland	2,510	2,414	408,291	113,768	2,893,560	449,240	165,610	884,168	1,010,635	38,230	....
Ector[1]	25	23	767,321	92	514,080	16,830	18,110	595,876	69,681	10,020	....
Edwards	349	302	994,590	5,104	1,251,150	97,080	35,120	1,499,790	576,718	50,700	200
Ellis	5,963	5,558	521,644	394,968	13,279,370	2,237,810	687,500	2,306,485	5,216,610	353,600	318
El Paso	318	305	945,105	6,280	1,297,520	77,790	31,500	1,442,049	148,344	16,780	10
Erath	3,783	3,657	693,352	199,563	4,125,670	926,120	302,770	1,592,069	1,819,958	42,770	780
Falls	4,523	4,334	383,320	260,780	6,941,790	1,182,810	366,390	1,448,075	3,127,357	240,760	....
Fannin	7,202	6,777	449,399	346,288	9,574,060	1,970,960	692,210	2,162,029	4,434,277	222,400	....
Fayette	5,189	5,092	635,848	221,173	8,548,580	1,957,620	488,610	1,636,150	3,516,887	117,530	1,830
Fisher	519	506	623,272	299,801	1,344,160	190,870	71,350	799,162	298,482	18,490	....
Floyd	286	282	651,483	18,607	914,990	61,920	30,330	1,337,193	124,049	32,030	....
Foard[1]	210	208	497,754	23,959	892,920	72,040	80,870	898,763	358,485	21,390	....
Fort Bend	2,365	2,262	432,087	189,909	5,218,690	690,410	543,740	1,153,703	989,663	269,480	260
Franklin	1,622	1,377	118,528	59,841	724,820	288,290	81,630	334,990	547,662	15,570	124
Freestone	3,302	3,126	323,851	159,174	2,032,710	655,250	164,830	808,462	1,386,980	49,040	175
Frio[1]	394	385	836,733	33,105	1,934,960	201,140	43,960	1,103,246	405,196	48,780	....

[1] Includes some large live-stock ranches with portions of area in other counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Gaines	6	6	338,300	55	$297,050	$2,250	$1,090	$329,323	$52,776	$4,440	....
Galveston	832	805	85,021	18,091	1,801,840	439,570	69,570	492,564	576,094	33,250	$7,590
Garza	38	36	505,118	545	509,990	13,850	3,890	621,272	155,004	16,630	....
Gillespie	1,153	1,142	638,962	56,930	2,453,850	505,050	154,220	928,360	674,352	23,300	20
Glasscock	49	48	481,910	1,100	542,940	21,670	14,850	629,006	182,457	10,350	....
Goliad[1]	981	954	585,855	55,999	4,102,910	399,260	82,400	1,535,401	736,987	60,310	....
Gonzales	3,816	3,590	596,546	193,954	5,892,480	969,750	254,080	1,486,709	2,231,374	122,450	....
Gray	88	87	445,890	8,782	646,650	29,350	17,000	564,984	84,561	16,070	....
Grayson	5,762	5,432	526,240	362,918	11,636,210	2,096,080	732,920	2,226,397	4,175,075	284,080	870
Gregg	1,168	1,145	112,894	63,953	501,370	228,960	68,120	242,556	438,057	13,560	450
Grimes	3,835	3,708	355,150	169,060	2,777,480	869,660	202,940	921,455	1,644,110	65,430	510
Guadalupe	2,880	2,698	374,660	169,676	6,824,160	1,287,280	283,080	939,564	1,929,060	138,730	860
Hale	259	244	469,893	20,313	634,690	112,190	28,370	712,496	218,047	24,180	....
Hall[1]	219	212	718,876	25,360	1,441,690	89,620	21,510	1,831,318	378,793	29,930	....
Hamilton	1,872	1,733	517,864	132,826	3,533,940	538,500	209,750	1,134,351	958,366	36,700	....
Hansford	22	22	174,892	2,266	226,740	27,140	7,120	352,487	58,613	13,190	....
Hardeman[1]	262	249	375,380	43,764	964,540	130,080	47,380	747,774	202,882	26,310	....
Hardin	296	288	37,731	6,281	104,410	84,670	15,030	133,454	70,319	1,690	....
Harris	1,987	1,967	391,946	70,355	3,965,940	963,320	182,500	1,409,776	1,000,799	71,470	6,600
Harrison	4,088	3,953	348,926	175,020	1,424,280	598,530	178,310	734,971	1,520,427	46,220	1,800
Hartley	27	25	3,246,335	2,641	6,394,880	97,560	13,350	3,260,747	416,463	54,790	....
Haskell	256	250	353,859	25,552	1,134,760	103,990	32,380	494,360	189,396	3,070	....
Hays	1,556	1,458	389,325	87,241	3,316,420	643,670	165,570	904,523	1,346,963	100,270	....
Hemphill	76	72	503,437	11,994	1,036,080	42,700	17,070	899,689	293,896	22,300	....
Henderson	3,325	3,072	286,015	129,422	1,546,150	662,080	185,560	844,466	1,474,149	28,610	2,100
Hidalgo	490	465	1,187,419	23,125	1,796,800	88,630	30,340	824,794	155,332	30,530	....
Hill	5,190	4,900	531,507	365,155	9,662,850	1,879,130	629,150	2,159,487	3,852,077	225,630	360
Hockley	5	5	353,855	360	660,160	27,800	12,400	330,447	19,839	27,500	....
Hood	1,477	1,319	231,205	115,113	1,622,130	326,420	101,920	689,364	665,644	12,380	....
Hopkins	4,578	4,173	387,795	213,041	2,843,330	924,910	283,950	1,194,348	1,873,018	52,490	1,880
Houston	4,181	3,743	425,167	174,444	2,080,760	680,360	228,790	853,645	1,768,281	89,980	3,410
Howard[1]	130	128	773,207	6,835	942,730	68,280	15,860	974,053	124,093	14,460	....
Hunt	5,946	5,610	469,926	306,701	8,396,380	1,865,670	614,160	2,017,846	3,802,380	199,930	2,879
Hutchinson	63	56	325,238	1,805	383,090	10,710	3,690	724,681	140,614	11,430	....
Irion[1]	52	48	927,046	1,226	1,085,490	32,840	20,540	1,202,590	507,619	35,380	....
Jack	1,475	1,412	533,390	83,691	2,315,190	335,250	110,430	1,344,984	725,911	22,220	....
Jackson	809	794	487,794	64,999	2,460,000	306,930	61,220	1,366,729	390,059	29,180	....
Jasper	849	838	113,998	20,511	328,520	163,060	34,080	281,118	258,017	6,280	3,750
Jeff Davis[1]	48	48	1,552,421	1,168	643,830	60,810	17,400	1,631,540	223,456	42,060	....
Jefferson	360	321	199,842	16,122	1,049,860	159,230	62,530	507,867	337,229	47,540	360
Johnson	3,876	3,699	431,918	248,968	6,907,850	1,319,140	458,640	1,661,326	2,433,887	123,460	950
Jones[1]	820	793	667,366	77,970	2,499,200	316,615	109,780	1,154,978	574,094	31,110	....
Karnes	1,047	981	454,754	70,994	3,324,480	326,190	99,340	874,377	779,441	44,050	....
Kaufman	3,773	3,562	384,779	245,395	6,098,240	1,224,180	317,600	1,532,373	2,788,291	195,810	710
Kendall	542	527	339,653	22,300	1,303,260	302,980	76,130	428,063	278,306	21,540	120
Kent[1]	134	110	524,057	5,750	650,500	46,770	10,810	611,954	124,912	29,530	....
Kerr[1]	506	503	881,886	24,887	2,048,430	212,510	79,260	1,274,922	390,998	31,380	....
Kimble	271	264	719,615	13,931	1,047,070	105,140	30,090	752,651	186,278	8,560	....
King	53	51	480,232	1,609	755,670	27,990	4,760	855,044	146,456	8,540	....
Kinney	83	77	579,274	1,543	736,460	40,150	12,610	636,329	192,470	29,640	....
Knox	366	352	449,229	45,706	907,700	89,000	45,760	624,804	206,497	12,550	....
Lamar	6,514	6,041	427,781	300,036	7,124,050	1,589,200	425,690	1,718,583	3,390,162	165,140	1,690
Lamb	5	5	158,520	370	207,090	21,510	1,290	242,262	3,779	4,550	....
Lampasas[1]	996	956	529,519	62,188	2,016,750	339,940	115,130	1,273,344	625,015	33,980	....
Lasalle[1]	107	101	1,121,228	4,039	2,086,920	124,370	14,980	1,228,543	167,374	34,930	....
Lavaca	3,876	3,722	519,630	177,377	6,840,010	1,162,090	279,070	1,417,945	2,376,563	68,740	....
Lee	2,266	2,164	300,900	94,695	2,305,450	548,380	152,980	687,084	1,372,527	39,760	....
Leon	2,874	2,729	304,330	112,273	1,369,100	458,770	111,850	735,573	1,200,649	35,520	....
Liberty	1,001	887	197,837	45,489	1,074,090	238,030	60,420	613,054	393,064	14,810	....
Limestone	4,665	4,472	434,448	273,432	6,045,150	1,209,560	374,760	1,577,419	2,811,813	185,620	....
Lipscomb	117	112	471,918	11,213	565,080	61,590	24,820	869,188	212,482	22,750	....
Live Oak	278	273	637,880	18,521	1,676,490	163,340	27,180	971,072	245,081	22,430	....
Llano	854	843	513,396	37,309	1,815,050	268,040	85,320	1,076,626	521,659	9,140	....
Loring[1]	6	6	727,108	....	400,410	16,550	7,550	568,406	87,567	12,700	....
Lubbock	46	44	446,680	3,768	415,400	41,810	12,520	739,138	102,122	23,160	....
Lynn	5	5	259,371	246	183,680	5,850	1,850	186,453	194,935	19,050	....
McCulloch	531	509	661,324	27,411	2,171,390	151,560	56,000	1,108,980	353,528	20,680	....
McLennan	5,240	5,055	571,345	385,672	12,152,210	2,149,450	596,710	2,103,816	3,892,461	218,030	1,000
McMullen	91	88	504,378	2,859	880,270	49,870	8,970	458,696	54,612	7,910	....
Madison	1,742	1,686	191,771	70,790	877,700	333,010	81,880	529,673	779,820	22,180	....
Marion	1,260	1,228	116,093	49,775	265,790	127,920	40,460	191,185	295,442	7,190	660
Martin	33	29	591,948	203	554,420	13,100	3,125	811,342	145,961	10,465	....
Mason[1]	773	755	647,469	31,437	1,948,850	342,010	69,610	1,239,175	587,161	18,100	....
Matagorda	448	443	349,072	44,145	2,316,060	221,700	55,290	947,530	415,026	53,610	....
Maverick[1]	26	25	955,313	7,099	1,692,700	26,600	7,220	1,099,888	38,179	29,290	....
Medina	903	880	748,137	81,366	2,338,690	382,320	101,940	894,374	461,842	29,870	....
Menard[1]	204	199	672,965	7,597	1,461,460	99,090	30,700	1,214,266	301,721	44,470	....
Midland[1]	73	70	898,047	897	692,220	74,760	9,365	1,199,422	214,822	23,690	....
Milam	5,337	4,995	490,726	291,362	7,031,970	1,244,080	374,230	1,620,963	3,285,195	169,970	200
Mills	1,059	1,017	336,180	61,650	1,346,730	235,540	100,270	716,037	550,886	9,110	....

[1] Includes some large live-stock ranches with portions of area in other counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES—Continued.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
Mitchell[1]	232	225	946,607	17,334	$1,879,870	$104,340	$23,630	$1,283,983	$328,352	$23,340	...
Montague	3,571	3,292	520,329	210,634	3,913,440	784,940	286,800	1,615,188	1,676,767	61,720	...
Montgomery	2,097	2,040	173,243	71,089	1,035,940	357,670	104,500	463,458	845,767	30,970	$1,530
Moore	57	52	115,494	1,708	165,450	20,370	5,120	231,279	25,476	2,450	...
Morris	1,126	1,079	102,903	49,560	506,100	213,850	53,700	256,431	469,734	7,360	...
Motley[1]	209	209	924,565	8,432	1,435,040	87,500	17,610	1,454,603	259,070	27,330	...
Nacogdoches	3,678	3,416	344,707	140,247	1,642,210	645,890	159,080	788,853	1,392,138	30,180	730
Navarro	5,106	4,814	496,675	301,290	8,004,790	1,402,970	466,680	2,082,765	3,463,160	153,280	880
Newton	921	908	109,182	22,397	274,000	70,710	14,480	265,982	258,620	6,660	1,620
Nolan	293	277	390,372	179,640	890,480	110,920	22,250	626,504	144,360	10,580	...
Nueces[1]	339	335	1,611,053	21,750	4,733,780	318,560	52,310	2,360,490	433,838	53,440	...
Ochiltree	71	67	156,599	2,602	270,580	37,740	9,370	260,055	35,774	7,940	...
Oldham	23	23	578,246	11,519	849,040	27,480	2,030	772,383	94,756	20,640	...
Orange	327	302	78,128	14,530	440,630	108,440	29,560	217,898	166,349	17,160	780
Palo Pinto	1,271	1,184	461,755	168,792	2,100,820	335,320	118,000	1,014,893	559,745	18,440	...
Panola	3,413	3,190	337,713	140,931	1,151,360	547,390	126,150	541,682	1,123,366	32,250	2,010
Parker	3,529	3,208	512,809	193,912	4,027,910	869,350	323,560	1,537,967	1,736,044	63,570	...
Parmer	1	1	450,000	350	894,000	6,000	500	402,887	44,020	4,200	...
Pecos	95	82	2,158,547	5,346	1,447,610	60,570	26,280	1,794,597	341,992	92,680	...
Polk	1,769	1,658	174,461	49,924	652,820	230,650	70,490	418,746	667,763	13,480	280
Potter[1]	79	76	684,304	7,414	1,054,220	76,500	18,170	968,232	143,910	21,350	...
Presidio	83	67	711,715	2,497	755,170	42,100	12,920	743,857	144,936	17,420	...
Rains	1,037	1,001	92,638	44,030	633,710	161,890	61,520	332,650	434,892	10,250	600
Randall[1]	96	92	577,396	8,278	771,710	108,460	19,260	762,873	84,280	10,100	...
Red River	5,003	4,453	252,910	148,132	2,580,190	529,140	179,360	1,146,888	2,086,425	27,740	1,290
Reeves	63	50	596,268	8,017	1,089,640	51,570	11,230	964,463	238,669	31,210	...
Refugio	139	130	479,123	35,870	2,326,590	78,360	10,930	1,045,350	274,925	16,070	...
Roberts	59	57	401,372	3,676	460,660	30,580	9,370	741,323	41,816	12,250	...
Robertson	4,094	3,958	339,470	202,367	3,460,280	882,270	276,690	1,035,710	1,971,784	204,080	560
Rockwall	1,090	1,036	80,411	64,281	2,235,670	369,450	116,300	400,638	863,142	65,360	550
Runnels[1]	669	652	840,730	47,695	2,495,330	256,070	75,880	1,426,199	516,928	20,000	...
Rusk	4,338	3,994	393,749	181,590	1,641,250	632,780	174,110	904,084	1,576,508	32,590	4,520
Sabine	1,065	997	111,110	37,015	389,600	157,030	33,010	205,092	292,755	8,390	990
San Augustine	1,406	1,330	135,465	51,019	514,760	180,270	42,900	261,348	367,339	57,980	100
San Jacinto	1,471	1,393	120,702	46,916	625,190	182,020	56,470	362,953	558,572	15,470	340
San Patricio	190	154	402,004	12,110	1,304,990	85,870	20,780	598,783	226,707	24,140	...
San Saba	1,021	962	568,815	47,042	2,111,590	321,710	103,930	1,353,742	569,451	20,460	...
Schleicher	60	60	730,179	1,177	895,000	62,520	18,180	1,109,771	136,154	25,580	...
Scurry[1]	586	572	702,776	38,144	1,253,330	140,320	64,300	1,030,826	334,379	16,970	...
Shackelford[1]	251	243	677,520	34,710	2,326,560	175,030	46,290	1,579,310	473,054	1,640	...
Shelby	3,218	3,004	291,668	113,096	1,132,980	539,200	120,390	607,583	1,091,773	19,060	780
Sherman	18	17	195,315	2,880	303,940	40,160	9,020	710,520	214,213	22,540	...
Smith	4,993	4,709	379,740	221,102	2,340,330	920,640	226,560	924,618	2,102,765	61,330	4,810
Somervell	491	448	74,940	27,303	415,080	72,490	36,160	185,755	169,375	2,660	...
Starr	382	320	1,005,065	11,266	1,378,570	111,700	14,860	682,749	218,368	29,040	...
Stephens	1,049	981	517,645	58,135	1,661,510	216,500	101,360	1,041,168	462,292	22,670	...
Sterling	86	85	425,655	3,429	1,004,650	67,400	26,330	657,410	166,898	9,550	...
Stonewall	381	344	468,448	19,035	680,390	61,020	24,250	710,906	191,748	7,120	...
Sutton	93	92	928,178	1,367	1,121,830	51,710	17,660	1,266,889	280,070	41,290	...
Swisher	186	183	447,922	16,210	725,680	80,250	24,010	692,855	191,193	12,910	...
Tarrant	3,556	3,348	513,502	242,952	8,760,350	1,445,540	465,530	1,978,399	2,480,846	160,720	1,800
Taylor	1,152	1,048	516,777	79,699	2,280,220	296,380	119,790	890,349	522,842	16,380	...
Terry	6	3	287,840	115	322,540	1,300	1,300	260,571	30,533	7,600	...
Throckmorton[1]	272	257	634,660	30,514	2,116,050	103,010	36,350	1,046,104	289,177	27,610	...
Titus	2,099	1,899	151,881	78,935	899,480	278,310	86,250	427,775	780,525	11,620	530
Tom Green	243	232	1,146,491	20,862	2,330,390	148,380	45,150	1,689,680	277,897	42,350	...
Travis	3,554	3,443	467,950	203,715	8,985,150	1,570,070	422,060	1,560,964	3,194,455	353,640	2,200
Trinity	1,271	1,221	104,190	41,221	379,570	187,760	52,880	410,623	487,463	14,810	540
Tyler	1,199	1,147	322,969	33,671	408,620	177,010	43,460	270,111	408,322	11,220	5,510
Upshur	2,711	2,457	241,312	108,107	929,710	362,780	121,430	499,910	983,351	16,390	200
Upton[1]	18	16	902,592	85	936,970	7,880	8,260	678,436	76,637	24,220	...
Uvalde	275	263	940,462	13,851	2,045,860	161,900	29,680	1,178,841	266,412	27,880	...
Valverde	152	141	1,798,132	3,316	1,917,310	91,950	20,830	1,029,254	266,570	116,210	...
Van Zandt	4,208	3,951	376,600	194,514	2,634,990	827,180	247,220	1,072,686	1,895,559	70,360	5,520
Victoria[1]	1,204	1,129	603,258	126,720	5,363,710	583,800	97,180	1,797,861	978,183	64,130	...
Walker	1,703	1,663	189,521	72,943	863,810	305,040	90,720	449,026	711,746	25,280	510
Waller	2,000	1,951	186,258	81,531	1,822,700	389,930	104,630	529,158	592,393	30,470	810
Ward	167	147	423,966	5,491	477,450	23,040	8,730	281,368	167,791	8,470	40
Washington	4,359	4,097	338,251	200,382	7,064,220	1,603,950	429,780	1,262,352	2,837,737	121,160	1,460
Webb	408	342	1,238,262	21,072	1,575,990	111,600	34,370	1,002,290	320,371	38,670	...
Wharton	2,049	2,000	438,117	116,400	4,388,550	610,030	155,870	1,008,365	1,160,595	88,970	740
Wheeler	119	103	470,280	11,889	706,630	35,870	13,910	723,580	247,961	16,730	...
Wichita[1]	423	399	580,017	106,152	2,630,550	240,150	131,050	1,609,936	649,519	36,950	...
Wilbarger	636	608	401,725	116,221	1,998,160	247,130	118,730	933,266	563,046	35,880	...
Williamson	4,403	4,140	652,907	299,387	11,835,303	2,406,777	586,330	2,252,454	4,581,689	371,550	750
Wilson[1]	1,785	1,733	521,466	102,819	2,634,800	505,530	115,120	845,591	786,232	41,080	...
Winkler	12	11	67,537	...	157,890	3,280	1,240	230,174	40,383	2,350	...
Wise	4,029	3,770	524,451	243,999	4,741,040	1,013,190	323,740	1,626,751	1,831,373	57,650	...
Wood	3,094	2,940	275,187	120,515	1,472,800	560,460	143,240	637,301	1,280,543	40,300	1,730
Yoakum	1	1	140,160	10	9,780	300	500	154,507	82,730	3,360	...
Young	899	853	495,150	65,289	1,840,913	226,240	92,820	1,050,923	473,700	21,380	...
Zapata	204	119	201,240	2,452	329,220	26,140	7,160	274,326	26,603	7,480	...
Zavalla	102	100	431,672	2,338	748,910	54,790	10,170	497,979	153,538	4,180	...

[1] Includes some large live-stock ranches with portions of area in other counties.

In the majority of counties the number of farms increased in the last decade. The few counties reporting decreases are situated in the western part of the state. The total area of farm land decreased in but eleven counties, while most of the remaining counties report remarkable increases. The decrease in improved acreage shown in a large number of the counties is due to a more intensive cultivation of smaller farm areas and to the use of a more strict definition of the term "improved land" by the Twelfth than by any preceding census. The average size of farms for the state is 357.2 acres, and varies from 50.6 acres in Red River county to 450,000 acres in Parmer county. The large average areas of farms are, as a rule, in the western part of the state, in the counties containing large live-stock ranches.

For the state, the average value of farms, (including land, improvements, and buildings) was $1,964. Between 1890 and 1900 the value of farms decreased in but ten counties. With the exception of Atascosa, Calhoun, Hardeman, and Wilbarger, the value of implements and machinery increased in all counties, while Freestone and Limestone counties showed a decrease in the value of live stock.

The average expenditure for labor per farm in 1899 varied greatly. By far the highest expenditures were shown in the western counties, where there were numerous live-stock ranches, and the smallest amounts were paid in the eastern counties, containing large numbers of small cotton, dairy, and vegetable farms.

FARM TENURE.

Table 4 gives a comparative exhibit of farm tenure for 1880, 1890, and 1900. Tenants are divided into two groups: "Cash tenants," who pay a rental in cash or a stated share of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, the farms operated by owners being subdivided into 4 groups, designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	352,190	177,199	25,810	149,181	50.3	7.3	42.4
1890	228,126	132,616	20,081	75,429	58.1	8.8	33 1
1880	174,184	108,716	12,089	53,379	62.4	6.9	30.7

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	352,190	151,954	21,005	1,680	2,560	25,810	149,181
White	286,654	134,829	18,107	1,564	2,469	17,370	112,315
Colored	65,536	17,125	2,898	116	91	8,440	36,866
Chinese	13					9	4
Indian	51	42	3			1	5
Negro	65,472	17,083	2,895	116	91	8,430	36,857

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	43.1	6.0	0.5	0.7	7.3	42.4
White	100.0	47.0	6.3	0.5	0.9	6.1	39.2
Colored	100.0	26.1	4.4	0.2	0.1	12.9	56.3

In the period from 1880 to 1900 the total number of farms increased 102.2 per cent, and in the last decade 54.4 per cent. Since 1890 the number of farms operated by owners has increased 33.6 per cent; by cash tenants, 28.5 per cent; and by share tenants, 97.8 per cent. The percentages in Table 4 indicate that the number of farms operated by owners has not increased at so fast a rate since 1890 as the number of tenant-operated farms. Share tenants constituted 79.0 per cent of all tenants in 1890, and 85.3 per cent in 1900, the large percentage being due to the fact that the greatest number of cotton and hay and grain farms are reported as being operated by share tenants.

In 1900, 81.4 per cent of the farms of the state were operated by white farmers and 18.6 per cent by colored farmers. Of the white farmers, 53.9 per cent own all or a part of the farms they operate, and 46.1 per cent operate farms owned by others. The corresponding percentages for colored farmers are 30.7 and 69.3.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS. Average.	Total.	Per cent.	VALUE OF FARM PROPERTY. Total.	Per cent.
The State	352,190	357.2	125,807,017	100.0	$962,476,273	100.0
White farmers	286,654	425.5	121,965,376	96.9	906,237,063	94.2
Negro farmers	65,472	58.6	3,835,979	3.1	56,180,207	5.8
Indian farmers	51	95.2	4,854	(1)	37,201	(1)
Chinese farmers	13	62.2	808	(1)	21,802	(1)
Owners	151,954	253.5	38,520,509	30.6	420,269,976	43.7
Part owners	21,005	1,244.6	26,143,033	20.8	129,742,464	13.5
Owners and tenants	1,680	327.7	550,519	0.4	5,159,859	0.5
Managers	2,560	16,402.9	41,991,308	33.4	149,302,594	16.5
Cash tenants	25,810	291.2	7,516,154	6.0	54,792,498	5.7
Share tenants	149,181	74.3	11,085,494	8.8	203,208,882	21.1

[1] Less than one-tenth of 1 per cent.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$1,680	$285	$85	$683	$594	21.8
White farmers	1,933	325	97	806	655	20.7
Negro farmers	571	109	33	144	329	38.3
Indian farmers	445	85	20	179	215	29.5
Chinese farmers	1,222	172	77	207	592	35.3
Owners	1,655	392	105	614	591	21.4
Part owners	3,515	430	132	2,100	1,038	16.8
Owners and tenants	1,854	400	114	703	656	21.4
Managers	34,324	1,229	503	22,265	7,386	12.7
Cash tenants	1,343	192	63	525	484	22.8
Share tenants	943	153	65	211	437	32.1

In all classes of farm property and in gross income white farmers show by far the highest values, with Chinese farmers ranking second. Negro farmers show the greatest per cent of average gross income on total investment, with Chinese ranking second, for these two classes have comparatively little invested. Colored farmers operate about one-fifth of the farms of the state, their farms constituting but 3.1 per cent of the total acreage and only 5.8 per cent of the total value of farm property.

Managers control the largest farms and more of the total area than any other class. The average values of all forms of farm property, and the average gross income are highest for farms operated by managers, but owing to the very large investments, the per cent of gross income is least. Owners operate a greater number of farms and control a greater part of the total value of farm property than any other class. Share tenants rank second in number of farms and total value, and first in per cent of gross income on investment.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS. Average.	Total.	Per cent.	VALUE OF FARM PROPERTY. Total.	Per cent.
The State	352,190	357.2	125,807,017	100.0	$962,476,273	100.0
Under 3 acres	1,302	2.2	2,864	(1)	2,945,115	0.3
3 to 9 acres	6,785	6.1	41,634	(1)	5,077,533	0.5
10 to 19 acres	19,633	14.4	282,457	0.2	10,617,827	1.1
20 to 49 acres	99,137	32.5	3,220,806	2.6	81,316,594	8.5
50 to 99 acres	88,537	70.7	6,261,082	5.0	134,544,833	14.0
100 to 174 acres	71,392	129.6	9,255,798	7.4	158,881,773	16.5
175 to 259 acres	24,000	208.0	4,991,057	4.0	77,956,188	8.1
260 to 499 acres	20,001	343.1	6,861,736	5.4	85,575,643	8.9
500 to 999 acres	10,183	660.9	6,730,336	5.3	63,564,773	6.6
1,000 acres and over	11,220	7,857.3	88,159,247	70.1	341,995,994	35.5

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$1,680	$285	$85	$683	$594	21.8
Under 3 acres	330	288	37	1,607	449	19.9
3 to 9 acres	288	252	36	172	162	21.6
10 to 19 acres	257	129	29	126	178	32.9
20 to 49 acres	491	131	41	157	314	38.3
50 to 99 acres	964	224	71	261	506	33.3
100 to 174 acres	1,426	318	99	382	626	28.2
175 to 259 acres	2,123	451	135	539	746	23.0
260 to 499 acres	2,794	534	160	791	794	18.6
500 to 999 acres	4,047	646	188	1,361	886	14.2
1,000 acres and over	17,845	1,063	316	11,258	3,625	11.9

The group of farms containing from 20 to 49 acres represents a larger number of farms than any other, but the group containing 1,000 acres and over comprises nearly three-fourths of the total acreage and more than one-third of the total value. Three-fourths of the farms in the latter group are large live-stock farms with the highest average values for all forms of farm property and the largest gross income, but the lowest per cent of gross income on investment of any class. For the group containing less than 3 acres, the values are comparatively high, as this class includes many live-stock farms using the public domain for range, besides several city dairies, truck farms, and others supplying city markets. The average gross income per acre for the various groups classified by area are as follows: Farms containing less than 3 acres, $204.27; 3 to 9 acres, $26.34; 10 to 19 acres, $12.37; 20 to 49 acres, $9.68; 50 to 99 acres, $7.15; 100 to 174 acres, $4.83; 175 to 259 acres, $3.59; 260 to 499 acres, $2.32; 500 to 999 acres, $1.34; 1,000 acres and over, $0.46.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading statistics relating to farms classified by principal source of income. If the value of hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40 per cent of such products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40 per cent of their income from any one class of farm products. Farms for which no income was reported in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	352,190	357.2	125,807,017	100.0	$962,476,273	100.0
Hay and grain	26,132	194.5	5,083,482	4.0	83,777,915	8.7
Vegetables	4,258	89.6	381,379	0.3	7,631,481	0.8
Fruit	1,129	95.5	107,837	0.1	3,200,359	0.3
Live stock	42,624	2,115.6	90,174,477	71.7	391,788,647	40.7
Dairy produce	4,668	200.1	934,253	0.7	14,115,155	1.5
Tobacco	160	140.4	22,462	(1)	603,976	0.1
Cotton	228,606	98.3	22,473,709	17.9	381,138,388	39.6
Rice	125	632.0	79,006	0.1	946,748	0.1
Sugar	264	392.4	103,599	0.1	1,854,087	0.2
Flowers and plants	66	4.0	267	(1)	306,423	(1)
Nursery products	73	67.6	4,932	(1)	355,758	(1)
Miscellaneous	44,085	146.1	6,441,614	5.1	76,757,336	8.0

1 Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,680	$285	$85	$683	$594	21.8
Hay and grain	2,226	370	144	466	630	19.7
Vegetables	1,090	355	74	273	457	25.5
Fruits	1,840	549	100	346	692	24.4
Live stock	5,046	528	133	3,485	1,231	13.4
Dairy produce	1,680	504	105	735	599	19.8
Tobacco	2,622	475	94	584	959	25.4
Cotton	1,124	216	69	258	509	30.5
Rice	5,996	553	516	509	2,486	32.8
Sugar	5,011	579	1,007	426	897	12.8
Flowers and plants	2,714	1,770	112	47	1,548	33.3
Nursery products	3,365	1,143	167	198	4,027	82.6
Miscellaneous	998	309	82	352	398	22.9

For the several classes of farms, the average values per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $382.66; nursery products, $59.60; fruit, $7.24; tobacco, $6.83; cotton, $5.17; vegetables, $5.10; rice, $3.93; hay and grain, $3.24; dairy produce, $2.99; miscellaneous, $2.73; sugar, $2.29; and live stock, $0.58.

The wide variations shown in the averages and percentages of gross income are largely due to the fact that in computing gross incomes no deductions are made for expenditures. For florists' establishments, nurseries, and market gardens, the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than in the case of "hay and grain," "live-stock," or "miscellaneous" farms. Were it possible to present the average net incomes the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	352,190	357.2	125,807,017	100.0	$962,476,273	100.0
$0	5,767	1,039.4	5,994,216	4.7	21,360,960	2.2
$1 to $49	10,600	216.6	2,296,132	1.8	11,819,590	1.2
$50 to $99	14,608	187.1	2,732,634	2.2	16,265,440	1.7
$100 to $249	72,948	124.8	9,105,624	7.2	81,385,340	8.5
$250 to $499	117,486	130.4	15,325,287	12.2	171,086,092	17.8
$500 to $999	94,083	197.4	18,576,083	14.8	240,430,382	25.0
$1,000 to $2,499	32,030	525.3	16,825,480	13.4	187,927,601	19.5
$2,500 and over	4,668	11,772.0	54,951,561	43.7	232,200,868	24.1

Table 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$1,680	$285	$85	$683	$594	21.8
$0	2,032	131	40	1,501	....	....
$1 to $49	684	117	30	284	24	2.2
$50 to $99	681	137	34	261	70	6.3
$100 to $249	684	149	40	243	181	16.2
$250 to $499	860	207	62	327	368	25.3
$500 to $999	1,644	331	105	476	686	26.8
$1,000 to $2,499	3,799	669	198	1,201	1,397	23.8
$2,500 and over	28,994	1,812	585	18,352	9,057	18.2

Of the farms reporting no income in 1899, some were homesteads taken up too late for cultivation that year, some lay idle, others had crop failures, and some were summer homes conducted for pleasure and not for profit. Many were farms in charge, June 1, 1900, of persons who did not operate them in 1899, and could give no definite information concerning the crops of that year. To this extent the reports fall short of giving a complete exhibit of farm income in 1899.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined in accordance with their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in previous census reports.

Table 14 presents a summary of live-stock statistics.

Table 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS AND RANGES, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS OR RANGES.

LIVE STOCK.	Age in years.	ON FARMS AND RANGES.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	2,148,261	$19,528,804	$9.09	43,747
Steers	1 and under 2.	957,163	14,007,199	14.63	8,439
Steers	2 and under 3.	593,603	12,106,522	20.39	2,719
Steers	3 and over	341,286	9,272,747	27.17	4,690
Bulls	1 and over	202,145	8,183,295	40.48	1,196
Heifers	1 and under 2.	954,835	13,473,384	14.11	9,003
Cows kept for milk	2 and over	861,023	19,995,327	23.22	63,876
Cows and heifers not kept for milk.	2 and over	3,369,880	66,661,626	19.78	33,745

Table 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS AND RANGES, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS OR RANGES—Continued.

LIVE STOCK.	Age in years.	ON FARMS AND RANGES.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Colts	Under 1	95,429	$1,099,900	$11.53	2,417
Horses	1 and under 2.	96,825	1,623,489	16.77	1,797
Horses	2 and over	1,077,178	31,773,694	29.50	120,217
Mule colts	Under 1	32,544	649,984	19.97	413
Mules	1 and under 2.	41,080	1,284,649	31.27	643
Mules	2 and over	433,657	23,186,986	53.47	18,314
Asses and burros	All ages	16,409	868,747	52.94	2,446
Lambs	Under 1	449,358	620,873	1.38	2,003
Sheep (ewes)	1 and over	924,174	2,037,517	2.20	6,987
Sheep (rams and wethers).	1 and over	515,766	1,323,727	2.57	506
Swine	All ages	2,665,614	7,605,687	2.85	113,267
Goats	All ages	627,333	923,777	1.47	13,377
Fowls:[1]					
Chickens[2]	....	13,562,302	3,595,243	....	....
Turkeys	....	648,671			
Geese	....	415,709			
Ducks	....	234,664			
Bees (swarms of)	....	392,644	749,483	1.91	....
Unclassified	....	....	4,295	....	....
Value of all live stock.	....	....	240,576,955		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The value of live stock on farms and ranges, June 1, 1900, was $240,576,955, or 25.0 per cent of the total value of farm property. Of this amount, 59.5 per cent represents the value of neat cattle other than dairy cows; 14.3 per cent, that of horses; 10.4 per cent, that of mules; 8.3 per cent, that of dairy cows; 3.2 per cent, that of swine; 1.7 per cent, that of sheep; 1.5 per cent, that of poultry; and 1.1 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms and ranges, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, the value of domestic animals not on farms was $8,133,526, and the total value of domestic animals in the state, exclusive of poultry and bees not on farms, was approximately $248,710,481.

CHANGES IN LIVE STOCK ON FARMS.

Table 15 presents the changes in the number of the most important classes of domestic animals since 1850.

Table 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS AND RANGES: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	861,023	8,567,173	1,269,432	523,690	1,439,940	2,665,614
1890[2]	1,003,439	5,198,113	1,026,002	227,432	3,454,858	2,252,476
1880[2]	606,176	3,478,429	805,606	132,447	2,411,633	1,950,371
1870	428,048	3,065,995	424,504	61,322	714,351	1,202,445
1860	601,540	2,934,228	325,698	63,334	753,363	1,371,532
1850	217,811	112,303	76,760	12,463	100,530	692,022

[1] Lambs not included.
[2] Exclusive of live stock on ranges.

The live-stock enumerations in 1880 and 1890 did not include domestic animals on ranges, and hence the figures for these years presented in the table are not strictly comparable with the figures for 1900. The number of animals on ranges in Texas and the Pan Handle in 1890 was estimated by special agents to be as follows: Dairy cows and "other neat cattle," 2,342,083; sheep, 809,329; horses, 99,838; swine, 2,744; mules and asses, 1,973. In comparing the number of animals reported in 1900 with the number reported in 1890, these estimates are disregarded.

Four times as many dairy cows were reported in 1900 as in 1850, although the last decade shows a decrease of 14.2 per cent. It is probable that this decrease is more apparent than real, as many of the 3,369,880 "cows and heifers not kept for milk" were doubtless cows milked for a time, but not "kept for milk" exclusively. The fact that twice as much milk was reported in 1900 as in 1890 supports this view.

The number of "other neat cattle" in 1900 is seventy-six times as great as in 1850, the gain in the last decade being 64.8 per cent. The report for 1900 includes 2,148,261 calves. It is uncertain whether or not calves were included in the reports for previous census years. If not, their number should be deducted from the total for 1900 when making comparison with such reports. In that case the gain since 1890 would be 23.5 per cent.

The number of horses has increased steadily since 1850. In 1900 there were sixteen times as many as in 1850, and 23.7 per cent more than in 1890. With the exception of the Civil War period, the increase in number of mules has been constant, forty-two times as many being reported in 1900 as in 1850, and more than twice as many as in 1890.

The number of sheep has fluctuated, but fourteen times as many were reported in 1900 as in 1850. For the last decade a decrease of 58.3 per cent is shown. Nearly four times as many swine were reported in 1900 as in 1850, and 18.3 per cent more than in 1890.

In comparing the poultry report for 1900 (see Table 14) with that of 1890, it should be borne in mind that in 1900 the enumerators were instructed to report no fowls under three months old, while in 1890 no such limitation was made. This fact explains, to a great extent, the comparatively small increases in numbers of chickens and turkeys, of 17.7 per cent and 21.0 per cent, respectively, and the decreases of 21.3 per cent and 40.0 per cent in the numbers of geese and ducks.

ANIMAL PRODUCTS.

Table 16 is a summarized exhibit of the products of the animal industry.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS, IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	9,638,002	$1,428,122
Mohair and goat hair	Pounds	274,810	77,478
Milk	Gallons	[1] 251,342,698	[2] 15,504,978
Butter	Pounds	47,991,492	
Cheese	Pounds	136,133	
Eggs	Dozens	58,040,810	4,672,187
Poultry			5,311,362
Honey	Pounds	4,780,204	468,527
Wax	Pounds	159,690	
Animals sold			34,357,265
Animals slaughtered			11,032,614
Total			72,852,533

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of milk sold or consumed, and of butter and cheese made.

In 1899 the value of animal products was $72,852,533, or 30.4 per cent of the value of all farm products. Of this amount, 62.3 per cent represents the value of animals sold and animals slaughtered on farms; 21.3 per cent, that of dairy produce; 13.7 per cent, that of poultry and eggs; 2.1 per cent, that of wool, mohair, and goat hair; 0.6 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

Animals slaughtered were reported by 238,255 farmers, or 67.6 per cent of all in the state, the average value per farm being $46.31. Sales were reported by 141,533 farmers, or 40.2 per cent of the total number, the average receipts per farm being $242.75. Crane county reported sales from 7 farms amounting to $197,061, or an average of $28,151.57 per farm. In obtaining these reports the enumerators were instructed to secure from each farm operator a statement of the amount received from sales in 1899, less the amount paid for animals purchased during the same year.

DAIRY PRODUCE.

In 1899, 260,432 farmers, or 73.9 per cent of the total number, reported dairy produce. Of the $15,504,978 given in Table 16 as the value of dairy produce, 82.9 per cent represents the value of such produce consumed on farms, and 17.1 per cent, the receipts from sales of dairy produce. Of the latter amount, $1,331,235 was received from the sale of 7,928,646 pounds of butter; $1,276,438, from 8,091,205 gallons of milk; $32,981, from 46,406 gallons of cream; and $7,462, from 76,148 pounds of cheese.

Twice as much milk was reported in 1900 as in 1890. The quantity of butter made on farms increased 49.5 per cent in the last decade, but that of cheese decreased 6.6 per cent.

POULTRY, EGGS, WOOL, HONEY, AND WAX.

Of the $9,983,549 which is the value of poultry and eggs for 1899, 53.2 per cent represents the value of poultry raised, and 46.8 per cent, that of eggs produced. The production of eggs in 1899 was 78.8 per cent greater than in 1889.

The production of wool in 1899 was 35.4 per cent less than in 1889, although the average weight of fleeces increased in the same time from 3.9 pounds to 4.7 pounds.

The production of honey increased 45.5 per cent in the decade 1890 to 1900, and twice as much wax was reported in 1900 as in 1890.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	292,988	1,269,432	4.3	260,437	861,023	3.3
White farmers	244,631	1,165,981	4.8	231,132	796,442	3.4
Colored farmers	48,357	103,451	2.1	29,305	64,581	2.2
Owners[1]	157,181	825,691	5.3	151,124	594,026	3.9
Managers	2,287	77,784	34.0	1,744	19,672	11.8
Cash tenants	22,426	81,448	3.6	16,498	47,599	2.9
Share tenants	111,094	284,509	2.6	91,071	199,726	2.2
Under 20 acres	19,910	46,896	2.4	11,946	30,593	2.6
20 to 99 acres	146,299	352,038	2.4	126,675	286,553	2.3
100 to 174 acres	64,492	221,485	3.4	63,289	209,013	3.3
175 to 259 acres	22,488	101,437	4.5	22,220	96,834	4.4
260 acres and over	39,799	547,576	13.8	36,307	238,030	6.6
Hay and grain	21,081	95,467	4.5	17,417	51,198	2.9
Vegetable	3,548	11,191	3.2	2,461	6,335	2.6
Fruit	837	3,099	3.7	816	2,232	2.7
Live stock	39,933	501,056	12.5	36,403	190,086	5.2
Dairy	4,141	20,220	4.9	4,668	43,685	9.4
Tobacco	112	527	4.7	100	287	2.9
Cotton	185,557	505,255	2.7	160,760	442,196	2.8
Rice	111	423	3.8	74	157	2.1
Sugar	208	721	3.5	174	581	3.3
Miscellaneous[2]	37,460	131,473	3.5	37,564	124,266	3.3

[1] Including "part owners" and "owners and tenants."
[2] Including florists' establishments and nurseries.

CROPS.

The following table gives the statistics of the principal crops grown in 1899:

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	5,017,690	Bushels	109,970,350	$34,424,871
Wheat	1,027,947	Bushels	12,266,320	7,051,477
Oats	847,225	Bushels	24,190,668	5,240,791
Barley	4,380	Bushels	80,366	33,354
Rye	3,984	Bushels	42,770	27,362
Buckwheat	41	Bushels	333	310
Broom corn	3,743	Pounds	1,638,150	60,313
Rice	8,711	Pounds	7,186,863	224,387
Kafir corn	22,813	Bushels	482,096	130,01[illegible]
Flaxseed	75	Bushels	640	561
Clover seed		Bushels	94	380
Grass seed		Bushels	20,398	13,594
Hay and forage	938,024	Tons	1,494,305	7,294,450
Cottonseed		Tons	[1]1,262,651	12,396,591
Cotton	6,960,367	Bales	2,506,212	84,332,713
Tobacco	1,443	Pounds	550,120	104,694
Peanuts	10,734	Bushels	184,860	178,542
Dry beans	2,878	Bushels	28,129	40,652
Dry pease	33,974	Bushels	333,462	349,306
Potatoes	21,810	Bushels	1,342,316	725,145
Sweet potatoes	43,561	Bushels	3,299,135	1,689,015
Onions	1,639	Bushels	187,720	150,675
Miscellaneous vegetables	110,260			5,109,963
Sugar cane	17,824	Tons	170,485	
(a) Cane sold		Tons	54,758	219,905
(b) Sugar made		Pounds	2,789,250	134,074
(c) Molasses made		Gallons	98,950	6,719
(d) Sirup made		Gallons	888,637	365,819
Sorghum cane	26,803	Tons	[2]88,933	263,518
Sorghum sirup		Gallons	877,232	291,272
Sugar beets	135	Tons	523	2,451
Small fruits	3,904			304,680
Grapes	[3]2,213	Centals	40,862	[4]126,355
Orchard fruits	[3]121,797			[5]1,345,423
Tropical fruits				12,996
Nuts				78,971
Forest products				3,776,569
Flowers and plants	167			120,249
Seeds	17			2,901
Nursery products	2,093			314,511
Miscellaneous	324			25,138
Total	15,236,576			166,970,711

[1] Exclusive of 29,761 tons, valued at $292,253, sold in seed cotton and included with the cotton.
[2] Sold as cane.
[3] Estimated from number of vines or trees.
[4] Including value of raisins, wine, etc.
[5] Including value of cider, vinegar, etc.

Of the total value of crops, cotton and cottonseed contributed 57.9 per cent; cereals, including Kafir corn, 28.2 per cent; hay and forage, 4.4 per cent; miscellaneous vegetables, 3.1 per cent; forest products, 2.3 per cent; sweet potatoes, 1.0 per cent; orchard fruits, 0.8 per cent; and all other products, 2.3 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $720; nursery products, $150; onions, $92; small fruits, $78; tobacco, $73; grapes, $57; miscellaneous vegetables, $46; sugar cane and sugar-cane products, $41; sweet potatoes, $39; potatoes, $33; sorghum cane and sorghum sirup, $21; peanuts, $17; broom corn, $16; dry beans, $14; cotton and cottonseed, $14; orchard fruits, $11; dry pease, $10; hay and forage, $8; and cereals, $7. The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production requires a relatively great amount of labor, and large expenditures for fertilizers.

COTTON.

The following table shows the changes in cotton production since 1849:

TABLE 19.—ACREAGE AND PRODUCTION OF COTTON: 1849 TO 1899.

YEAR.	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	6,960,367	76.9	2,506,212	1,292,404,967	84.2
1889	3,934,525	80.6	1,471,242	701,782,434	92.4
1879	2,178,435		805,284	364,793,652	139.7
1869				152,172,552	[1]20.7
1859				192,001,035	726.6
1849				23,228,800	

[1] Decrease.

In 1859 the total number of pounds of cotton produced in Texas was over eight times as great as the quantity reported for the previous census. During the next decade, the Civil War caused a depression in all industries and there was a decrease of 20.7 per cent. For the year 1879 there is recorded an increase of over 200,000,000 pounds, and although the percentage of gain lessened in the following decade, there was a steady increase in both the area under cultivation and in the quantity of cotton grown.

In 1899, 284,037 farmers devoted to cotton 6,960,367 acres, or 35.6 per cent of the total improved farm land of the state, and an average of 24.5 acres per farm. From this land was produced 1,292,404,967 pounds of cotton, an average of 4,550 pounds per farm, 186 pounds per acre, and 424 pounds per capita.

The total value of this product, including the value of the cottonseed, was $96,729,304, an average of $340.55 per farm, and $13.90 per acre. This value constituted 46.2 per cent of the gross farm income.

The counties devoting the greatest area to the production of cotton were Ellis, McLennan, Fannin, Hill, Navarro, Williamson, Falls, Milam, and Bell, ranking in the order named, and reporting 20.5 per cent of the total acreage. These counties are located in a belt extending north from Austin to the Red River. Little or no cotton is raised in the counties along the western border of the state or those in the extreme north or south.

CEREALS.

Table 20 is a statement of the changes in cereal production since 1849.

TABLE 20.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	4,380	5,017,690	847,225	8,711	3,984	1,027,947
1889	2,782	3,079,907	528,924	178	5,255	352,477
1879	5,527	2,468,587	238,010	335	3,326	373,570

[1] No statistics of acreage were secured prior to 1879.

TABLE 20.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899—Continued.

PART 2.—BUSHELS PRODUCED.[1]

YEAR.[2]	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	80,366	109,970,350	24,190,668	7,186,863	42,770	12,266,320
1889	48,152	69,112,150	12,581,360	168,423	62,370	4,283,344
1879	72,786	29,065,172	4,893,359	62,152	25,399	2,567,737
1869	44,351	20,554,538	762,663	63,844	28,521	415,112
1859	67,562	16,500,702	985,889	26,031	111,860	1,478,345
1849	4,776	6,028,876	199,017	88,203	3,108	41,729

[1] Rice reported in pounds.
[2] No statistics of acreage were secured prior to 1879.

The total area devoted to cereals in 1879 was 3,089,403 acres; in 1889, 3,969,622 acres; and in 1899, 6,932,791, an increase for the twenty years of 124.4 per cent. In addition to the acreages mentioned in the table, those for buckwheat in 1879, 1889, and 1899, and for Kafir corn in 1899 are included in these totals. The increase in the areas devoted to the various cereals in the decade from 1889 to 1899 were: Rice, approximately, fiftyfold; wheat, 191.6 per cent; corn, 62.9 per cent; oats, 60.2 per cent; and barley, 57.4 per cent. There was a decrease in acreage under rye of 24.2 per cent.

Of the total area under cereals in 1899, 72.4 per cent was devoted to corn; 14.8 per cent, to wheat; 12.2 per cent, to oats; 0.3 per cent, to Kafir corn; and 0.3 per cent, to barley, buckwheat, rice, and rye.

Corn, wheat, oats, rye, Kafir corn, and barley were reported from nearly all parts of the state. Buckwheat was grown in 9 counties only, and rice in 17 counties, in the southeastern part of the state. Of these 17 counties, 2, Jefferson and Orange, furnished 94.2 per cent of the entire acreage in rice.

HAY AND FORAGE.

In 1900, 95,371 farmers, or 27.1 per cent of the total number, reported hay or forage crops. Excluding cornstalks and corn strippings, they obtained an average yield of 1.6 tons per acre. The total acreage in hay and forage for 1899 was 938,024, or 148.5 per cent greater than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 286,079 acres and 280,145 tons; millet and Hungarian grasses, 152,750 acres and 234,680 tons; alfalfa or lucern, 18,999 acres and 33,394 tons; clover, 1,940 acres and 3,344 tons; other tame and cultivated grasses, 63,605 acres and 88,645 tons; grains cut green for hay, 52,051 acres and 87,273 tons; crops grown for forage, 362,600 acres and 738,971 tons; cornstalks and corn strippings, 79,150 acres and 27,853 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is included under "corn," as the forage secured was an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table:

TABLE 21.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES. 1900	NUMBER OF TREES. 1890	BUSHELS OF FRUIT. 1899	BUSHELS OF FRUIT. 1889
Apples	1,484,846	622,801	591,985	742,993
Apricots	35,301	7,220	1,620	1,580
Cherries	36,800	14,241	2,189	3,863
Peaches	7,248,358	4,486,901	1,400,240	5,106,332
Pears	1,044,680	37,370	166,418	17,034
Plums and prunes	1,121,589	688,995	180,813	160,256

The total number of fruit trees in 1890 was 5,857,528. In 1900 there were 11,036,196, showing an increase of 5,178,668, or 88.4 per cent. The rates of increase for the decade are as follows: Apples, 138.4 per cent; apricots, 388.9 per cent; cherries, 158.4 per cent; peaches, 61.5 per cent; and plums and prunes, 62.8 per cent. The number of pear trees is 27 times as great as it was in 1890.

Of the total number of trees reported in 1900, 13.4 per cent were apple trees; 65.7 per cent, peach trees; 10.2 per cent, plum and prune trees; 9.5 per cent, pear trees; and 1.2 per cent, apricot, cherry, and unclassified trees. The last mentioned, which are not included in the table, numbered 64,622 trees, and yielded 16,466 bushels of fruit.

The value of orchard products, given in Table 18, includes the value of 1,764 barrels of cider, 1,386 barrels of vinegar, and 84,630 pounds of dried and evaporated fruits. All these orchard fruits are grown quite generally throughout the state, but 57.6 per cent of the pear trees are reported from the counties of Brazoria, Galveston, and Harris.

SMALL FRUITS.

Of the 3,904 acres devoted by 6,496 farmers to small fruits, 1,802 acres, or nearly one-half, were reported by Smith, Galveston, Brazoria, and Tarrant counties, all of which are situated in the eastern part of the state. Blackberries and dewberries occupied 2,394 acres, or 61.3 per cent of the total area, and yielded 2,701,750 quarts. The acreages and productions of other berries were as follows: Strawberries, 1,361 acres and 2,344,220 quarts; raspberries and Logan berries, 103 acres and 123,640 quarts; currants, 4 acres and 5,370 quarts; gooseberries, 1 acre and 760 quarts; and other small fruits, 41 acres and 33,180 quarts.

VEGETABLES.

The total value of vegetables grown in 1899, including potatoes, sweet potatoes, and onions, was $7,674,798, of which 22.0 per cent represents the value of sweet potatoes; 9.4 per cent, that of potatoes; 2.0 per cent that of onions; and 66.6 per cent, that of miscellaneous vegetables.

Sweet potatoes were grown in 1899 by 63,209 farmers, or 17.9 per cent of the total number in the state. The area devoted to this crop in 1889 was 52,506 acres, and in 1899, 43,561 acres, a decrease of 17.0 per cent.

In the growing of miscellaneous vegetables, 110,260 acres were used. The products of 68,849 acres were not reported in detail. Of the remaining 41,411 acres, 26,276 acres were devoted to watermelons; 5,781 acres, to muskmelons; 4,088 acres, to cabbages; 2,821 acres, to tomatoes; 952 acres, to sweet corn; 855 acres, to cucumbers; and 638 acres, to other vegetables.

SUGAR CANE.

Table 22 presents a comparative exhibit of the acreage of sugar cane and the production of sugar and sirup, 1849 to 1899.

TABLE 22.—ACREAGE OF SUGAR CANE AND PRODUCTION OF SUGAR AND SIRUP: 1849 TO 1899.

YEAR.[1]	Acreage in cane.	SUGAR. Production in pounds.	SUGAR. Average yield per acre in pounds.	SIRUP. Production in gallons.	SIRUP. Average yield per acre in gallons.
1899	17,824	2,789,250	156.5	987,587	55.4
1889	16,284	5,482,030	336.6	2,159,339	132.6
1879	10,224	5,941,200	581.1	810,605	79.3
1869	....	2,424,000	....	246,062	....
1859	....	6,118,800	....	408,358	....
1849	....	8,821,200	....	....	....

[1] No statistics of acreage were secured prior to 1879.

The present census shows that in 1899 sugar cane was grown by 15,694 farmers on 17,824 acres, an average of 1.1 acres for each farm reporting. From this area they sold 54,758 tons of cane for $219,905, and from the remaining product, manufactured 987,587 gallons of sirup and molasses, valued at $372,538, and 2,789,250 pounds of sugar, valued at $134,074. This was an increase of 9.5 per cent in acreage over that reported for 1889. The total value of the sugar-cane products was $726,517, an average of $46.29 for each farm reporting, and of $40.76 per acre. The average value of the sugar was 4.8 cents per pound, and of the sirup and molasses, 37.7 cents per gallon.

SORGHUM CANE.

Sorghum cane was grown in 1899 by 31,948 farmers on 26,803 acres, an average of 0.8 acre for each farm reporting. From this area they sold 88,933 tons of cane for $263,518, and from the remaining product, manufactured 877,232 gallons of sirup, valued at $291,272. This was a decrease in acreage from 1889 of 6.1 per cent. The total value of sorghum-cane products was $554,790, an average of $17.36 for each farm reporting, and of $20.70 per acre. The average value per gallon was 33.2 cents.

TOBACCO.

The present census shows that in 1899 tobacco was grown by 1,746 farmers, who reported 1,443 acres, and a yield of 550,120 pounds, a gain in ten years of 241.1 per cent in acreage and 213.1 per cent in production. The production of 1899 was the largest ever reported. The next largest was in 1879, when 685 acres yielded 221,283 pounds. The average yield per acre in 1899 was 381.2 pounds, compared with 415.4 pounds in 1889. The total value of the 1899 crop was $104,694, an average of $59.96 for each farm reporting, and of $72.55 per acre. The average value per pound was 19 cents. The crop was grown in 98 counties, Montgomery county leading, with 507 acres, or 35.1 per cent of the total.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 167 acres, and the value of the products sold therefrom was $120,249. These flowers and plants were grown by 157 farmers and florists, of whom 66 made commercial floriculture their principal business. The capital invested in land, buildings, implements, and live stock was $306,423, of which $116,825 represents the value of buildings. Their sales of flowers and plants amounted to $93,259, and they obtained other products valued at $8,910. The expenditure for labor was $28,000, and for fertilizers, $1,575. The average income for each farm reporting (including products fed to live stock) was $1,551.

In addition to 59 of the florists' establishments, 208 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 171,474 square feet, making, with the 223,106 square feet belonging to the florists' establishments, a total of 394,580 square feet.

NURSERIES.

The total value of nursery products sold in 1899 was $314,511, reported by the operators of 223 farms and nurseries. Of this number, 73 derived their principal income from the nursery business. They had 4,932 acres of land valued at $245,650, buildings worth $83,445, implements and machinery worth $12,209, and live stock worth $14,454. Their total income, exclusive of products fed to live stock, was $293,945, of which $264,425 represents the value of nursery stock and $29,520 that of other products. The expenditure for labor was $42,740 and for fertilizers, $2,405. The average income for each farm reporting (including products fed to live stock) was $4,074.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $12,331,905, an average of $35 per farm. About one-half of this amount was expended for labor on cotton farms and nearly one-third for labor on live-stock farms. The average expenditure was $585 for nurseries, $452 for rice farms, $424 for florists' establishments, $112 for tobacco farms, $93 for live-stock farms, $89 for sugar farms, $57 for fruit farms, $47 for hay and grain farms, $45 for dairy farms, $32 for vegetable farms, and $25 for cotton farms. "Managers" expended, on an average, $833; "owners," $34; "cash tenants," $29; and "share tenants," $18. White farmers expended $41 per farm, and colored farmers, $9.

Fertilizers purchased in 1899 cost $124,716, an average of only 35 cents per farm, but an increase since 1890 of 112.6 per cent. The average expenditure was $69 for rice farms, $33 for nurseries, $24 for florists' establishments, $14 for tobacco farms, $4 for fruit farms, $2 for vegetable, dairy, and sugar farms, and less than $1 for hay and grain, live-stock, and cotton farms.

IRRIGATION STATISTICS.

Texas, with its vast area and greatly diversified topography and climate, contains areas well adapted to the successful cultivation of a wide variety of agricultural products. As the larger part of the state belongs to the humid region, irrigation has never been a prominent factor in agricultural development.

The arid region may be described as belonging to the drainage basin of the Rio Grande and Pecos rivers, and includes the counties of Pecos, Reeves, El Paso, Jeff Davis, Presidio, Brewster, and Ward. The elevation of this portion of the state varies from 2,000 to 6,000 feet and the annual precipitation ranges from 8 to 17 inches. The soil, particularly in the valley of the Rio Grande, is of exceeding fertility when sufficiently watered, and is adapted to the cultivation of almost all the agricultural products of the temperate and subtropical climates. In this valley irrigation is of ancient origin, and on many of the canals the methods of irrigating have undergone little change in the last two centuries. The irrigation of general crops in Texas is confined largely to the region above described.

In 1899 the number of irrigators in arid Texas was 429, or 32.4 per cent of all; the ditches had a length of 212 miles, or 47.1 per cent of the total length, and the cost of construction was $407,635, or 39.7 per cent of the total cost of all the systems of the state. El Paso county, with six large canals having a total length of 92 miles, leads all others in the number of irrigators and in the mileage of ditches.

At El Paso, after passing through a deep canyon in the Franklin Range, the Rio Grande flows out upon a broad valley which has a length of 60 miles and a general elevation of 4,000 feet. The bed of the river at this point is unstable and is often changed several miles during a flood. The banks are generally low, affording an excellent opportunity for the intake of gravity ditches. Sixty miles below El Paso the valley of the Rio Grande suddenly contracts where the river passes through the Whitman Mountains. From this point down to Del Rio, a distance of 400 miles, its course is through canyons in a region of wild and picturesque scenery and no opportunities are presented for irrigation, except at one point in Presidio county, near Fort Leaton, where it flows out upon a narrow valley for about 25 miles. In this valley it receives from Mexico the waters of an important tributary—the Concho. At Del Rio and 50 miles below, near Eagle Pass, the Rio Grande supplies water for several canals. A number of pumping stations are used in the vicinity of Laredo, Carrizzo, Rio Grande, Hidalgo, and Brownsville.

For a number of years during the irrigating season there was a shortage of the water supply in the Rio Grande. In the census year it sufficed for only one irrigation in El Paso county, and no crops were harvested, except a small quantity of hay and forage which yielded but slight returns. The marked yearly decrease in the volume of the Rio Grande has been the cause of much distress and suffering in that part of the state which is dependent upon this stream for water. Although the ditches in El Paso county cover 30,000 acres of land, in 1899 crops were grown on only 4,826 acres, and the products generally were such as would mature with water received during the flood season. The Rio Grande Valley in this county, once one of the most fertile and productive in the country, is rapidly returning to its original state—that of a desert.

Large canals along the Rio Grande in Colorado and Mexico exhaust the normal flow, and until a system of reservoirs is constructed to hold the flood waters, most of the farms in this part of Texas will have to be abandoned. A reservoir site has been surveyed and its capacity is claimed to be sufficient to irrigate all the arable land for 40 miles below El Paso on both sides of the river. As its construction involves questions of international importance, this work can not be attempted with private capital.

The Pecos River, flowing through arid and semiarid Texas, irrigates considerable areas in the counties of Reeves, Ward, and Pecos. The canals are of great length and designed to irrigate large areas. The irrigated acreage under ditches is about 70,000, and the irrigation systems have a total length of 104 miles and cost $231,800. In 1899 the acreage irrigated by them was 15,465.

In explanation of the small acreage cultivated, it may be stated that from the constant use of the water of the Pecos River for irrigation in New Mexico, it has become impregnated with mineral matter which is injurious to vegetable growth, and, until some remedy is found for this, the further extension of irrigated areas is not probable.

There are a number of irrigation systems in the valleys of the Colorado and Brazos rivers, several of considerable importance, used in the cultivation of forage crops, grain, orchard and small fruits, and truck. Many crops in this section were seriously damaged by severe floods early in June, 1899, and many irrigation plants were entirely destroyed. Some of the most important canals are at Menardville and San Angelo. During the census year in Tom Green and Menard counties there were 157 irrigators, operating 17 plants, costing $84,325, having a length of 69.9 miles, and irrigating 7,563 acres.

In 1889 there were 623 irrigators in the state, and in 1899, 1,325, an increase of 112.7 per cent. Within the same period, the number of irrigated acres increased from 18,241 to 49,652, or 172.2 per cent. Not including the area irrigated in rice, the increase in irrigated acreage in the state is 69.7 per cent.

The total value of all crops produced on irrigated land in 1899 was $539,212, divided as follows: Rice, $224,315; hay and forage, $101,569; cereals, $64,107; vegetables, $99,240; orchard fruits, $17,175; small fruits, $1,134; all other crops, $31,672.

The following table gives the number of irrigators and acreage irrigated in 1899, with the number and cost of construction of irrigation systems and the length of main ditches:

Table A.—NUMBER OF IRRIGATORS AND ACREAGE IRRIGATED IN 1899, WITH NUMBER AND COST OF CONSTRUCTION OF IRRIGATION SYSTEMS AND LENGTH OF MAIN DITCHES.

COUNTIES.	Number of irrigators.	Acreage irrigated.	IRRIGATION SYSTEMS.			
			Number.	Cost of construction.		Total length, of main ditches.
				Total.	Average per acre irrigated.	
The State [1] ...	[2]1,325	49,662	581	$1,027,608	$20.70	449.9
Bexar	76	1,720	4	13,600	7.91	16.0
Colorado	3	200	3	26,000	130.00	1.0
El Paso	200	4,826	6	192,200	39.83	92.0
Irion	35	760	3	2,450	3.22	9.5
Jefferson	37	5,859	10	265,000	45.23	20.0
Menard	70	2,820	5	30,400	10.78	18.8
Orange	19	2,352	4	29,337	12.47	7.0
Pecos	17	4,568	7	27,800	6.09	47.0
Presidio	25	1,404	4	8,550	6.09	6.6
Reeves	33	6,757	7	19,000	2.81	23.0
San Saba	28	464	15	3,825	8.24	7.2
Tom Green	87	4,743	12	53,925	11.37	50.8
Uvalde	9	366	9	5,500	15.03	6.5
Valverde	43	2,179	1	25,000	11.47	8.0
Ward	131	4,148	2	185,000	44.60	34.0
Other counties (107)	512	6,486	489	140,021	21.59	102.5

[1] Irrigation reported from 122 counties.
[2] Includes 95 irrigators from wells irrigating 385 acres; cost of plants approximately $17,193.

The relatively high average cost of construction per acre irrigated in Colorado and Jefferson counties is explained by the fact that the pumping plants have been only recently established and in 1899 were not utilized to their full capacity. The area capable of being irrigated by these systems is greatly in excess of that reported as irrigated in the census year.

RICE IRRIGATION.

The rice belt, which extends from Sabine county on the east to the Rio Grande on the southwest, includes all the counties bordering on the Gulf and several adjoining. Rice irrigation in Texas really began in 1897, the industry receiving great impetus from the success of the planters in southwest Louisiana. As southeastern Texas is an extension of the fertile prairies which have proven so well adapted to the growing of this cereal in Louisiana, the areas in rice have increased greatly each year. The rice belt at present includes two well-developed zones, the Beaumont, and the Colorado River valley. Beaumont section is a level prairie which, until a few years ago, was not deemed of much value for agricultural purposes. The slope is rarely more than one foot to the mile and the elevation is about 250 feet above the sea level at distances from 50 to 125 miles from the Gulf. In 1899, with the exception of 200 acres in the Colorado Valley and a few small areas in other counties, all of the irrigated rice was grown in this section. Jefferson county reported 5,859 acres in rice, yielding 5,643,194 pounds, or 67.3 per cent of the total acreage and 78.5 per cent of the total yield of the state. There were ten irrigation systems in this county, representing an expenditure for construction of $265,000. The total length of the main ditches was 20 miles.

The methods of cultivating and harvesting rice in Texas are the same as those of southwestern Louisiana. The rice is sown broadcast or with drills, on comparatively high land, from April 15 to June 15. From $1\frac{1}{4}$ bushels to $1\frac{3}{4}$ bushels are sown to the acre, the land having been plowed and harrowed as for wheat. The rice lands are flooded after the rice is up to the height of from 3 to 6 inches, the water being kept on the land from 90 to 110 days. The water kills the grass and weeds and promotes the rapid growth of the plant. From 10 to 20 days before harvest, depending upon the growth and nature of the soil, the levees at the lower sides of the fields are opened and the water is drawn off by means of ditches. The rice is cut with self-binders and thrashed from the shock or stacked to suit the convenience of the farmers. The same kind of machinery is used in cultivating, harvesting, and thrashing rice as is used with wheat in the Northwest.

The following table shows the number of irrigated rice farms, the acreage, yield, and value of crop, 1899:

TABLE B.—IRRIGATED RICE, BY COUNTIES.

COUNTIES.	Farms reporting.	Acres.	Pounds.	Value.
Chambers	2	37	9,360	$240
Colorado	1	200	300,000	13,000
Harris	1	35	113,400	3,780
Jasper	2	52	27,135	706
Jefferson	37	5,859	5,643,194	171,349
Liberty	4	162	65,588	2,118
Newton	1	2	2,700	60
Orange	19	2,347	1,017,934	32,917
Sabine	4	4	3,400	80
Waller	2	2	1,750	65
Total	73	8,700	7,184,461	224,315

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 230. WASHINGTON, D. C. July 3, 1902.

AGRICULTURE.

OKLAHOMA.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the territory of Oklahoma, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Oklahoma, June 1, 1900, numbered 62,495, and were valued at $123,941,235. Of this amount, $13,731,585, or 11.1 per cent, represents the value of buildings, and $110,209,650, or 88.9 per cent, the value of land and improvements other than buildings. On the same date the value of farm implements and machinery was $6,573,015, and of live stock, $54,829,568. These values, added to that of farms, give $185,343,818, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $45,447,744, of which amount $18,582,351, or 40.9 per cent, represents the value of animal products, and $26,865,393, or 59.1 per cent, the value of crops, including forest products cut or produced on farms. The total value for 1899 exceeds that reported for 1889 by $45,007,369, or more than one hundred times.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $8,109,946, leaving $37,337,798 as the gross farm income. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Oklahoma in 1899 it was 20.1 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Oklahoma.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN OKLAHOMA.

GENERAL STATISTICS.

Oklahoma has a total land area of 38,830 square miles, or 24,851,200 acres, of which 15,719,258 acres, or 63.3 per cent, are included in farms.

The surface of the territory is a high, gently rolling slope, whose elevation above sea level ranges from 500 to 4,000 feet. In the central portion of the territory are a few mountains, east of which are broad, fertile valleys. To the north and west are undulating uplands, requiring only irrigation to make them yield abundantly. The principal rivers extend generally from northwest to southeast, and afford sufficient water facilities for all sections.

The soil is mostly a rich red clay, or sandstone decomposition, mixed, in the valleys, with black alluvial deposits. It is of sufficient depth and character to render it almost inexhaustible, and needs no fertilization.

NUMBER AND SIZE OF FARMS.

Table 1 gives, for the years 1890 and 1900, the number of farms, the total and average acreage, and the per cent of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1890 AND 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	62,495	15,719,258	5,511,994	10,207,264	251.5	35.1
1890	8,826	1,606,423	563,728	1,042,695	182.0	35.1

There were more than seven times as many farms in the territory in 1900 as in 1890, with nearly ten times as great an area devoted to agriculture. The average size of farms almost doubled, but the ratio of improved and unimproved land remained unchanged.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for the census years 1890 and 1900.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1890 AND 1900.

YEAR.	Total value of farm property.	Land, improvements and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$185,343,818	$123,941,235	$6,573,015	$54,829,568	$45,447,744
1890	12,221,020	8,581,170	433,580	3,206,270	440,375

[1] For year preceding that designated.

The last decade shows very great progress in all agricultural pursuits, with from fourteen to seventeen times as great amounts invested, and more than one hundred times as great a value of products in 1900 as in 1890.

COUNTY STATISTICS.

Table 3 gives an exhibit of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURE IN 1899 FOR LABOR, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not feed to live stock.	Expenditure for labor.
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The Territory	62,495	60,505	15,719,258	5,511,994	$110,209,650	$13,731,585	$6,573,015	$54,829,568	$37,337,798	$2,359,650
Beaver	663	628	574,800	125,442	1,028,460	206,440	83,575	3,050,184	693,241	97,290
Blaine	1,985	1,779	375,703	167,244	2,806,310	304,330	202,580	943,206	800,178	57,510
Canadian	2,043	1,964	519,335	370,198	6,008,670	833,010	345,120	1,513,768	1,957,354	164,360
Cleveland	2,206	2,157	309,571	171,597	3,184,910	570,740	210,110	953,151	1,211,173	53,330
Custer	2,354	2,295	455,815	144,611	2,990,090	309,190	155,870	1,350,573	660,543	24,660
Day	388	374	107,154	20,586	340,600	60,220	29,180	923,076	265,634	18,470
Dewey	1,968	1,927	343,213	84,400	1,902,260	210,420	101,570	1,049,271	458,890	23,500
Garfield	3,744	3,630	645,844	424,169	8,001,155	1,120,600	552,390	2,063,919	2,769,037	226,020
Grant	3,411	3,322	605,554	425,901	6,718,600	814,490	470,140	2,062,688	2,206,313	180,740
Greer	3,465	3,330	912,804	189,582	3,272,440	392,920	196,950	2,501,594	1,063,731	22,190
Kay	2,748	2,709	480,453	349,281	8,729,570	1,203,570	531,160	1,988,482	2,543,743	238,860
Kingfisher	2,848	2,754	515,410	308,505	5,614,210	915,060	443,340	1,622,071	1,879,557	147,770
Lincoln	4,451	4,315	578,387	270,479	5,029,510	682,890	320,170	1,548,883	1,856,204	58,440
Logan	3,076	2,954	464,774	254,899	5,103,470	867,450	347,850	1,324,314	1,719,697	87,820
Noble	1,648	1,625	347,613	210,054	4,412,930	450,000	275,560	1,502,538	1,403,128	157,470
Oklahoma	2,663	2,584	451,582	249,768	5,318,820	819,920	345,180	1,224,599	1,558,778	123,210
Pawnee	1,844	1,789	414,768	131,415	3,109,290	296,400	166,070	2,002,491	647,741	46,240
Payne	3,128	3,080	437,021	267,035	4,591,350	618,490	237,070	1,403,125	1,440,566	51,410
Pottawatomie	3,266	3,176	338,887	164,744	3,214,170	466,400	231,360	1,205,074	1,350,830	48,150
Roger Mills	1,251	1,216	267,986	44,273	970,830	108,250	62,820	1,253,212	400,800	15,740
Washita	2,780	2,714	490,473	162,721	3,327,320	454,870	168,490	1,247,402	790,020	18,940
Woods	7,277	7,105	1,352,326	663,052	9,074,865	1,161,575	696,640	4,785,638	3,309,360	168,110
Woodward	1,613	1,539	845,414	90,404	2,103,710	277,640	141,270	4,429,634	868,432	87,570
Osage and Kaw[1]	960	902	1,088,843	141,252	3,208,220	353,920	145,950	5,685,553	3,666,113	66,280
Ponca and Otoe[1]	256	199	194,852	58,624	2,081,840	67,710	55,800	286,689	166,002	136,930
Wichita, Kiowa, and Comanche[1]	459	438	2,600,676	21,763	8,066,050	165,080	56,800	6,908,433	1,650,733	38,640

[1] Indian reservation.

The number of counties in Oklahoma increased in the last decade from 8 to 23, rendering comparisons by counties for the last two census years very difficult. The total acreage increased nearly tenfold, and more than doubled for all of the original counties but one. In three counties the improved acreage increased more than fivefold. The average size of farms is largest in the western counties where stock raising and cereal production are the principal industries, and smallest in the southeastern counties, which contain a number of cotton and vegetable farms, though the size does not vary greatly in any section of the territory. The size of farms on Indian reservations is larger than in the counties, bringing the territorial average up to 251.5 acres.

Many of the counties show more than a threefold increase over the total farm values reported ten years before. For the territory, the average value of farms in 1900 was $1,983, more than double that reported in 1890. A large gain in the value of implements and machinery was reported for all counties. The value of live stock also shows a general increase, the average value per farm being more than twice as great as in 1890.

The expenditure for labor in 1899 averaged $38 per farm. It varied greatly in the different parts of the territory, being very much higher in counties containing many live stock and grain farms than in those devoted to general farming.

FARM TENURE.

Table 4 gives a comparative statement of farm tenure for 1890 and 1900. The farms operated by tenants are divided into two groups designated as farms operated by "cash tenants" and "share tenants." These groups comprise, respectively: (1) Farms operated by individuals who pay a rental in cash or a stated amount of labor or farm produce; (2) farms operated by individuals who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, the farms operated by owners being subdivided into four groups designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These terms denote, repectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURE: 1890 AND 1900.

YEAR.	Number of farms.	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	62,495	49,346	5,020	8,129	79.0	8.0	13.0
1890	8,826	8,761	13	52	99.3	0.1	0.6

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURE, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURE.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The Territory	62,495	42,241	6,113	686	306	5,020	8,129
White	59,324	39,863	6,014	666	298	4,843	7,640
Indian	915	881	5	5	2	5	17
Negro	2,256	1,497	94	15	6	172	472

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURE.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The Territory	100.0	67.6	9.8	1.1	0.5	8.0	13.0
White	100.0	67.2	10.1	1.1	0.5	8.2	12.9
Indian	100.0	96.4	0.5	0.5	0.2	0.5	1.9
Negro	100.0	66.3	4.2	0.7	0.3	7.6	20.9

The number of farms operated by owners, June 1, 1900, was nearly six times as great as the number reported in 1890, the increase for the decade being 40,585. This increase was less rapid than that in the total number of farms, hence, the per cent of farms operated by this class was 20.3 less than in 1890. The corresponding increase in the percentages of tenant-operated farms gives to cash tenants an increase of 7.9, and to share tenants, 12.4. These great increases are largely due to the opening to settlement of large tracts of Government lands.

Of the total number of farms, 5.1 per cent are operated by colored farmers, of whom about one-third are Indians. Of the white farmers, 78.4 per cent own all or a part of the land they operate, while for colored farmers this percentage is 78.7.

The census of 1890 did not report the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the per cent of farms conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The Territory	62,495	251.5	15,719,258	100.0	$185,343,818	100.0
White farmers	59,324	256.5	15,217,347	96.8	179,895,037	97.0
Indian farmers	915	256.8	234,954	1.5	2,527,455	1.4
Negro farmers	2,256	118.3	266,957	1.7	2,921,326	1.6
Owners	42,241	164.2	6,935,760	44.1	98,401,427	53.1
Part owners	6,113	445.1	2,720,961	17.3	30,066,722	16.2
Owners and tenants	686	191.1	131,115	0.8	1,830,494	1.0
Managers	306	6,018.8	1,841,750	11.7	16,618,885	9.0
Cash tenants	5,020	564.8	2,835,470	18.1	22,211,948	12.0
Share tenants	8,129	154.3	1,254,202	8.0	16,214,342	8.7

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The Territory	$1,764	$220	$105	$877	$597	20.1
White farmers	1,800	224	108	900	616	20.3
Indian farmers	1,628	220	93	822	187	6.8
Negro farmers	848	94	47	306	271	20.9
Owners	1,476	213	99	542	477	20.5
Part owners	2,689	350	177	1,702	1,105	22.5
Owners and tenants	1,709	243	105	611	566	21.2
Managers	23,716	818	280	29,496	10,960	20.2
Cash tenants	2,437	183	104	1,701	697	15.7
Share tenants	1,322	157	78	438	392	19.7

The average values of farm property for Indian farmers are but little lower than for white farmers, but the average and percentage of gross income are very much lower. All the averages are very much lower for negro farmers, but the per cent of gross income is highest for this group. This high rate of gross income is due to the smaller average area and more intensive cultivation of the farms of this group and to the low values of farm property or capital invested.

The farms operated by managers are larger, have more capital invested, and a much larger gross income than any other class. The ratio which the latter amount bears to the total value of their farm property is, however, smaller than for some other tenure groups, because of the high average valuation of land and buildings.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The Territory	62,495	251.5	15,719,258	100.0	$185,343,818	100.0
Under 3 acres	76	2.0	152	[1]	511,932	0.3
3 to 9 acres	223	7.8	1,732	[1]	152,851	0.1
10 to 19 acres	458	15.9	7,304	[1]	236,294	0.1
20 to 49 acres	2,759	34.9	96,360	0.6	2,025,802	1.1
50 to 99 acres	6,425	77.6	498,382	3.2	8,381,492	4.5
100 to 174 acres	42,579	157.2	6,693,347	42.6	94,550,858	51.0
175 to 259 acres	3,665	209.0	765,871	4.9	11,734,648	6.3
260 to 499 acres	4,929	341.6	1,683,514	10.7	24,192,713	13.1
500 to 999 acres	800	699.8	559,812	3.6	6,460,602	3.5
1,000 acres and over	581	9,316.3	5,412,784	34.4	37,096,626	20.0

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The Territory	$1,764	$220	$105	$877	$597	20.1
Under 3 acres	260	203	28	6,245	237	3.5
3 to 9 acres	257	184	33	211	146	21.3
10 to 19 acres	240	93	32	151	161	31.3
20 to 49 acres	421	93	41	179	191	26.0
50 to 99 acres	825	139	62	279	312	23.9
100 to 174 acres	1,445	198	96	482	458	20.6
175 to 259 acres	2,092	289	149	672	736	23.0
260 to 499 acres	3,083	407	201	1,217	1,047	21.3
500 to 999 acres	4,317	563	251	2,945	1,728	21.4
1,000 acres and over	27,018	945	363	35,524	10,214	16.0

Over two-thirds of all farms in the state belong to the medium-sized class—100 to 174 acres. The acreage of this group is about two-fifths and the value about one-half of the state total. Of the 581 farms containing 1,000 acres and over, 280 were operated by "part owners" and 108 by "managers," and of the total number 470 were "live-stock farms."

With a few exceptions, the average values of the several forms of farm property increase with the size of the farms. The high average value of live stock and large gross income for farms under 3 acres are due to the fact that most of this class are live-stock farms, whose operators use the public domain for range purposes, while others are dairy or truck farms. The incomes from these industries depend less upon the acreage of owned or rented land than upon the capital invested in buildings, implements, and live stock, and the amount expended for labor.

The average gross income per acre for the various groups classified by area is as follows: Farms under 3 acres, $118.55; 3 to 9 acres, $18.78; 10 to 19 acres, $10.13; 20 to 49 acres, $5.47; 50 to 99 acres, $4.02; 100 to 174 acres, $2.91; 175 to 259 acres, $3.52; 260 to 499 acres, $3.07; 500 to 999 acres, $2.47; 1,000 acres and over, $1.10.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm. If vegetables are the leading crop, constituting 40.0 per cent of the value of such products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40.0 per cent of their income from any one class of farm products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The Territory	62,495	251.5	15,719,258	100.0	$185,343,818	100.0
Hay and grain	28,956	183.3	5,306,366	33.8	80,328,015	43.3
Vegetables	528	147.0	77,640	0.5	848,737	0.5
Fruit	161	134.4	21,631	0.1	412,020	0.2
Live stock	14,896	514.4	7,661,781	48.7	74,101,280	40.0
Dairy produce	3,238	185.7	601,135	3.8	6,442,276	3.5
Tobacco	20	253.8	5,076	(1)	50,836	(1)
Cotton	6,535	124.1	811,237	5.2	8,673,420	4.7
Sugar	58	249.5	14,473	0.1	153,798	0.1
Flowers and plants	7	4.6	32	(1)	25,145	(1)
Nursery products	26	102.9	2,675	(1)	92,739	(1)
Miscellaneous	8,070	150.8	1,217,212	7.8	14,215,552	7.7

1 Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The Territory	$1,764	$220	$105	$877	$597	20.1
Hay and grain	1,924	246	128	476	595	21.4
Vegetables	1,107	150	61	289	396	24.7
Fruit	1,763	363	93	340	604	23.6
Live stock	2,333	252	110	2,280	957	19.2
Dairy produce	1,103	154	69	664	192	9.7
Tobacco	1,520	363	105	554	430	16.9
Cotton	889	116	56	266	341	25.7
Sugar	1,394	804	82	372	327	12.8
Flowers and plants	1,793	1,643	142	14	1,150	32.0
Nursery products	2,693	648	121	105	2,936	82.3
Miscellaneous	1,151	169	75	367	321	18.2

For the several classes of farms the average values per acre of products not fed to live stock are as follows: Farms whose operators derive their principal income from flowers and plants, $251.56; nursery products, $28.54; fruit, $4.49; hay and grain, $3.24; cotton, $2.75; vegetables, $2.70; live stock, $1.86; tobacco, $1.69; sugar, $1.31; dairy products, $1.04; and miscellaneous, $2.13. In obtaining these averages the total acreage of each group was used and not the acreage in the crop from which the group is named.

The wide variations in the averages and percentages of gross income are largely due to the fact that in computing gross income no deductions are made for expenditures. Were it possible to present the average net income, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The Territory	62,495	251.5	15,719,258	100.0	$185,343,818	100.0
$0	2,777	994.8	2,762,461	17.6	16,233,190	8.8
$1 to $49	3,454	156.9	541,913	3.4	4,016,150	2.2
$50 to $99	3,817	158.3	604,059	3.8	4,894,020	2.6
$100 to $249	11,938	154.9	1,848,706	11.8	17,999,760	9.7
$250 to $499	16,278	161.0	2,620,581	16.7	33,089,065	17.8
$500 to $999	16,490	190.8	3,145,615	20.0	50,896,338	27.5
$1,000 to $2,499	6,862	270.7	1,857,715	11.8	34,618,305	18.6
$2,500 and over	879	2,648.7	2,338,208	14.9	23,696,990	12.8

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The Territory	$1,764	$220	$105	$877	$597	20.1
$0	2,642	73	43	3,088	....	....
$1 to $49	753	73	39	298	22	1.9
$50 to $99	809	91	46	336	62	4.8
$100 to $249	931	114	56	407	158	10.5
$250 to $499	1,311	169	82	471	355	17.5
$500 to $999	1,980	277	134	695	692	22.4
$1,000 to $2,499	3,129	512	229	1,160	1,396	27.8
$2,500 and over	12,072	820	412	13,655	9,516	35.3

Most of the farms reporting no income for 1899 were homesteads taken up too late for cultivation during that year. The facts that of the 2,777 farms in this class 2,029 were from 100 to 175 acres in size, and that 2,084 of them were operated by owners, sustain this view. There were some farms, also, from which no reports of the products of 1899 could be secured, as the persons in charge June 1, 1900, did not operate the farms during the preceding year and could give no information concerning the products of that year. To this extent the reports fall short of giving a complete exhibit of farm income in 1899.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping for neat cattle was determined by their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits a very close comparison with the figures published in the Eleventh Census.

Table 14 presents a summary of live-stock statistics.

TABLE 14.—NUMBER OF DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age, in years.	ON FARMS.			NOT ON FARMS.
		Number.	Value.	Average value.	Number.
Calves	Under 1	300,125	$3,208,409	$10.69	1,353
Steers	1 and under 2	159,651	2,961,890	18.55	497
Steers	2 and under 3	191,340	4,550,770	23.78	97
Steers	3 and over	306,675	8,892,081	29.00	41
Bulls	1 and over	22,823	917,477	40.20	101
Heifers	1 and under 2	125,029	2,262,978	18.10	410
Cows kept for milk	2 and over	165,852	5,045,668	30.42	3,761
Cows and heifers not kept for milk.	2 and over	438,257	9,943,942	22.69	737
Colts	Under 1	26,933	423,331	15.72	374
Horses	1 and under 2	28,382	656,139	23.12	230
Horses	2 and over	248,316	9,535,824	38.40	15,084
Mule colts	Under 1	6,272	162,288	25.88	127
Mules	1 and under 2	6,751	252,457	37.40	88
Mules	2 and over	42,654	2,413,885	56.59	1,524
Asses and burros	All ages	1,521	124,171	81.64	129
Lambs	Under 1	22,823	39,255	1.72	14
Sheep (ewes)	1 and over	37,641	105,841	2.81	15
Sheep (rams and wethers).	1 and over	10,894	34,642	3.18	11
Swine	All ages	584,878	2,380,025	4.07	6,102
Goats	All ages	3,772	10,854	2.88	105
Fowls:[1]					
Chickens[2]		2,527,353	900,743		
Turkeys		86,460			
Geese		12,934			
Ducks		71,562			
Bees (swarms of)		1,910	6,998	3.66	
Value of all live stock			54,829,568		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The total value of all live stock on farms, June 1, 1900, was $54,829,568, of which 59.7 per cent represents the value of neat cattle other than dairy cows; 19.4 per cent, that of horses; 9.2 per cent, that of dairy cows; 5.2 per cent, that of mules; 4.3 per cent, that of swine; and 2.2 per cent, that of all other live stock. No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the total value of the domestic animals not on farms, given in Table 14, is $888,806. Exclusive of poultry and bees not on farms, the total value of live stock in the state is approximately $55,718,374.

CHANGES IN LIVE STOCK KEPT ON FARMS.

The following table shows the changes since 1890 in the numbers of the most important domestic animals:

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1890 AND 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	165,852	1,543,900	303,631	57,198	48,535	584,878
1890	16,756	110,199	25,554	4,923	16,565	21,962

[1] Lambs not included.

In the last decade the opening up and settlement of new lands have effected important changes in the numbers of all classes of live stock. In comparison with the figures of 1890, the census of 1900 reports, approximately, ten times as many dairy cows; fourteen times as many other neat cattle; twelve times as many horses, mules, and asses; three times as many sheep; and twenty-seven times as many swine.

Although in 1900 the enumerators were instructed to report no fowls under three months old, and in 1890 no such limitation was made, the later census shows, approximately, eighteen times as many geese, sixteen times as many ducks, fifteen times as many turkeys, and seven times as many chickens.

ANIMAL PRODUCTS.

Table 16 is a summarized statement of the products of the animal industry.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	278,425	$37,750
Mohair and goat hair	Pounds	693	187
Milk	Gallons	[1]47,439,853	} [2]2,481,673
Butter	Pounds	8,781,359	
Cheese	Pounds	45,264	
Eggs	Dozen	13,724,900	1,284,414
Poultry			1,302,460
Honey	Pounds	16,540	} 2,257
Wax	Pounds	400	
Animals sold			10,547,764
Animals slaughtered			2,925,846
Total value			18,582,351

[1] Comprises all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Comprises the value of milk sold and consumed, and of butter and cheese made.

The value of animal products in 1899 was $18,582,351, of which 72.5 per cent represents the value of animals sold and animals slaughtered on farms; 13.9 per cent, that of poultry and eggs; 13.4 per cent, that of dairy products; and 0.2 per cent, that of wool, mohair, honey, and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED ON FARMS.

Of all farmers reporting domestic animals, 35,702, or 59.2 per cent, reported animals slaughtered, the average value per farm being $81.95. Of all reporting domestic animals, 31,560, or 52.3 per cent, reported sales, the average receipts per farm being $334.21. The value of animals sold and animals slaughtered on farms was $13,473,610, or 36.1 per cent of the gross farm income. In obtaining these reports the enumerators were instructed to secure from each farm operator a statement of the amount received from sales in 1899, less the amount paid for animals purchased the same year.

DAIRY PRODUCE.

The production of milk in 1899 was 47,439,853 gallons, thirty times as great as ten years before. There were made on farms in 1899 nearly twenty-three times as much butter, and more than twenty-eight times as much cheese, as ten years before.

Of the $2,481,673 given in Table 16 as the value of dairy products, $1,821,125, or 73.4 per cent, represents the value of such products consumed on farms, and $660,548, or 26.6 per cent, the receipts from sales of dairy products. Of the latter amount, $358,347 was received from the sale of 2,806,790 pounds of butter; $293,976, from 2,701,471 gallons of milk; $4,969, from 8,434 gallons of cream; and $3,256, from 30,628 pounds of cheese.

POULTRY, EGGS, WOOL, HONEY, AND WAX.

The total value of the products of the poultry industry in 1899 was $2,586,874, of which 50.3 per cent represented the value of poultry raised, and 49.7 per cent, the value of eggs produced. There were 13,724,900 dozen eggs produced in 1899, nearly fourteen times the number reported in 1890.

More than four times as much wool was reported in 1900 as in 1890, and the average weight of fleeces increased from 4.8 pounds in 1890 to 5.4 pounds in 1900.

In 1899, 16,540 pounds of honey were produced, almost six times as much as ten years before, and 400 pounds of wax, sixteen times the product of 1889.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	56,574	303,631	5.4	46,559	165,852	3.6
White farmers	53,946	280,668	5.2	45,335	163,196	3.6
Colored farmers	2,628	22,963	8.7	1,224	2,656	2.2
Owners[1]	44,989	244,052	5.4	37,767	139,443	3.7
Managers	246	5,507	22.4	164	693	4.2
Cash tenants	4,476	24,931	5.6	3,611	12,369	3.4
Share tenants	6,863	29,141	4.2	5,017	13,347	2.7
Under 20 acres	537	2,062	3.8	329	828	2.5
20 to 99 acres	7,723	25,019	3.2	5,761	14,506	2.5
100 to 174 acres	38,801	187,102	4.8	32,008	110,210	3.4
175 to 259 acres	3,414	20,449	6.0	3,140	12,085	3.8
260 acres and over	6,099	68,999	11.3	5,321	28,223	5.3
Hay and grain	25,702	141,997	5.5	19,738	58,612	3.0
Vegetable	449	1,964	4.4	270	670	2.5
Fruit	141	548	3.9	104	315	3.0
Live stock	14,236	100,489	7.1	12,731	56,049	4.4
Dairy	3,013	14,329	4.8	3,238	18,131	5.6
Cotton	5,599	16,112	2.9	4,293	12,690	3.0
Miscellaneous[2]	7,434	28,192	3.8	6,185	19,385	3.1

[1] Including "part owners" and "owners and tenants."
[2] Including tobacco farms, sugar farms, florists' establishments, and nurseries.

CROPS.

The following table gives the statistics of the principal crops of 1899:

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	1,320,506	Bushels	38,239,880	$8,699,271
Wheat	1,279,826	Bushels	18,124,520	8,989,416
Oats	156,619	Bushels	5,087,930	1,079,862
Barley	16,453	Bushels	346,730	80,153
Rye	3,501	Bushels	41,220	16,519
Buckwheat	13	Bushels	170	100
Kafir corn	63,455	Bushels	1,110,473	228,401
Flaxseed	759	Bushels	5,050	4,562
Clover seed		Bushels	178	728
Grass seed		Bushels	3,752	2,021
Hay and forage	695,313	Tons	1,146,455	2,883,682
Cotton	240,678	Pounds	36,006,020	2,217,119
Cottonseed		Tons	29,207	250,815
Tobacco	39	Pounds	11,880	1,531
Broom corn	12,366	Pounds	3,418,490	129,813
Peanuts	2,077	Bushels	47,280	27,642
Castor beans	13,997	Bushels	77,185	68,842
Dry beans	590	Bushels	4,353	5,000
Dry pease	171	Bushels	1,911	1,856
Potatoes	7,677	Bushels	559,532	288,117
Sweet potatoes	2,512	Bushels	195,799	96,040
Onions	434	Bushels	58,456	39,958
Miscellaneous vegetables	20,828			865,857
Sorghum cane	9,788	Tons	25,327	69,007
Sorghum sirup		Gallons	81,891	24,825
Small fruits	810			63,519
Orchard fruits[1]	114,700	Bushels		[2]245,990
Grapes[1]	5,060	Centals	61,110	[3]128,500
Nuts				352
Forest products				252,951
Flowers and plants	9			6,574
Seeds	169			4,825
Nursery products	711			84,437
Miscellaneous	2,248			17,108
Total	3,971,309			26,865,393

[1] Estimated from number of vines or trees.
[2] Including value of cider and vinegar.
[3] Including value of wine, raisins, etc.

Of the total value of crops, cereals, including Kafir corn, contributed 71.1 per cent; hay and forage, 10.7 per cent; cotton, including seed, 9.2 per cent; vegetables, including potatoes, sweet potatoes, and onions, 4.8 per cent; fruit, 1.6 per cent; and all other crops, 2.6 per cent.

The average values per acre of the various crops were as follows: Flowers and plants, $730.44; nursery products, $118.76; onions, $92.07; small fruits, $78.42; miscellaneous vegetables, $41.57; tobacco, $39.26; sweet potatoes, $38.23; potatoes, $37.53; seeds, $28.55; grapes, $25.40; peanuts, $13.31; broom corn, $10.50; cotton, $10.25; beans and pease, $9.01; and cereals, $6.72.

COTTON.

But three counties, Canadian, Cleveland, and Greer, reported cotton in 1889. The number of acres seeded to the crop in that year was 1,109, and the quantity of cotton produced was 202,725 pounds, an average of 183 pounds per acre.

In 1899, 16,316 farmers devoted an area of 240,678 acres to the production of cotton, an average of 14.8 acres per farm. From this land was obtained 36,006,020 pounds of cotton, an average of 2,207 pounds per farm, and 150 pounds per acre. The total value of this crop, including the value of the cottonseed, was $2,467,934, an average of $151.26 per farm, and $10.25 per acre. This value constituted 6.6 per cent of the gross farm income.

The counties having the largest area under cotton in 1899 were Lincoln, Pottawatomie, Cleveland, and Greer, ranking in the order named, and reporting, in the aggregate, 65.3 per cent of the total acreage. These counties are located in the central and extreme southwestern parts of the territory.

CEREALS.

The following table is a statement of the changes in cereal production since 1889:

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1889 AND 1899.

PART 1.—ACREAGE.

YEAR.	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	16,453	13	1,320,506	156,619	3,501	1,279,826
1889	17		13,307	4,446	110	2,003

PART 2.—BUSHELS PRODUCED.

YEAR.	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	346,730	170	38,239,880	5,087,930	41,220	18,124,520
1889	112		234,315	76,194	1,052	30,175

The total area devoted to cereals in 1889 was 19,883 acres; and in 1899, 2,776,918 acres. The increases in the acreages devoted to cereals in the decade from 1889 to 1899 were very rapid, the gains ranging from over thirty to nearly one thousand fold. The total number of bushels produced in 1889 was 341,848, while the production in 1899 was 61,840,450 bushels, or more than 180 times as great.

Of the total area under cereals in 1899, 47.6 per cent was devoted to corn; 46.1 per cent, to wheat; and 6.3 per cent, to oats, barley, rye, and buckwheat.

Corn was extensively raised in 1899, Woods county alone producing 4,521,110 bushels. Grant, Lincoln, Payne, Kay, and Garfield counties, and the Osage and Kaw Indian reservations, each reported over 2,000,000 bushels, and 10 others, each over 1,000,000 bushels. Wheat was grown in nearly all counties, those in the Arkansas River valley showing the largest returns. Oats, barley, and rye were produced in large quantities in the Cimarron and Canadian River valleys, but very little attention was given to buckwheat.

Kafir corn was grown in 1899 by 4,747 farmers on 63,455 acres, an average of 13.4 acres for each farm reporting. From this area was obtained a yield of 1,110,473 bushels, or an average of 17.5 bushels per acre. The total value of the crop was $228,401, an average of $48.11 for each farm reporting. The average value per bushel was $0.21, and the average value per acre was $3.60. The crop was grown in all parts of the territory, but 37.3 per cent of the entire acreage was furnished by the two counties of Greer and Woods.

HAY AND FORAGE.

In 1900, 36,693 farmers, or 58.7 per cent of the total number, reported hay and forage crops. Exclusive of cornstalks, they obtained an average yield of 1.6 tons per acre. The total acreage in hay and forage for 1899 was 695,313 acres. Of this acreage, 336,977 acres, or 48.5 per cent, produced 368,121 tons of wild, salt, and prairie grasses. The acreages and yields of the other kinds of hay and forage were as follows: Millet and Hungarian grasses, 33,327 acres and 60,788 tons; alfalfa or lucern, 15,116 acres and 27,563 tons; clover, 343 acres and 480 tons; other tame and cultivated grasses, 9,395 acres and 11,975 tons; grains cut green for hay, 25,039 acres and 58,446 tons; crops grown for forage, 275,116 acres and 609,923 tons; and cornstalks, 9,768 acres and 8,159 tons.

In Table 18 the production of cornstalks is included under "hay and forage," but the acreage is included under "corn," as the forage secured was an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1889 are shown in the following table:

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	2,054,894	265	111,235	....
Apricots	231,268	....	493	....
Cherries	404,758	30	1,766	....
Peaches	5,519,072	206	255,933	....
Pears	177,265	4	1,968	....
Plums and prunes	403,317	214	7,986	49

The number of trees reported in the territory in 1889 was only 719, while in 1899 this number had increased to 8,962,971. In 1900, 61.6 per cent of all fruit trees were peach trees; 22.9 per cent, apple trees; 4.5 per cent, cherry trees; 4.5 per cent, plum and prune trees; 2.6 per cent, apricot trees; and 3.9 per cent, pear, and unclassified trees.

A large percentage of the apples grown was reported in Payne, Lincoln, and Pottawatomie counties, in the southeastern part of the territory. Peaches are reported by 37,125 farmers, or 59.4 per cent of the total. Nearly one-half of the trees are in the four north central counties of Woods, Garfield, Grant, and Logan. These counties also report very large percentages of each of the remaining varieties.

In addition to the trees shown in Table 20, unclassified orchard trees to the number of 172,397 are reported, with a yield of 1,136 bushels. The value of orchard products given in Table 18 includes the value of 646 barrels of cider, 519 barrels of vinegar, and 14,350 pounds of dried and evaporated fruits.

SORGHUM CANE.

The present census shows that in 1899 sorghum cane was raised by 2,367 farmers on 9,788 acres, an average of 4.1 acres for each farm reporting. From this area 25,327 tons of cane were sold for $59,007, and from the remaining product 81,891 gallons of sirup, valued at $24,825, were manufactured. This was an increase in acreage since 1889 of 8,944 acres, or over tenfold, and in production of 50,592 gallons, or 161.6 per cent, not including the product of the 25,327 tons of cane sold. The total value of the sorghum cane products was $83,832, an average for each farm reporting of $35.42. The average value per gallon was $0.30. The crop was grown in 25 counties and reservations, Greer county leading with an area of 1,574 acres.

CASTOR BEANS.

Castor beans were grown in 1899 by 1,296 farmers, who devoted to their cultivation 13,997 acres, and secured therefrom a product of 77,185 bushels, an average of 5.5 bushels per acre. Of the total acreage, 94.0 per cent was reported from the central and eastern counties of Payne, Dewey, Lincoln, Pawnee, Logan, Garfield, Noble, and Custer, ranking in the order named.

VEGETABLES.

The total area devoted to vegetables in 1899, including potatoes, sweet potatoes, and onions, was 31,451 acres. Aside from the land devoted to potatoes, sweet potatoes, and onions, 20,828 acres were used in the growing of miscellaneous vegetables. Of this area, the products of 12,077 acres were not reported in detail. Of the remaining 8,751 acres, 4,469 acres were devoted to watermelons; 1,371, to muskmelons; 1,019, to sweet corn; 864, to cabbages; 690, to tomatoes; 263, to cucumbers; and 75, to other vegetables.

SMALL FRUITS.

The total area used in the growing of small fruits was 810 acres. Of this area, 620 acres, or 76.5 per cent, were devoted to blackberries and dewberries, the total production of which was 646,320 quarts. The acreages and productions of the other berries were as follows: Strawberries, 124 acres and 197,290 quarts; raspberries and Logan berries, 35 acres and 42,530 quarts; currants, 10 acres and 9,720 quarts; gooseberries, 8 acres and 7,550 quarts; and other berries, 13 acres and 13,300 quarts.

FLORICULTURE.

Floriculture in Oklahoma, as in all new states and territories, is a relatively unimportant industry. In 1899 the operators of 17 farms raised flowers and foliage plants valued at $6,574, but of this number only 7 derived their principal income from this source. These 7 commercial florists had a gross income of $8,050, of which $5,900 was derived from flowers and plants, and $2,150, from other products. The capital invested was $25,145; of which $12,550 was in land; $11,500, in buildings; $995, in implements; and $100, in live stock. The expenditure for labor was $800.

In addition to the 7 principal florists' establishments, 23 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 5,598 square feet, making, with the 20,422 square feet belonging to the florists' establishments, 26,020 square feet.

NURSERIES.

The total value of nursery stock sold in 1899 was $84,437, reported by the operators of 78 farms and nurseries. Of this number, 26 derived their principal income from the nursery business. They had 2,675 acres of land, valued at $70,015; buildings worth $16,835; implements and machinery valued at $3,159; and live stock worth $2,730. Their total gross income was $76,333, of which $72,743 was derived from the sale of trees, shrubs, and vines, and $3,590 from the sale of other farm products.

LABOR.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $2,359,650, an average of $38 per farm. The average was highest on the most intensively cultivated farms, being $455 for nurseries, $114 for florists' establishments, $51 for live-stock farms, $47 for hay and grain farms, $45 for fruit farms, $26 for sugar farms, $16 for vegetable farms, $10 for dairy and tobacco farms, and $9 for cotton farms. "Managers" expended on an average $689; "cash tenants," $58; "owners," $27; and "share tenants," $18. White farmers expended $39 per farm, and colored farmers, $9.

INDIAN RESERVATIONS.

The Indians of Oklahoma represent several linguistic stocks and many different tribes, having been collected from adjoining states and even remote regions. The Kiowa, Comanche, and a small band of Apache are the only native tribes of this locality. The lands of the following bands have been allotted and the surplus opened to settlement: Cheyenne and Arapaho, Iowa and Tonkawa, Mexican, Kickapoo, Tonkawa and Lipan, Pawnee, Absentee Shawnee and Potawatomi, Ottawa, Sac and Fox of the Missouri and Mississippi. There were still six reservations intact when the Twelfth Census was taken, Osage, Kaw, Ponca, Otoe, Wichita, and Kiowa and Comanche. The two last-named, however, have since been allotted and thrown open. Much of the Indian land is suitable either for cultivation or grazing and some Indians have made fair progress in the development of their allotments, but annuity payments and the returns from leased land have allowed many of them to live in idleness, and comparatively little attention is devoted to agriculture.

OSAGE AND KAW RESERVATIONS.

Osage reservation, embracing an area of 2,297 square miles, is situated in the extreme northeastern part of Oklahoma. Kaw, which adjoins it on the northwest, was formerly a portion of the Osage reserve and contains 156¼ square miles. The land included within these tracts was originally purchased by the Osage from the Cherokee of Indian Territory. The river bottoms and small valleys contain fine tracts of farming land, while the prairies and upland hills yield abundant prairie grass, thus making an excellent grazing country of vast extent.

The Osage (Siouan) are the largest, physically, and also the wealthiest Indians in the United States. The population of their reserve is 6,717, of which only about about one-third is Indian. Farming and stock raising have been their only occupations, but they have too much money to put any energy into agriculture, the majority preferring to live at the village in idleness. Their income from annuity payments and from farming and grazing leases amounts to over $200 per man, woman, and child. Nearly every family has one or more farms rented to white men. The full bloods are still "blanket Indians" to a large extent, and very nonprogressive, although many can speak English. The mixed bloods, however, are more industrious, having well kept farms and stock. All speak English and have a common school education, while some of them are wealthy. Annuity payments furnish 92.0 per cent of the support of the Osage.

The Kaw, also of Siouan stock, are no more progressive than their neighbors, although they have to work to some extent, as they receive much less annuity money. Most of their farms are rented out and many of them live in idleness. The total population of the reserve is 768, of which number less than one-third is Indian. Annuity payments constitute 75.0 per cent of their support.

Corn and wheat are the principal crops of the Osage and Kaw, and wild hay is cut in large quantities. Some farmers also raise Kafir corn, millet, and Hungarian grasses, and a few have small areas in sorghum cane. A number grow potatoes and small fruits, but vegetable gardens are not general. Orchards of apple, peach, pear, plum, and cherry trees are quite common among these Indians, and some cultivate grapes.

Of the 960 farms on the two reservations, only 133 are operated by Indians. The majority of Indian farmers cultivated from 50 to 300 acres, and one had 900 acres under cultivation. No allotments have been made on either reserve, and several intelligent Indians have taken advantage of this fact to occupy extensive tracts and enjoy the profits derived from their cultivation.

Most Indian farmers are well supplied with horses and cattle, and many own mules. A number have large herds of range cattle, and reported sales of live stock from \$1,000 to \$3,000. Dairy cows are found on the majority of farms, and on some, chickens and swine.

PONCA AND OTOE RESERVATIONS.

Ponca and Otoe reservations are situated in Noble county, in the northeastern part of Oklahoma, and contain 159 and 201⅝ square miles, respectively. The greater part of the former and more than one-half of the latter has been allotted. About nine-tenths of the Ponca and eight-tenths of the Otoe reserves are cultivable, as the land is largely prairie, with a rich, well-watered soil, peculiarly adapted to wheat raising and suitable for cotton.

The Ponca, of Siouan stock, are agriculturists, but as they can readily lease their lands few have any desire to labor. The only perceptible progress seems to be in house building and many now have good homes with furniture, cooking utensils, and other modern conveniences. The population of the reserve is 1,537, of which a little more than one-third is Indian.

The crops of the Ponca, Otoe, and Missouri are corn and wheat, and large quantities of wild prairie grass are cut. Many of the white tenants raised sorghum cane, and Kafir corn for forage, while some cultivated large areas of broom corn. Only 39 of the 256 farms on these two reserves were operated by Indians, an evidence of the prevalent leasing system. The majority of Indian farmers cultivated from 15 to 30 acres.

The Indian farmers owned no cattle, their live stock consisting principally of work horses.

WICHITA, KIOWA, AND COMANCHE RESERVATIONS.

Wichita, Kiowa, and Comanche reservations, which have been allotted and opened to settlement since 1900, are located in the extreme southern part of Oklahoma and adjoin the Chickasaw Nation on the west. Wichita, the more northern of the two, comprises an area of 1,162 square miles, while Kiowa and Comanche contains 4,639 square miles. This is the most extensive grazing section of Oklahoma, embracing immense prairies, well watered and covered with native grasses, which will withstand a long drought. Walled valleys among the Kiowa mountains also furnish an excellent winter range, and large areas of grazing land are leased to white cattlemen. This tract is not generally adapted to cultivation, although fine farms are found in the bottom lands along streams. The soil is well suited to cotton, but only a very little of it has ever been grown, as the prevailing hot winds of summer and the uncertainty of rainfall are greatly detrimental to successful agriculture.

The Wichita (Pani Caddoan), with a few small bands of affiliated tribes, live on the reservation bearing that name, which has a population of 1,420, about one-third of which is Indian. Having been largely dependent upon their own efforts for support, they are peaceable and more industrious than their neighbors, the Kiowa and Comanche, who, with a small band of Apache (Athapascan) and Delaware (Algonquian), inhabit the Kiowa and Comanche Reservation, which has a total population of 4,968, two-thirds Indian.

Agriculture and stock raising are the principal industries carried on by the tribes on these two reservations, while a few are engaged in freighting Government supplies. The Wichita are the best farmers, and some who raise cattle are now able to support themselves from the returns of their sales of live stock. Fort Sill and the agency furnish a market for their principal crops, consisting of corn, prairie grass, millet, and Kafir corn. The latter will mature on the uplands where the drought would kill Indian corn, and is considered excellent forage. Some reported small areas in sweet potatoes, melons, and sweet corn, but garden vegetables are not generally raised. Considerable interest is taken in stock raising, and all Indian farmers own some range cattle, but few have dairy cows. A number are exclusively engaged in the industry and have acquired large herds. All have more Indian ponies than necessary, and a few farmers raise chickens and swine. There were 459 farms on the two reserves, of which 285 were operated by Indians. The majority of them cultivated from 10 to 70 acres, while a few had over 100 acres in cultivation.

IRRIGATION STATISTICS.

In the territory of Oklahoma the necessity for irrigation is not so imperative as in other states and territories near the one-hundredth meridian. The areas artificially watered in 1899 were principally confined to the counties in the extreme northwestern part of the territory.

More than one-half of the irrigated area is in Beaver county, a long, narrow strip of land extending west of the main part of the territory, across the northern end of the Texas Panhandle and bounded by Kansas, Colorado, New Mexico, and Texas. The Cimarron River, which rises in the mountains in the northeastern part of New Mexico, flows across the northwestern end of the county into Kansas. A number of ditches are taken out of the main stream and its tributaries. The principal branch of the Cimarron used for irrigation is Beaver Creek, which rises just over the border line of New Mexico, and flows in a general easterly direction through the center of Beaver county, and diagonally across Woodward county. This stream and its numerous spring-fed branches furnish an ample supply of water to the ditches taken from them. Its valley is narrow, but fertile, and the soil, when watered, is well adapted to the cultivation of all crops of the temperate zone.

The total acreage irrigated in the territory in 1899 was 2,759 acres. Of this, 139 acres were irrigated from wells by the use of pumping plants costing $2,200. The remaining 2,620 acres were irrigated from streams. The principal crops grown on this land were alfalfa and vegetables, with some fruits.

The following table shows, by counties, the number of irrigators, the number of acres irrigated from streams and wells in 1899, the value of irrigated and unirrigated arable land, and the number, length, and cost of construction of ditches:

TABLE A.—NUMBER OF IRRIGATORS, AND NUMBER OF ACRES IRRIGATED FROM STREAMS AND WELLS IN 1899, WITH VALUE OF IRRIGATED AND UNIRRIGATED ARABLE LAND, AND NUMBER, LENGTH, AND COST OF CONSTRUCTION OF DITCHES.

COUNTIES.	Number of irrigators.	ACRES IRRIGATED.			AVERAGE VALUE OF ARABLE LAND PER ACRE.		DITCHES.		
		Total.	From streams.	From wells.	Irrigated.	Unirrigated.	Number.	Length in miles.	Cost of construction.
The Territory	124	2,759	2,620	139			69	68	$19,672
Beaver	54	1,393	1,290	103	$37.28	$2.67	38	44	9,267
Woodward	18	251	250	1	32.48	4.30	11	4	2,155
Other counties	52	1,115	1,080	35			20	20	8,250

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Twelfth Census of the United States.

CENSUS BULLETIN.

No. 231. WASHINGTON, D. C. July 5, 1902.

AGRICULTURE.

WASHINGTON.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of Washington, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations.

The farms of Washington, June 1, 1900, numbered 33,202, and were valued at $115,609,710. Of this amount, $16,299,200, or 14.1 per cent, represents the value of buildings; and $99,310,510, or 85.9 per cent, the value of the land and improvements other than buildings. On the same date the value of farm implements and machinery was $6,271,630, and of live stock, $22,159,207. These values added to that of farms give $144,040,547, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed, "total value of farm products." This value for 1899 was $34,827,495, of which amount $11,295,345, or 32.4 per cent, represents the value of animal products, and $23,532,150, or 67.6 per cent, the value of crops, including forest products cut or produced on farms. The "total value of farm products" for 1899 exceeds that for 1889 by $21,152,565, or 154.7 per cent, but a part of this gain is doubtless due to a more detailed enumeration in 1900 than in 1890.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $5,209,040, leaving $29,618,455 as the gross farm income for that year. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For Washington in 1899 it was 20.6 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

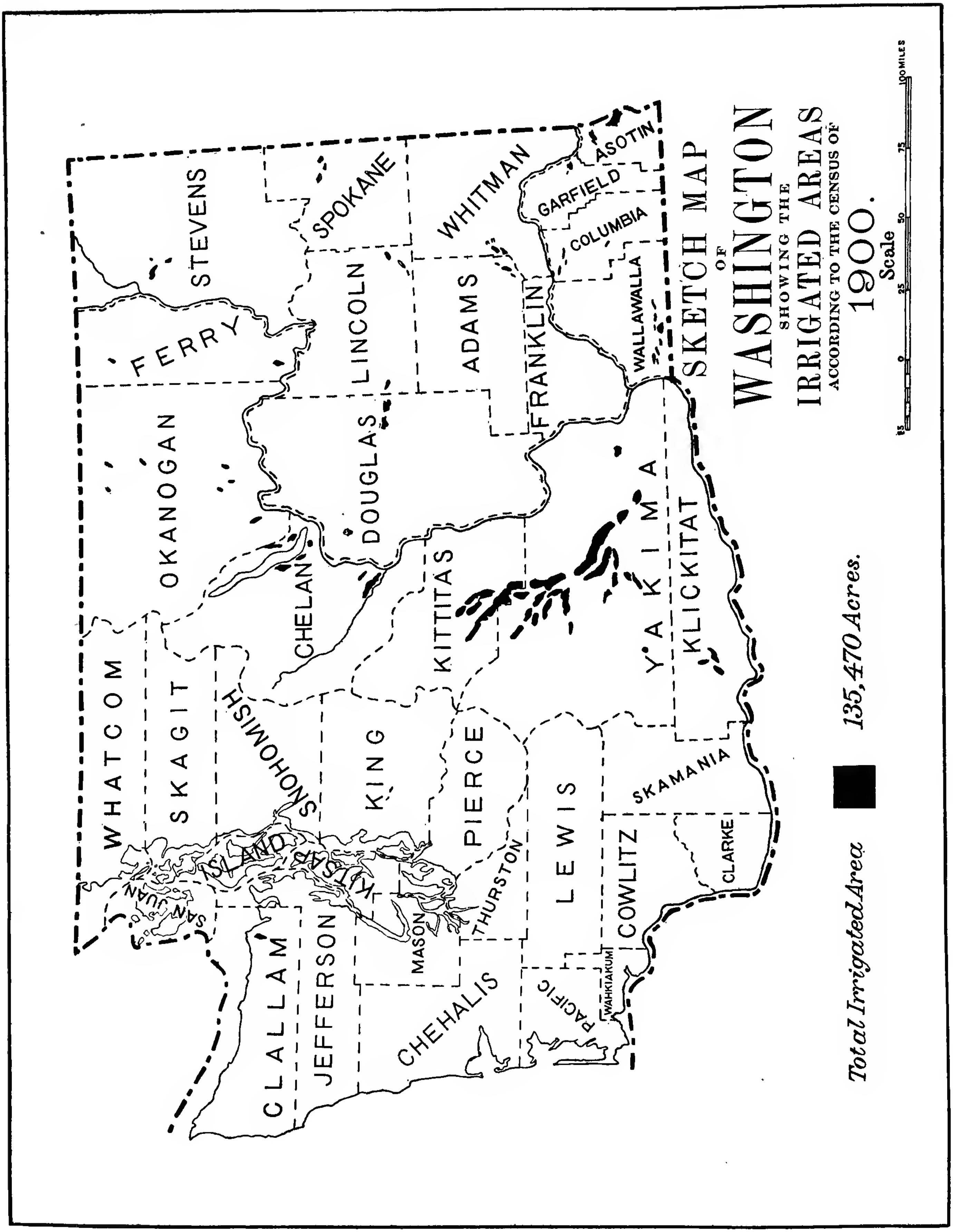
Special reports as to the dimensions and cost of the leading irrigation ditches and canals, the area of land under them, methods for the artificial application of water to the growing crops, and other facts relating to irrigation were obtained by correspondence with farmers, engineers, and others. This correspondence was under the joint direction of Mr. F. H. Newell, chief hydrographer of the Geological Survey, acting as expert special agent for the division of agriculture, and Mr. Clarence J. Blanchard.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for Washington.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.



SKETCH MAP OF WASHINGTON SHOWING THE IRRIGATED AREAS ACCORDING TO THE CENSUS OF 1900.

AGRICULTURE IN WASHINGTON.

GENERAL STATISTICS.

Washington has a total land area of 66,880 square miles, or 42,803,200 acres, of which 8,499,297 acres, or 19.9 per cent, are included in farms.

The state of Washington comprises two natural divisions. Eastern Washington, through which the Columbia River flows, includes all that portion of the state lying east of the Cascade Range. It is, in great part, composed of rolling plateaus, rising from its lowest portion, along the Columbia and Snake rivers, at an elevation of from 300 to 700 feet above sea level, to altitudes of 2,000 feet along the eastern boundary. The soil of this part of the state is generally of volcanic origin and very productive. The rainfall is not heavy, but commonly sufficient for agriculture without irrigation.

Western Washington differs widely in topography and climate from eastern Washington. The arable lands lie in a depression between the Cascade Range on the east and the Coast Range and Olympic Mountains on the west, a depression comprising Puget Sound and the valleys of Cowlitz, Clark and other rivers. The whole of western Washington enjoys an ample rainfall and is heavily forested.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1860, the number of farms, the total and average acreage, and the per cent of farm land improved.

TABLE 1.—FARMS AND FARM ACREAGE: 1860 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	33,202	8,499,297	3,465,960	5,033,337	256.0	40.8
1890	18,056	4,179,190	1,820,832	2,358,358	231.5	43.6
1880	6,529	1,409,421	484,346	925,075	215.9	34.4
1870	3,127	649,139	192,016	457,123	207.6	29.6
1860	1,330	366,156	81,869	284,287	275.3	22.4

Between 1860 and 1900 the number of farms increased rapidly, the rate for the last decade being 83.9 per cent. The total area in farms is over twenty-three times as great as it was forty years ago, and more than double that of 1890. Since 1870 there has been a steady increase in the average size of farms, which is especially marked in the last decade, but this is largely the result of additions made to ranges, recently taken from the public domain and enumerated as farm land for the first time in 1900. The gain in the percentage of farm land improved has been continuous throughout the period except in the last decade, for which a decrease is shown. This decrease is doubtless the result of a stricter construction of the term "improved land" in 1900 than heretofore, as the increased acreage devoted to all crops indicates that there has been an increase in the acreage actually improved.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1860.

TABLE 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY AND OF FARM PRODUCTS: 1860 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$144,040,547	$115,609,710	$6,271,630	$22,159,207	$34,827,495
1890	100,724,970	83,461,660	3,150,200	14,113,110	13,674,930
1880	19,655,044	13,844,224	958,513	4,852,307	4,212,750
1870[2]	6,362,235	3,978,341	280,551	2,103,343	[3]2,111,902
1860	3,508,155	2,217,842	190,402	1,099,911	....

[1] For year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other years they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

As shown in the above table, there has been a remarkable increase in the value of every form of farm property from 1860 to 1900. In the last decade the gain in the total value of farm property was $43,315,577, or 43.0 per cent. The increase in value of land, improvements, and buildings was $32,148,050, or 38.5 per cent; in that of implements and machinery, $3,121,430, or 99.1 per cent; and in that of live stock, $8,046,097, or 57.0 per cent. The value of farm products shown for 1900 is 154.7 per cent greater than that reported for 1889, but a portion of this increase is doubtless due to the fact that the enumeration of 1900 was more detailed and complete than that made by any previous census. The most important item enumerated in 1900, but not in 1890, is the value of animals sold and animals slaughtered on farms, which for 1899 amounted to $4,685,855.

COUNTY STATISTICS.

Table 3 gives a statement of general agricultural statistics by counties.

TABLE 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH VALUE OF PRODUCTS OF 1899 NOT FED TO LIVE STOCK, AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Value of products not fed to live stock.	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	33,202	32,222	8,499,297	3,465,960	$99,310,510	$16,299,200	$6,271,630	$22,159,207	$29,618,455	$5,280,190	$29,165
Adams	783	747	494,452	275,778	3,557,850	328,100	262,090	612,971	746,859	137,640	...
Asotin	533	520	128,649	37,516	1,211,990	202,230	73,820	427,320	314,784	63,507	718
Chehalis	600	572	85,214	21,726	1,502,310	327,890	89,310	407,034	578,329	85,177	...
Chelan	457	443	94,135	14,034	882,480	129,200	54,920	226,477	254,221	26,030	...
Clallam	395	394	52,667	10,108	722,890	154,790	45,980	160,989	251,870	22,840	180
Clarke	1,873	1,808	192,737	51,102	3,641,380	756,340	173,120	624,415	791,136	101,976	3,830
Columbia	706	693	262,239	151,589	3,849,390	414,560	243,160	641,970	1,140,033	207,420	187
Cowlitz	751	744	108,888	18,641	1,230,290	325,520	60,960	332,426	313,623	39,750	520
Douglas	854	815	421,804	186,232	2,097,150	281,350	219,740	949,449	682,903	98,980	200
Ferry	62	62	15,767	3,833	199,700	26,100	7,780	35,239	38,317	9,650	200
Franklin	61	45	101,547	4,788	91,860	8,860	6,310	168,489	86,873	16,800	...
Garfield	521	511	257,826	115,211	2,074,230	250,980	185,190	559,081	775,356	150,370	100
Island	254	234	30,705	9,368	679,990	142,780	38,460	130,122	197,044	18,520	50
Jefferson	212	211	29,289	6,111	452,300	133,840	29,660	124,429	161,552	22,350	...
King	1,785	1,745	280,558	42,196	5,622,640	1,172,740	190,530	754,637	1,238,835	244,540	9,140
Kitsap	446	442	29,132	5,204	489,940	155,790	20,160	91,718	173,565	18,980	170
Kittitas	699	664	199,085	55,057	1,838,980	328,590	138,530	880,320	827,267	141,620	350
Klickitat	1,080	1,049	404,947	115,530	2,679,200	458,430	216,330	1,007,380	1,045,749	142,040	...
Lewis	1,786	1,772	224,755	53,558	2,773,130	692,800	162,520	702,958	976,832	98,410	300
Lincoln	1,911	1,829	903,997	516,924	8,282,450	839,920	642,280	1,473,528	2,179,851	419,990	100
Mason	274	265	33,636	5,718	445,270	128,380	28,630	114,779	135,874	16,570	500
Okanogan	506	489	80,196	19,599	666,830	127,190	71,810	504,861	207,903	32,770	...
Pacific	342	341	51,936	8,123	621,880	179,620	29,420	182,725	211,346	23,350	...
Pierce	1,455	1,434	146,050	28,505	2,599,340	783,060	139,200	548,795	1,030,759	166,590	7,310
San Juan	338	336	50,981	11,612	725,200	186,440	44,880	148,403	205,461	16,640	...
Skagit	889	880	87,151	38,553	2,956,110	599,200	169,570	542,027	1,043,861	241,930	500
Skamania	239	233	39,851	4,060	306,870	63,730	12,080	85,584	83,303	2,910	50
Snohomish	1,024	1,010	97,507	23,371	2,248,440	532,690	111,900	486,552	692,376	88,900	150
Spokane	2,911	2,856	655,372	280,159	8,373,130	1,514,330	573,190	1,367,962	2,259,296	311,600	200
Stevens	1,132	1,117	215,041	57,582	1,602,190	361,550	146,680	515,649	513,424	64,250	20
Thurston	665	656	128,822	24,018	1,375,410	336,300	84,890	379,421	383,701	26,620	1,540
Wahkiakum	247	239	32,564	4,458	469,680	130,090	23,510	117,264	149,677	16,650	10
Wallawalla	1,029	974	651,847	391,719	10,955,090	1,053,830	528,560	1,442,837	2,827,594	664,010	723
Whatcom	1,262	1,254	119,434	26,642	2,154,160	645,190	134,440	540,428	749,217	45,870	1,070
Whitman	3,081	2,967	1,168,817	711,975	14,805,620	1,768,070	978,610	2,669,902	4,540,101	1,019,340	...
Yakima	1,293	1,210	542,376	104,680	4,237,340	622,440	226,290	1,675,306	1,547,649	411,820	947
Colville and Spokane[1]	351	325	21,969	10,599	141,340	43,280	50,310	211,793	90,986	10,750	100
Lummi[1]	28	26	4,489	956	95,720	15,340	5,580	14,976	12,900	...	...
Makah[1]	7	...	...	...	...	...	...	5,061	377	...	...
Muckleshoot[1]	30	28	3,252	467	52,630	6,830	2,170	5,427	5,074	...	...
Queniult[1]	24	24	3,841	114	20,990	3,320	1,030	3,345	1,857	...	...
Swinomish[1]	7	...	234	234	9,320	...	1,500	1,332	5,157	250	...
Tulalip[1]	30	30	4,296	317	41,080	6,670	1,700	8,297	7,677	...	...
Yakima[1]	269	228	41,242	17,993	526,720	60,840	44,830	275,529	137,886	52,780	...

[1] Indian reservation.

The number of farms increased in the last decade in all counties except Columbia and Garfield. In over one-half of the counties more than twice as many farms were reported. Kitsap county alone reports a decrease in its total farm area, all others showing substantial gains since 1890. The decrease reported in improved acreage in a few counties is due to the use of a more strict construction of the term "improved land" by the Twelfth than by any preceding census. The average size of farms for the state is 256.0 acres, and varies from 65.3 acres in Kitsap county to 1,664.7 acres in Franklin county. The average size of farms is largest in the eastern counties, where cereals and stock raising are the leading agricultural pursuits. Two-thirds of the counties report increases in the value of farms in the last ten years. Of the counties reporting decreases only one is situated in the eastern part of the state. The average value of farms for the state is $3,482.

Marked increases are reported for all counties except Kitsap in the value of implements and machinery, and decreases in the value of live stock are reported for only the three eastern counties of Columbia, Garfield, and Spokane.

The expenditure for labor in 1899 averaged $159.03 per farm. In the live-stock and cereal counties, the average was, as a rule, much higher than in the western counties, where diversified farming prevails.

FARM TENURE.

Table 4 gives a comparative statement of farm tenure for 1880, 1890, and 1900. The farms operated by tenants are divided into two groups, designated as farms operated by "cash tenants," who pay a rental in cash or a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, and farms operated by owners are subdivided into 4 groups, designated as "owners," "part owners," "owners and tenants," and "managers." These terms denote, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or part of it, and the other or others owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURE: 1880 TO 1900.

YEAR.	Total number of farms	NUMBER OF FARMS OPERATED BY—			PER CENT OF FARMS OPERATED BY—		
		Owners.[1]	Cash tenants.	Share tenants.	Owners.[1]	Cash tenants.	Share tenants.
1900	33,202	28,425	2,341	2,436	85.6	7.1	7.3
1890	18,056	16,529	541	986	91.5	3.0	5.6
1880	6,529	6,058	209	262	92.8	3.2	4.0

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURE, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURE.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	33,202	24,327	3,499	194	405	2,341	2,436
White	32,112	23,346	3,485	191	403	2,271	2,416
Colored	1,090	981	14	3	2	70	20
Chinese	69	3	2			59	5
Indian	966	934	8	3	1	7	13
Negro	55	44	4		1	4	2

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURE.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	73.3	10.5	0.6	1.2	7.1	7.3
White	100.0	72.7	10.8	0.6	1.3	7.1	7.5
Colored	100.0	90.0	1.3	0.3	0.2	6.4	1.8

The total number of farms increased 26,673, or 408.5 per cent, in the last two decades. Since 1890 the farms operated by owners increased 11,896, or 72.0 per cent; farms operated by cash tenants, 1,800, or 332.7 per cent; and farms operated by share tenants, 1,450, or 147.1 per cent. This increase has been continuous through both decades, but was greater for cash tenants than for owners or share tenants, showing a growing sentiment in favor of the cash payment system.

Of the total number of farms, 96.7 per cent are operated by white farmers and 3.3 per cent by colored farmers. Of the white farmers, 84.1 per cent own all or part of the farms they operate. For colored farmers the corresponding per cent is 91.6, as most of them are Indians who have received allotments from the Government.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number of farms conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

Tables 6 and 7 present the principal statistics for farms classified by race of farmer and by tenure.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	33,202	256.0	8,499,297	100.0	$144,040,547	100.0
White farmers	32,112	260.9	8,378,339	98.6	141,831,986	98.5
Negro farmers	55	145.6	8,008	0.1	131,227	0.1
Indian farmers	966	115.1	111,180	1.3	1,847,635	1.3
Chinese farmers	69	25.7	1,770	(1)	229,699	0.1
Owners	24,327	191.1	4,648,740	54.7	85,300,698	59.2
Part owners	3,499	651.6	2,279,953	26.8	29,038,242	20.2
Owners and tenants	194	362.3	70,295	0.8	1,198,362	0.8
Managers	405	922.2	373,499	4.4	5,242,025	3.6
Cash tenants	2,341	199.5	467,076	5.5	9,468,044	6.6
Share tenants	2,436	270.8	659,734	7.8	13,793,176	9.6

[1] Less than one-tenth of 1 per cent.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$2,991	$491	$189	$667	$892	20.6
White farmers	3,052	501	191	672	911	20.6
Negro farmers	1,696	307	72	311	323	13.5
Indian farmers	1,025	187	123	578	274	14.3
Chinese farmers	2,911	217	83	118	1,090	32.7
Owners	2,335	460	155	556	714	20.4
Part owners	6,048	659	394	1,198	1,769	21.3
Owners and tenants	4,458	624	276	819	1,303	21.1
Managers	8,403	1,402	382	2,756	2,133	16.5
Cash tenants	2,802	428	129	685	847	20.9
Share tenants	4,315	458	248	641	1,213	21.4

While colored farmers constitute 3.3 per cent of the total number in the state, they occupy but 1.4 per cent of the total area, and the farms they operate constitute but 1.5 per cent of the total value of farm property.

The average values of farm property and products and the per cent of gross income are very much lower for Indian and negro farmers than for white farmers, but the averages and percentages are high for Chinese farmers, as most of their farms are intensively cultivated market gardens.

Of the groups by tenure, the averages are generally highest for managers, but as a result of these high values the per cent of gross income is lowest. Many of these farms are large grain farms and cattle ranches, while some are operated by the state and county authorities in connection with eleemosynary and reformatory institutions.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	33,202	256.0	8,499,297	100.0	$144,040,547	100.0
Under 3 acres	358	2.1	745	(1)	731,892	0.5
3 to 9 acres	1,056	6.5	6,848	0.1	1,494,718	1.0
10 to 19 acres	1,611	13.0	20,878	0.3	2,683,183	1.9
20 to 49 acres	4,240	34.1	144,567	1.7	8,005,016	5.6
50 to 99 acres	4,387	75.7	332,077	3.9	11,285,002	7.8
100 to 174 acres	11,249	157.0	1,765,952	20.8	31,793,870	22.1
175 to 259 acres	2,400	217.4	521,648	6.1	12,071,548	8.4
260 to 499 acres	4,938	375.3	1,853,346	21.8	31,512,083	21.9
500 to 999 acres	2,015	697.3	1,405,025	16.5	22,201,175	15.4
1,000 acres and over	948	2,582.5	2,448,211	28.8	22,262,060	15.4

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF— Farm property June 1, 1900.					Per cent of gross income on total investment in farm property.
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	
The State	$2,991	$491	$189	$667	$892	20.6
Under 3 acres	343	315	36	1,350	642	31.4
3 to 9 acres	768	395	44	208	319	22.5
10 to 19 acres	1,022	388	60	196	347	20.9
20 to 49 acres	1,165	368	76	279	410	21.8
50 to 99 acres	1,652	414	109	397	558	21.7
100 to 174 acres	1,855	389	128	454	681	20.6
175 to 259 acres	3,459	625	226	720	1,079	21.4
260 to 499 acres	4,577	600	307	898	1,296	20.3
500 to 999 acres	8,280	846	476	1,416	2,109	19.1
1,000 acres and over	16,970	1,295	896	4,322	4,779	20.3

The group of farms containing from 100 to 174 acres each includes a larger number of farms than any other class, showing the frequency of quarter-section holdings. The group "1,000 acres and over" constitutes a larger part of the total acreage than any other.

With a few exceptions the average values of all forms of farm property increase with the size of the farms. For the group of farms of less than 3 acres each all values are comparatively high, as this class contains a number of the florists' establishments of the state, and many market gardens, poultry farms, and city dairies. The high value of live stock for this group is due to the fact that it includes many ranges consisting of large areas of public domain, though the area actually owned or leased is less than 3 acres. The incomes from these industries are determined not so much by the area of owned or rented land used as by the amount of capital invested and the amounts expended for labor and fertilizers. The average gross incomes per acre for the various groups, classified by area, are as follows:

Farms under 3 acres, $308.39; 3 to 9 acres, $49.18; 10 to 19 acres, $26.81; 20 to 49 acres, $12.05; 50 to 99 acres, $7.37; 100 to 174 acres, $3.70; 175 to 259 acres, $4.96; 260 to 499 acres, $3.45; 500 to 999 acres, $3.02; 1,000 acres and over, $1.85. With the exception of the group of farms of 100 to 174 acres, which has a low average on account of the number of homesteads it contains, the average gross income per acre decreases regularly as the farms increase in size.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop, and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm; similarly, if vegetables are the leading crop, constituting 40.0 per cent of the total value of products not fed to live stock, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive their principal income from any one class of farm products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

TABLE 10.—NUMBER AND ACREAGE OF FARMS AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	33,202	256.0	8,499,297	100.0	$144,040,547	100.0
Hay and grain	10,396	377.5	3,924,178	46.2	69,766,405	48.4
Vegetables	1,723	93.9	161,712	1.9	4,423,136	3.1
Fruits	1,065	99.8	106,242	1.3	3,973,805	2.8
Live stock	7,613	325.4	2,477,278	29.1	28,725,519	19.9
Dairy produce	4,495	153.5	689,785	8.1	16,320,333	11.3
Sugar	4	897.5	3,590	(1)	146,946	0.1
Flowers and plants	17	29.5	501	(1)	103,610	0.1
Nursery products	15	42.2	633	(1)	93,084	0.1
Miscellaneous	7,874	144.2	1,135,378	13.4	20,487,709	14.2

[1] Less than one-tenth of 1 per cent.

Table 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$2,991	$491	$189	$667	$892	20.6
Hay and grain	6,080	575	335	721	1,398	20.8
Vegetables	1,815	397	96	259	546	21.3
Fruits	2,728	606	124	273	806	21.6
Live stock	2,108	443	140	1,082	797	21.1
Dairy produce	2,331	499	132	669	665	18.3
Sugar	29,450	3,500	1,387	2,399	8,195	22.3
Flowers and plants	2,571	3,127	218	179	3,090	50.7
Nursery products	4,924	1,033	113	136	1,756	28.3
Miscellaneous	1,742	418	104	338	524	20.1

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms deriving their principal income from flowers and plants, $104.85; nursery products, $41.61; sugar, $9.13; fruits, $8.08; vegetables, $5.82; dairy produce, $4.34; hay and grain, $3.70; miscellaneous, $3.63; and live stock, $2.45.

The wide variations shown in the averages and percentages of gross income are due largely to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than in the case of "hay and grain," "live-stock," or "miscellaneous" farms. Were it possible to present the average net incomes, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

Table 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS. Average.	Total.	Per cent.	VALUE OF FARM PROPERTY. Total.	Per cent.
The State	33,202	256.0	8,499,297	100.0	$144,040,547	100.0
$0	1,173	174.1	204,246	2.4	1,979,040	1.4
$1 to $49	1,205	122.2	147,218	1.7	1,599,640	1.1
$50 to $99	1,723	123.6	213,009	2.5	2,504,800	1.8
$100 to $249	5,641	118.1	666,392	7.9	9,559,430	6.6
$250 to $499	7,348	138.9	1,020,317	12.0	16,610,860	11.5
$500 to $999	7,338	194.7	1,428,762	16.8	26,619,177	18.5
$1,000 to $2,499	6,385	343.1	2,190,597	25.8	43,077,340	29.9
$2,500 and over	2,389	1,100.4	2,628,756	30.9	42,090,260	29.2

Table 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$2,991	$491	$189	$667	$892	20.6
$0	1,239	128	60	260	....	....
$1 to $49	936	166	54	172	33	2.5
$50 to $99	1,002	193	56	203	60	4.1
$100 to $249	1,120	254	69	252	159	9.4
$250 to $499	1,457	344	99	361	351	16.6
$500 to $999	2,393	478	169	588	691	19.0
$1,000 to $2,499	4,716	741	307	983	1,517	22.6
$2,500 and over	12,691	1,430	722	2,775	4,705	26.7

There were 1,173 farmers reporting no income for 1899. Most of these farms are homesteads taken up too recently to have yielded any products in 1899. Some are suburban or summer homes, and many of them had changed owners or tenants, and the persons in charge, June 1, 1900, were unable to give definite information concerning the products of the preceding year. To this extent the reports fall short of giving a complete exhibit of farm income in 1899.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the Twelfth Census. The age grouping for neat cattle was determined by their present and prospective relation to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep by age and sex. The new classification permits of a very close comparison with previous census reports.

Table 14 presents a summary of live-stock statistics.

Table 14.—NUMBER OF DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS AND RANGES, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS OR RANGES.

LIVE STOCK.	Age in years.	ON FARMS OR RANGES. Number.	Value.	Average value.	NOT ON FARMS OR RANGES. Number.
Calves	Under 1	105,130	$889,058	$8.46	4,276
Steers	1 and under 2	39,340	698,051	17.74	732
Steers	2 and under 3	24,128	648,161	26.86	398
Steers	3 and over	9,096	330,940	36.38	211
Bulls	1 and over	7,489	269,811	36.03	121
Heifers	1 and under 2	44,113	805,325	18.26	1,274
Cows kept for milk	2 and over	107,232	4,076,189	38.01	11,809
Cows and heifers not kept for milk.	2 and over	58,395	1,722,503	29.50	300
Colts	Under 1	22,359	253,658	11.34	381
Horses	1 and under 2	30,312	502,760	16.59	386
Horses	2 and over	191,314	7,794,016	40.74	21,692

Table 14.—NUMBER OF DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS AND RANGES, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS OR RANGES—Continued.

LIVE STOCK.	Age in years.	ON FARMS OR RANGES.			NOT ON FARMS OR RANGES.
		Number.	Value.	Average value.	Number.
Mule colts	Under 1	441	$10,669	$24.19	3
Mules	1 and under 2	322	12,992	40.35	10
Mules	2 and over	1,927	114,524	59.43	394
Asses and burros	All ages	160	16,481	103.01	23
Lambs	Under 1	371,851	728,640	1.96	348
Sheep (ewes)	1 and over	459,158	1,382,745	3.01	597
Sheep (rams and wethers).	1 and over	98,864	339,544	3.43	170
Swine	All ages	181,535	830,704	4.58	5,569
Goats	All ages	2,876	10,757	3.74	132
Fowls:[1]					
Chickens[2]		1,196,639	614,838		
Turkeys		29,155			
Geese		64,488			
Ducks		66,433			
Bees (swarms of)		30,870	106,841	3.46	
Value of all live stock.			22,169,207		

[1] The number reported is of fowls over 3 months old. The value is of all, old and young.
[2] Including Guinea fowls.

The value of all live stock on farms and ranges, June 1, 1900, was $22,159,207, of which 38.6 per cent represents the value of horses; 24.2 per cent, that of neat cattle other than dairy cows; 18.4 per cent, that of dairy cows; 11.1 per cent, that of sheep; 3.7 per cent, that of swine; and 4.0 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms or ranges, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, however, the value of all domestic animals not on farms or ranges is $1,502,639. Exclusive of poultry and bees not on farms, the total value of live stock in the state is approximately $23,661,846.

CHANGES IN LIVE STOCK KEPT ON FARMS AND RANGES.

The following table shows the changes since 1860 in the number of the most important domestic animals:

Table 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS AND RANGES: 1860 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	107,232	287,691	243,985	2,850	558,022	181,535
1890	70,721	184,413	153,770	1,345	265,267	90,274
1880	27,622	106,932	45,848	626	292,883	46,828
1870	16,938	30,316	11,138	943	44,063	17,491
1860	9,660	18,799	4,772	159	10,157	6,383

[1] Lambs not included.

In comparison with those of 1860, the reports for 1900 show over eleven times as many dairy cows, over fifteen times as many other neat cattle, more than fifty times as many horses, nearly eighteen times as many mules, nearly fifty-five times as many sheep, and over twenty-eight times as many swine. The increase between 1890 and 1900 is indicated by the following percentages: Dairy cows, 51.6 per cent; other neat cattle, 56.0 per cent; horses, 58.7 per cent; mules and asses, 111.9 per cent; sheep, 110.4 per cent; and swine, 101.1 per cent.

The enumerators in 1900 were instructed to report no fowls under three months old, and in 1890 no such limitation was made, yet each class of fowls shows an increase in number. More than eleven times as many geese, and nearly five times as many ducks were reported in 1900 as in 1890. Turkeys increased in number 69.6 per cent, and chickens, 53.4 per cent in the same period of time.

ANIMAL PRODUCTS.

Table 16 is a summary of the products of the animal industry.

Table 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS AND RANGES IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	5,268,088	$618,975
Mohair and goat hair	Pounds	4,000	1,097
Milk	Gallons	[1]50,182,415	[2]3,816,691
Butter	Pounds	7,372,106	
Cheese	Pounds	151,669	
Eggs	Dozens	7,473,790	1,259,225
Poultry			848,291
Honey	Pounds	530,790	65,211
Wax	Pounds	9,540	
Animals sold			3,517,053
Animals slaughtered			1,168,802
Total			11,295,345

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of milk sold or consumed, and of butter and cheese made.

The value of animal products in 1899 was $11,295,345, or 32.4 per cent of the value of all farm products, and 38.1 per cent of the gross farm income. Of the total value, 41.5 per cent represents the value of animals sold and animals slaughtered; 33.8 per cent, that of dairy products; 18.6 per cent, that of poultry and eggs; 5.5 per cent, that of wool, mohair, and goat hair; and 0.6 per cent, that of honey and wax.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

The value of animals sold and animals slaughtered on farms was $4,685,855, or 15.8 per cent of the gross farm income. Of the whole number of farmers reporting domestic animals, 15,362, or 48.9 per cent, reported sales of live animals, the average amount per farm being

$228.94; and 17,106, or 54.5 per cent, report animals slaughtered, the average value per farm being $68.33. In securing reports of the sales of live animals the enumerators were directed to obtain from each farmer a statement of the amount received from sales in 1899, less the amount paid for animals purchased the same year.

DAIRY PRODUCE.

The production of milk in 1899 was 30,309,134 gallons greater than in 1889, a gain of 152.5 per cent. Butter made on farms increased 111.7 per cent in the last decade, and cheese made on farms, 112.8 per cent.

Of the $3,816,691 given in Table 16 as the value of all dairy produce, $2,452,525, or 64.3 per cent, represents the receipts from sales, and $1,364,166, or 35.7 per cent, the value of such produce consumed on farms. Of the former amount, $1,476,720 was received from the sale of 14,897,273 gallons of milk; $882,344 from 4,172,820 pounds of butter; $78,441 from 145,555 gallons of cream; and $15,020 from 126,670 pounds of cheese.

POULTRY AND EGGS.

The total value of the products of the poultry industry in 1899 was $2,107,516, of which amount 59.7 per cent represents the value of eggs produced and 40.3 per cent the value of fowls raised. Nearly five million dozen more eggs were produced in 1899 than in 1889, the rate of gain being 175.7 per cent.

WOOL.

Each decade since 1850 shows a marked increase in the amount of wool grown. More than three times as much wool was reported in 1900 as in 1890. But a part of this gain is only apparent, as the fleeces from a large number of sheep were omitted from the tables in 1890, but included in a general estimate of wool shorn after the enumeration. The average weight of fleeces increased from 6.3 pounds in 1890 to 9.1 pounds in 1900, which indicates improvement in the grade of sheep. The counties in the southeastern part of the state show the greatest increase in numbers of sheep, and in quantities of wool produced.

HONEY AND WAX.

The quantity of honey produced in 1899 was 530,790 pounds, three times as much as ten years before. There were 9,540 pounds of wax reported in 1899, three times as much as in 1889.

HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses and dairy cows, the total number of these animals, and the average number per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

TABLE 17.—HORSES AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.			DAIRY COWS.		
	Farms reporting.	Number.	Average per farm.	Farms reporting.	Number.	Average per farm.
Total	28,256	243,985	8.6	26,042	107,232	4.1
White farmers	27,208	219,280	8.1	25,663	106,101	4.1
Colored farmers	1,048	24,705	23.6	379	1,131	3.0
Owners[1]	23,784	206,520	8.7	22,073	86,977	3.9
Managers	331	7,149	21.6	298	2,116	7.1
Cash tenants	1,937	10,499	5.4	1,783	11,166	6.3
Share tenants	2,204	19,817	9.0	1,888	6,973	3.7
Under 20 acres	1,909	24,829	13.0	2,047	5,391	2.6
20 to 99 acres	6,915	27,694	4.0	6,818	22,724	3.3
100 to 174 acres	9,565	53,364	5.6	8,304	32,339	3.9
175 to 259 acres	2,237	16,510	7.4	2,075	11,287	5.4
260 acres and over	7,630	121,588	15.9	6,798	35,491	5.2
Hay and grain	9,350	113,399	12.1	7,580	24,772	3.3
Vegetable	1,344	5,529	4.1	985	2,434	2.5
Fruit	829	3,324	4.0	714	1,531	2.1
Live-stock	6,688	79,317	11.9	6,236	25,254	4.0
Dairy	3,873	19,638	5.1	4,573	35,075	7.7
Miscellaneous[2]	6,172	22,778	3.7	5,954	18,166	3.1

[1] Including "part owners" and "owners and tenants."
[2] Including florists' establishments, nurseries, and sugar farms.

CROPS.

The following table gives the statistics of the principal crops grown in 1899:

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	10,483	Bushels	218,706	$104,263
Wheat	1,088,102	Bushels	21,187,527	9,028,209
Oats	126,841	Bushels	5,336,486	1,765,547
Barley	122,298	Bushels	3,641,056	1,268,480
Rye	3,077	Bushels	44,945	23,566
Buckwheat	96	Bushels	1,865	1,332
Flaxseed	149	Bushels	850	767
Clover seed		Bushels	12	54
Grass seed		Bushels	825	1,492
Hay and forage	497,139	Tons	827,413	5,831,088
Tobacco	5	Pounds	1,180	187
Hops	5,296	Pounds	6,813,830	589,582
Broom corn	67	Pounds	20,000	1,000
Peanuts	(1)	Bushels	15	15
Dry beans	296	Bushels	3,830	7,084
Dry pease	3,573	Bushels	91,899	78,124
Potatoes	25,119	Bushels	3,557,876	1,312,948
Sweet potatoes	52	Bushels	4,672	2,250
Onions	472	Bushels	107,111	73,623
Miscellaneous vegetables	13,376			967,045
Maple sirup		Gallons	126	113
Sorghum cane	28	Tons	82	146
Sorghum sirup		Gallons	438	198
Sugar beets	1,863	Tons	6,149	26,176
Small fruits	2,915			326,646
Orchard fruits	[2] 89,261	Bushels	1,180,357	[3] 999,487
Grapes	[2] 311	Centals	11,947	[4] 27,242
Nuts				810
Forest products				1,002,126
Flowers and plants	34			50,450
Seeds	86			11,667
Nursery products	155			28,699
Miscellaneous	15			[5] 1,784
Total	1,991,109			23,532,150

[1] Less than 1 acre.
[2] Estimated from number of vines or trees.
[3] Including value of cider, vinegar, etc.
[4] Including value of wine, raisins, etc.
[5] The greater part of this value was derived from products for which no acreage was reported.

Of the total value of crops, cereals contributed 51.8 per cent; hay and forage, 24.8 per cent; vegetables, including potatoes, sweet potatoes, and onions, 10.0 per cent; fruits, 5.7 per cent; forest products, 4.3 per cent; hops, 2.5 per cent; and all other crops, 0.9 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $1,483.82; nursery products, $185.15; seeds, $135.66; small fruits, $112.06; hops, $111.33; grapes, $87.59; miscellaneous vegetables, $72.30; potatoes, $52.27; beans and pease, $22.01; sugar beets, $14.05; hay and forage, $11.73; orchard fruits, $11.20; and cereals, $9.02.

CEREALS.

The following table is an exhibit of the changes in cereal production since 1859:

TABLE 19.—ACREAGE AND PRODUCTION OF CEREALS: 1859 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	122,298	96	10,483	126,841	3,077	1,088,102
1889	51,551	27	9,583	65,089	1,763	372,658
1879	14,680	106	2,117	37,962	518	61,554

[1] No statistics of acreage were secured prior to 1879.

PART 2.—BUSHELS PRODUCED.

YEAR.	Barley.	Buckwheat.	Corn.	Oats.	Rye.	Wheat.
1899	3,641,056	1,865	218,706	5,336,486	44,946	21,187,527
1889	1,269,140	430	156,413	2,273,182	19,188	6,345,426
1879	566,537	2,498	39,183	1,571,706	7,124	1,921,322
1869	55,787	316	21,781	255,169	4,453	217,043
1859	4,621	707	4,712	134,334	144	86,219

The total area devoted to cereals in 1879 was 136,937 acres; in 1889, 500,671 acres; and in 1899, 1,350,897 acres, nearly ten times the acreage reported twenty years before.

The increases in area under cereals in the decade 1889 to 1899, were: Buckwheat, 255.6 per cent; wheat, 192.0 per cent; barley, 137.2 per cent; oats, 94.9 per cent; rye, 74.5 per cent; and corn, 9.4 per cent. The total number of bushels produced in 1859 was 230,737, and in 1899, 30,430,585.

Of the total area devoted to cereals in 1899, 80.5 per cent was devoted to wheat; 9.4 per cent, to oats; 9.1 per cent, to barley; and 1.0 per cent, to corn, rye, and buckwheat.

The five counties, Whitman, Lincoln, Wallawalla, Spokane, and Adams in the eastern part of the state ranking in the order named, reported 76.3 per cent of the total area under wheat, while Whitman, Skagit, and Spokane contributed one-half of the total acreage in oats. The adjoining counties, Whitman, Columbia, Garfield, and Wallawalla reported 73.1 per cent of the total area devoted to barley, and, substituting Chelan county for Garfield county, the same group furnished 62.7 per cent of the acreage under corn.

HAY AND FORAGE.

In 1900, 26,738 farmers, or 80.5 per cent of the total number, reported hay or forage crops. Exclusive of cornstalks, they obtained an average yield of 1.7 tons per acre. The total acreage in hay and forage for 1899 was 73.8 per cent greater than ten years before.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 49,963 acres and 51,260 tons; millet and Hungarian grasses, 319 acres and 496 tons; alfalfa or lucern, 35,166 acres and 118,559 tons; clover, 18,484 acres and 40,054 tons; other tame and cultivated grasses, 158,872 acres and 301,656 tons; grains cut green for hay, 226,652 acres and 301,676 tons; crops grown for forage, 7,683 acres and 13,196 tons; and cornstalks, 522 acres and 516 tons.

In Table 18 the production of cornstalks is included under "hay and forage," but the acreage is part of that given for "corn," as the forage secured was an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 are shown in the following table:

TABLE 20.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	2,735,824	315,479	728,978	295,196
Apricots	31,129	5,142	5,254	3,856
Cherries	210,516	22,852	62,114	11,692
Peaches	226,636	72,701	80,990	63,497
Pears	310,597	32,513	78,236	26,868
Plums and prunes	1,290,845	85,657	229,207	66,909

In 1900 over one-third of the farmers of the state reported orchard products worth $999,487. Of this amount, Whitman county contributed $132,569; Yakima, $108,696; Spokane, $78,592; King, $54,278; Wallawalla, $52,767; and Chelan, $50,640.

Large increases are to be noted in the numbers of all kinds of trees during the last decade, the gain in the total number of trees being over 4,000,000. In this period the number of apple trees has increased 2,420,345. In 1890, 59.0 per cent of all fruit trees in the state were apple trees, while in 1900 apple trees comprised but 56.9 per cent. The largest numbers of these trees are found in the southeastern counties of the state, Spokane leading.

Not only has the number of plum and prune trees increased more than fifteenfold during the decade, but the relative importance of these fruits has risen from 16.0 per cent of the total number of orchard trees in 1890 to 26.9 per cent of the number reported in 1900.

There were over nine times as many pear trees in 1900 as ten years before. More than one-third the total number of these trees was grown in Whitman, Wallawalla, and Spokane counties.

The total number of peach trees has more than tripled during the decade. This increase was very generally distributed, decreases being reported in but four counties. The largest numbers of trees were reported by Yakima and Whitman counties. Comparatively little attention was given to apricots. All counties show increases in cherries during the decade.

In addition to the trees given in Table 20, unclassified fruit trees to the number of 65,312 were reported, with a yield of 5,578 bushels of fruit. The value of orchard products given above includes the value of 1,102 barrels of cider, 416 barrels of vinegar, and 253,720 pounds of dried and evaporated fruits manufactured on farms.

VEGETABLES.

The value of all vegetables produced in the state in 1899, including potatoes, sweet potatoes, and onions, was $2,355,866, of which the value of potatoes constituted 55.7 per cent. This important crop was reported by 21,539 farmers, or 64.9 per cent of the total number in the state. The largest acreages devoted to potatoes were in the southeastern counties of Spokane and Whitman.

Aside from the land devoted to potatoes, sweet potatoes, and onions, 13,376 acres were used in the growing of miscellaneous vegetables. Of this area, the products of 8,409 acres were not reported in detail. Of the remaining 4,967 acres, concerning which detailed reports were received, 1,146 acres were devoted to cabbages, 1,016 to carrots, 584 to turnips, 569 to sweet corn, 494 to watermelons, 338 to beets, 303 to tomatoes, 198 to muskmelons, and 319 to other vegetables.

SMALL FRUITS.

The total area used in the cultivation of small fruits in 1899 was 2,915 acres distributed among 9,638 farms. The value of the fruit grown was $326,646, an average of $33.89 per farm. Of the total area, 1,268 acres, or 43.5 per cent, were devoted to strawberries, the total production of which was 2,577,580 quarts, grown principally in King, Pierce, Wallawalla, Spokane, and Clarke counties. The acreages and productions of the other berries were as follows: Raspberries and Logan berries, 625 acres and 1,134,970 quarts; blackberries and dewberries, 388 acres and 808,340 quarts; currants, 238 acres and 416,170 quarts; gooseberries, 211 acres and 356,570 quarts; and other berries, 185 acres and 124,150 quarts.

SUGAR BEETS.

Washington had in 1900 but three counties reporting sugar beets, but the industry bids fair to become one of importance in the state. In 1899, 29 farms devoted to this crop an area of 1,863 acres, an average of 64.2 acres per farm. There were obtained and sold from this land 6,149 tons of beets, an average of 3.3 tons per acre, for which was received $26,176, an average of $903 per farm, $14 per acre, and $4.26 per ton. This crop was grown in the southeastern part of the state, Spokane county alone reporting 92.8 per cent of the total acreage.

HOPS.

The earliest report of hops for Washington was in 1860, when the amount produced was 44 pounds. The industry has become one of great importance, as is shown by the rapid increase in the number of acres devoted to their production. For 1879, 534 acres were reported; for 1889, 5,113 acres; and for 1899, 415 farmers reported 5,296 acres, an average of 12.8 acres per farm. They obtained and sold from this land 6,813,830 pounds of hops, an average of 1,287 pounds per acre, for which they received $589,582, an average of $1,421 per farm, $111 per acre, and $0.09 per pound.

The two counties producing the most hops in 1899 were Yakima and Pierce, which reported 66.0 per cent of the total acreage.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 34 acres, and the value of the products sold therefrom was $50,450. These flowers and plants were grown by 35 farmers and florists, of whom 17 made commercial floriculture their principal business. These 17 had invested in land, buildings, implements, and live stock $103,610, of which $53,160 represents the value of the buildings. Their sales of flowers and plants amounted to $46,970, and they secured other products valued at $5,560. They expended $10,210 for labor, and $985 for fertilizers. The average gross income was $3,090.

In addition to the 17 principal florists' establishments, 139 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 227,550 square feet, making, with the 125,820 square feet belonging to the florists' establishments, a total of 353,370 square feet of land under glass.

NURSERIES.

The total value of nursery products sold in 1899 was $28,699. This was reported by the operators of 36 farms and nurseries, of whom 15 derived their principal income from the nursery business. They had invested in the aggregate $93,084, of which $73,855 represents the value of land and improvements other than buildings; $15,495, that of buildings; $1,690, that of implements; and $2,044, that of live stock. Their sales of nursery products amounted to $24,256, and they obtained other products worth $2,082. Their expenditure for labor was $4,910, and for fertilizers, $20. The average gross income was $1,756.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $5,280,190, an average of $159 per farm. The average expenditure was $1,788 for sugar farms, $601 for florists' establishments, $327 for nurseries, $310 for hay and grain farms, $109 for fruit farms, $96 for live-stock farms, $86 for vegetable farms, and $83 for dairy farms. "Managers" expended on an average, $683; "share tenants," $260; "cash tenants," $146; and "owners," $107. White farmers expended $163 per farm, and colored farmers, $54.

Fertilizers purchased in 1899 cost only $29,165, an average of less than $1 per farm, but almost three times the amount expended in 1889. The average expenditure was $58 for florists' establishments, $3 for vegetable farms, and $1 for hay and grain farms.

INDIAN RESERVATIONS.

The Indian population of Washington, although not as large as that of several other states, is composed of numerous small tribes, principal among which are the Salishan, Shahaptian, and Chinookan. The tribes along the coast are fishermen and fur traders, their catches including the whale and seal. Those among the mountains live largely on game, fish, and berries. Nine reservations, as follows, reported agriculture: Colville, Lummi, Makah, Muckleshoot, Queniult, Spokan, Swinomish, Tulalip and Yakima.

COLVILLE AND SPOKAN.

Colville reserve, embracing an area of 4,374 square miles, is situated in Ferry and Okanogan counties. The land is adapted to agriculture and stock raising, and most of the tribes here have made commendable progress in these occupations. The population of the reserve is 1,477.

The Spokan reservation, whose agricultural statistics were enumerated with those of Colville, lies in Stevens county and contains an area of 240 square miles. The Indians are thrifty and industrious, but need the assistance of improved agricultural implements and machinery.

The principal crops of the 351 Indian farmers of the two reserves are wheat and oats, supplemented by a few acres of corn. Their hay consists largely of grains cut green. Many raise gardens of potatoes and other vegetables. Some of them own a considerable number of range cattle in addition to their Indian pony stock, and a few possess chickens and swine.

LUMMI.

Lummi reservation, with an area of 3 square miles, is situated in Whatcom county. The Indians are bands of Dwamish, Etakmur, Lummi, Snohomish, and Swinomish tribes, with a total population of 359. They do some fishing and logging in addition to tilling the soil, and are largely self-supporting.

The 28 Indian farmers raised small patches of oats, wheat, tame hay, potatoes, and other vegetables. Nearly all own orchards of apple, pear, plum, and cherry trees, and a few also raise small fruits. Their live stock consists principally of good American farm horses, small flocks of sheep, and a few cattle. A number own dairy cows and report milk and butter; others report small sales of live stock and animal products. Chickens and swine are found on most of the farms.

MAKAH.

Makah reservation, in Clallam county, has an area of 36 square miles. The Makah and Quileute Indians on this reserve, with a population of 371, are self-supporting, but very poor. Fish is their principal diet and source of income. Seven Indians reported small herds of horses and cattle, but as grass is very limited they can not carry on stock raising extensively. Small sales of live stock were reported by four of them.

MUCKLESHOOT.

Muckleshoot reservation contains an area of 5 square miles and is situated in King county. The Muckleshoot is a self-supporting agricultural tribe, numbering 146. All wear citizens' clothing, and the majority know enough English to carry on ordinary conversation. The principal crops of the 30 Indian farmers are oats, wheat, and tame hay. Potatoes are also quite generally raised, and a few have small fruit. A number possess orchards of apple, plum, and cherry trees. The tracts cultivated by these farmers are mere patches of from 5 to 30 acres. Their live stock consists of a few horses, Indian ponies, cattle, and sheep. Chickens and swine are found on a few farms.

QUENIULT.

Queniult reserve, embracing an area of 350 square miles, is located in Chehalis county. The larger portion of the land is broken, mountainous, and thickly covered with underbrush, the only cultivable tracts lying along the river bottoms. The 23 Indian farmers raised small patches of potatoes and tame hay, and one had 3 acres in oats. Most of them own work horses or ponies, and some have a few beef cattle and dairy cows. Chickens are common among these Indians, while but one reported swine.

SWINOMISH.

Swinomish reserve has an area of 11 square miles and is situated in Skagit county, on Fidago Island. The Indians here are practically self-supporting, obtaining their living by fishing and tilling the soil. The present population is 275. Oats and tame hay are the crops of the 7 Swinomish farmers. Their live stock consists of a few horses, sheep, and dairy cows, and 2 farmers owned chickens.

TULALIP.

Tulalip reservation, having an area of 14 square miles, is located in Snohomish county, on Puget Sound. The greater portion of this reserve is heavily timbered and requires considerable energy and money to clear it. The Indians are not agriculturists, as a rule, only 29 Indian farmers being reported. These raised a few acres of tame hay, potatoes, and garden vegetables; some also cultivated small fruit. Nearly all had orchards of apple, pear, plum, and cherry trees. Horses, a few sheep, and beef cattle largely comprised their live stock. A number also owned dairy cows and chickens.

YAKIMA.

Yakima reservation, with an area of 1,250 square miles, is situated in the south central part of the state. Approximately two-thirds of this tract is a dry, sagebrush desert with no facilities for irrigation. Bands of Klikitat, Paloos, Topnish, Wasco, and Yakima Indians are located on this reserve, and number in all 2,219. Agriculture is the principal occupation where it can be carried on, and the Indians who are so situated that irrigation is available are making remarkable progress. They are accumulating stock, extending their agricultural operations, and building comfortable homes. Under the direction of a surveyor, they have constructed a large number of ditches and utilize all the water available. Indians who have no water on their allotments hunt, dig roots, and gather berries for subsistence. The principal crops are oats, wheat, and barley, in the order named. The hay crops consisted of wild grasses, alfalfa, and other tame grasses and grains cut green. Of the 269 farms on the reservation, 196 were operated by Indians, the others being largely those of white renters. The majority of Indian farmers had from 10 to 80 acres under cultivation. A number raised patches of potatoes and garden vegetables and some also had small fruit. Many own orchards of apple, peach, pear, plum, and cherry trees. A number have accumulated substantial herds of range cattle, while a few have large flocks of sheep. Chickens and swine are common, and a few Indians have dairy cows.

IRRIGATION STATISTICS.

The Cascade Mountains, extending across the western third of the state of Washington, divide it into two parts unlike in climate and agricultural conditions. West of the mountains the annual precipitation is heavy. Eastward the climate is arid and semiarid. The arid region is bounded on the west by the foothills of the Cascade Mountains, and on the east gradually merges into the semiarid foothills near the Idaho line. The soil of central and eastern Washington is very fertile, and when water is artificially applied to growing crops the results are marvelous.

These regions, lying entirely within the drainage basin of the Columbia River, have an area of 42,328 square miles, or 63.0 per cent of the state. The Columbia River enters the state from the northeastern corner, flows south for a distance of about 159 miles, then veering abruptly westward forms a great curve as it pursues its course in a southerly direction to about the center of the state, then turning west, forms the boundary between Oregon and Washington. With its numerous branches it furnishes an abundant water supply.

With the exception of a few current water wheels, no irrigation works have yet been undertaken on the Columbia River. On its tributary streams, however, great progress has been made toward reclaiming areas of the arid lands. The most important of these branches is the Yakima River, which has its sources in numerous lakes near the crest of the Cascade Mountains. From these lakes it takes its way southeast for a distance of about 40 miles through a rugged country, where the rocky soil and frequent frosts make agriculture a hazardous undertaking.

Turning directly south, the river flows into the Kittitas Valley. Here irrigation has made rapid advances, and a network of ditches, large and small, diverts water from the river and its branches upon thousands of acres in crops. The Ellensburg Water and Power Company and the West Side Canal Company are the most important irrigation enterprises in this vicinity. At the lower end of the valley the banks converge, forming a canyon with high, precipitous walls, through which the river rushes for a distance of 18 miles, emerging into the Yakima Valley, where it receives the waters of the Naches River and Selah and Atanum creeks, all of which are mountain streams. As these streams approach the main river, the great spurs forming their canyons gradually recede from the banks, leaving a broad, fertile valley, where several important canals have transformed what was originally a desert into a region of ideal farms.

Just below Yakima Valley the river is tapped on its left bank by the Sunnyside Canal, the largest in Washington. This canal was built at a cost of $600,000, is 42 miles long, and irrigates 10,000 acres in fruits and field crops.

Gradually curving to the east, the river pursues its course for a distance of almost 75 miles. At intervals irrigation improvements of varying importance are evidenced by productive farms and comfortable homes.

From the source of Yakima River to its mouth, the annual precipitation gradually decreases. The moisture in the foothills is sufficient to raise crops not too sensitive to cold, but farther down the river the soil can not be successfully cultivated without irrigation. In several places are elevated tablelands, notably Swauk and Thorp prairies, which receive sufficient natural moisture to produce fair crops of grain.

The Blue Mountains and foothills in southeastern Washington form a watershed for Wallawalla River and Asotin Creek, two important streams.

The Wallawalla River rises in Oregon and flows in a northeasterly direction into Washington, where it receives water from a score of tributaries. These streams, near their mouths, form deltas of rich alluvium peculiarly adapted to the cultivation of orchard fruits. A rapid fall in the creeks admits of the construction of ditches at a very moderate expense, but the valleys are narrow and only small areas can be irrigated. Several canals are in use, and others are in course of construction. On the higher ground the precipitation is sufficient for cereals, and good crops are raised. After leaving this valley the Wallawalla gradually sinks lower in its canyon and maintains a westward course for a distance of about 40 miles to its junction with the Columbia River.

Many small streams rising in the eastern foothills of the Blue Mountains unite to form Asotin Creek, which furnishes its valley with a plentiful supply of water. From the left bank, about 6 miles from its mouth, the Vineland ditch, 14 miles long, has been constructed by the Lewiston Water and Power Company at a cost of $80,000. This company has divided its land holdings into small farms worth from $150 to $300 per acre. Purchasers give their entire attention to gardens and orchards, and remarkable results are obtained. The ditch at present irrigates 1,400 acres, but is designed to supply 5,000 acres. The sketch map represents, by areas in solid black, the regions in which irrigation is successfully practiced to any considerable extent.

The following table shows the relative increase of irrigation in the whole state since 1899, including counties west of the Cascade Mountains, where irrigation is very beneficial to truck farmers:

TABLE A.—NUMBER OF IRRIGATORS AND ACRES IRRIGATED IN 1889 AND 1899, WITH PERCENTAGES OF INCREASE, BY COUNTIES.

COUNTIES.	NUMBER OF IRRIGATORS.			NUMBER OF ACRES IRRIGATED.		
	1899	1889	Per cent of increase.	1899	1889	Per cent of increase.
The State	3,513	1,046	235.9	135,470	48,799	177.6
Adams	12	....	....	423	....	....
Asotin	222	32	593.8	1,698	320	430.6
Chelan[1]	309			6,406		
Kittitas[1]	549	350	216.9	47,373	25,212	138.6
Okanogan[1]	251			6,377		
Clallam	16	....	....	127	....	....
Columbia	25	15	66.7	440	139	216.5
Douglas	55	34	61.8	2,627	1,016	158.6
Ferry[2]	16	66	81.8	625	1,350	89.0
Stevens[2]	104			1,926		
Garfield	25	24	4.2	328	229	43.2
King	17	....	....	151	....	....
Klickitat	151	71	112.7	1,235	1,702	[3]27.4
Lincoln	54	12	350.0	1,069	238	349.2
Spokane	31	3	933.3	718	80	797.5
Wallawalla	231	121	90.9	6,100	2,809	117.2
Whitman	44	22	100.0	863	531	62.5
Yakima	1,123	293	283.3	47,588	15,129	214.5
All other counties	51	3	1,600.0	233	44	429.5
Indian reservations:						
Spokane	43	....	....	140	....	....
Yakima	184	....	....	9,023	....	....

[1] Chelan organized from parts of Kittitas and Okanogan in 1899.
[2] Ferry organized from part of Stevens in 1899.
[3] Decrease.

In the ten years ending with 1899, the number of irrigators in the state increased from 1,046 to 3,513, or 235.9 per cent, and the area irrigated from 48,799 acres to 135,470 acres, or an increase of 177.6 per cent.

As the artificial application of water requires more than an ordinary amount of labor and capital, there is a marked tendency toward a more intense cultivation of small areas. In 1889 the average size of the irrigated area of farms of Washington was 47 acres, while in 1899 it was but 39 acres.

Table B is an exhibit, by counties, of the number of irrigated farms compared with the total number of farms, and of the irrigated acreage compared with the total improved acreage.

TABLE B.—COMPARISON OF IRRIGATED FARMS TO TOTAL NUMBER OF FARMS, AND OF IRRIGATED ACREAGE TO IMPROVED ACREAGE, JUNE 1, 1900.

COUNTIES.	NUMBER OF FARMS.			IMPROVED ACREAGE.		
	Total.	Irrigated.	Per cent irrigated.	Total.	Irrigated.	Per cent irrigated.
The State	33,202	3,513	10.6	3,465,960	135,470	3.9
Adams	783	12	1.5	275,778	423	0.2
Asotin	533	222	41.7	37,616	1,698	4.5
Chelan	457	309	67.6	14,034	6,406	45.6
Clallam	395	16	4.1	10,108	127	1.3
Columbia	706	25	3.5	151,589	440	0.3
Douglas	854	55	6.4	186,232	2,627	1.4
Ferry	62	16	25.8	3,833	625	16.3
Garfield	521	25	4.8	115,211	328	0.3
King	1,785	17	1.0	42,196	151	0.4
Kittitas	699	549	78.5	55,057	47,373	86.0
Klickitat	1,080	151	14.0	115,530	1,235	0.1
Lincoln	1,911	54	2.8	516,924	1,069	0.2
Okanogan	506	251	49.6	19,599	6,377	32.5
Spokane	2,911	31	1.1	280,159	718	0.3
Stevens	1,132	104	9.2	57,582	1,926	3.3
Wallawalla	1,029	231	22.4	391,719	6,100	1.6
Whitman	3,081	44	1.4	711,975	863	0.1
Yakima	1,293	1,123	86.9	104,680	47,588	45.6
All other counties	12,844	51	0.4	347,646	233	0.1
Indian reservations:						
Spokan	351	43	12.3	10,699	140	1.3
Yakima	269	184	68.4	17,993	9,023	50.1

Of the 33,202 farms of the state, 3,513, or 10.6 per cent, were irrigated in 1899. Of the total improved acreage, 3.9 per cent was irrigated.

Alfalfa, vegetables, and fruits are generally relied upon to give the highest returns where water is available. Cereals are seldom irrigated, being raised on the high plateaus, which receive sufficient moisture to produce fair yields.

Table C gives the acreage and production of all crops in eastern Washington, and of the crops grown on irrigated land.

TABLE C.—ACREAGE AND PRODUCTION OF ALL CROPS, AND OF IRRIGATED CROPS: 1899.[1]

CROPS.	ACREAGE.			Unit of measure.	PRODUCTION.		
	Total.	Irrigated.	Per cent irrigated.		Total.	Irrigated.	Per cent irrigated.
All crops	1,709,320	117,798	6.9	....	....	....	.....
Corn	9,665	1,579	16.3	Bushels.	200,976	43,650	21.7
Wheat	1,073,827	14,204	1.3	Bushels.	20,817,763	328,958	1.6
Oats	69,035	3,125	4.5	Bushels.	2,238,304	113,070	5.1
Barley	120,708	3,899	3.2	Bushela.	3,579,274	119,190	3.3
Rye	2,529	117	4.6	Bushels.	34,415	3,280	9.5
Wild, salt, or prairie grasses.	46,150	6,638	14.4	Tons	46,470	8,063	17.4
Millet and Hungarian grasses.	191	112	58.6	Tons	319	226	70.8
Alfalfa or lucern	34,763	28,161	81.0	Tons	116,897	101,548	86.9
Clover	5,801	5,296	91.3	Tons	12,680	11,944	94.2
Other tame and cultivated grasses.	46,701	15,358	32.9	Tons	65,056	25,708	39.5
Grains cut green for hay.	213,939	11,308	5.3	Tons	277,204	17,073	6.2
Forage[2]	6,187	566	9.1	Tons	[3]8,642	1,239	14.3
Hops	2,203	2,162	98.1	Pounds.	2,934,830	2,914,280	99.3
Dry beans	212	48	22.6	Bushels.	2,142	645	30.1
Potatoes	13,397	2,809	21.0	Bushels.	1,761,855	446,530	25.3
Sweet potatoes	27	8	29.6	Bushels.	2,147	821	38.2
Sorghum cane	28	28	100.0	Tons	82	82	100.0
Onions	321	146	45.5	Bushels.	73,992	34,854	47.1
Miscellaneous vegetables.	7,846	3,759	47.9	....	....	....	.....
Small fruits	1,306	553	42.3	Quarts	2,109,524	948,012	44.9
Orchard fruits[4]	61,918	17.590	33.9	Bushels.	663,840	344,801	51.9
Grapes[4]	263	205	77.9	Centals.	11,063	6,821	61.7
Other crops[5]	2,303	127	5.5	....	....	....	.....

[1] East of Cascade mountains, including Spokane and Yakima Indian reservations.
[2] Not including area of "duplicate forage crop" (cornstalks and strippings).
[3] Including cornstalks and corn atrippings.
[4] Estimated from number of vines or trees.
[5] Including tobacco, nurseries, seeds, products from land under glass, and other crops not mentioned.

In Table D is given values of land on the different classes of farms.

TABLE D.—AVERAGE VALUE PER ACRE OF FARMS, JUNE 1, 1900.

COUNTIES.	All farms.	Unirrigated farms.	Irrigated farms.	Irrigated land.	Unirrigated arable land.
The State[1]	$10.22	$9.81	$12.87	$48.85	$19.45
Adams	7.20	7.33	4.12	35.00	6.00
Asotin	9.42	5.46	24.96	206.88	30.00
Chelan	9.37	3.86	16.13	71.64	13.48
Columbia	14.68	15.05	8.40	61.43	17.14
Douglas	4.97	6.10	2.20	91.17	7.57
Ferry	12.67	10.54	16.62	50.00	20.00
Franklin	0.90	0.81	1.76	50.00	5.00
Garfield	8.05	8.20	5.44	32.50	7.00
Kittitas	9.24	3.64	10.40	35.30	6.75
Klickitat	6.62	6.52	7.34	60.28	11.61
Lincoln	9.16	9.20	7.57	75.65	15.89
Okanogan	8.32	5.34	11.22	62.69	7.55
Spokane	12.78	12.67	24.62	59.38	15.00
Stevens	7.45	7.05	11.36	33.15	9.69
Wallawaila	16.81	14.86	34.89	122.98	31.48
Whitman	12.67	12.76	8.31	71.07	10.34
Yakima	7.81	1.55	16.17	40.25	8.58

[1] East of Cascade mountains, not including Indian reservations.

Irrigation in eastern Washington has greatly increased land values. In counties where irrigation is practiced, the farm values steadily increase in proportion to the extent to which irrigation is carried on. In Asotin county small farms under the Vineland ditch produce the finest quality of fruits, and have thus acquired a value much higher than land in other counties.

Table E is an exhibit of the area irrigated from streams in 1899, with the number, and cost of construction of the irrigation systems, and total length of main ditches.

TABLE E.—ACREAGE IRRIGATED FROM STREAMS IN 1899, WITH NUMBER AND COST OF CONSTRUCTION OF SYSTEMS, AND TOTAL LENGTH OF MAIN DITCHES.

COUNTIES.	Number of acres irrigated.	SYSTEMS OPERATED IN 1899.			
		Number.	Length of main ditches in miles.	Cost of construction.	
				Total.	Average per acre irrigated in 1899.
The State	133,698	801	806	$1,679,319	$12.56
Adams	423	11	4	1,293	3.06
Asotin	1,698	12	23	82,089	48.34
Chelan	6,402	126	112	84,252	13.16
Columbia	440	21	7	1,668	3.79
Douglas	2,605	27	22	18,740	7.19
Ferry	625	12	8	1,707	2.73
Franklin	34	3	1	210	6.18
Garfield	265	23	3	858	3.24
Kittitas	47,373	71	118	119,706	2.53
Klickitat	1,111	60	16	4,282	3.85
Lincoln	1,069	15	9	1,298	1.21
Okanogan	6,368	82	76	36,474	5.73
Spokane	671	7	10	[1]41,850	[1]62.37
Stevens	1,926	47	27	7,564	3.93
Wallawalla	5,968	52	33	23,073	3.87
Whitman	758	21	15	8,855	11.68
Yakima	46,402	91	299	1,046,900	22.56
All other counties	397	75	4	1,500	3.78
Spokan and Yakima Indian reservations.	9,163	45	19	197,000	21.50

[1] Includes $40,000, cost of Liberty Lake ditch, designed to irrigate 2,600 acres; completed in 1899, but irrigated only 200 acres in that year.

Chelan county was formed in 1899 from parts of Kittitas and Okanogan counties. Yakima and Kittitas counties now comprise the entire territory drained by Yakima River. The area irrigated in Yakima Valley in 1889 was a little more than 38,300 acres. In 1899 there were irrigated from streams in this valley, exclusive of Yakima Indian reservation, 93,775 acres, an increase of 55,434 acres, or 144.6 per cent.

On account of the uncertainty of success and the great expense attached to prospecting for underground water, well irrigation in eastern Washington has not advanced very rapidly.

The principal artesian basins from which water is now taken are in Moxie Valley and in the vicinity of Wallawalla. In these localities flowing water has been obtained and is used for irrigation. Until recently no care has been exercised to prevent a waste of water, and, as a result, in several instances the pressure has become insufficient to force water to the surface. Now, however, wise statutes prohibit waste in any manner, the farmers have become more ambitious to develop and foster this mode of irrigation, and it promises to become an important factor in the raising of agricultural products. Water was obtained from wells, in 1899, for 77 farms with 1,772 acres of irrigated land. The total cost of construction of these systems was $43,050, or an average cost per acre irrigated of $24.29.

Table F shows the values, by counties, of crops produced on irrigated land.

TABLE F.—VALUE OF CROPS PRODUCED ON IRRIGATED LAND, BY COUNTIES.

COUNTIES.	All crops.	Hay and forage.	Cereals.	Vegetables.	Orchard fruits.	Small fruits.	Other crops.
The State	$2,361,838	$1,014,438	$227,171	$427,385	$351,015	$63,702	$278,127
Adams	2,518	2,005	....	265	258	....	....
Asotin	58,060	8,189	1,935	28,203	17,041	2,276	416
Chelan	159,046	54,810	7,792	47,759	42,685	4,973	1,027
Clallam	4,607	478	2,491	1,097	115	426	....
Columbia	18,710	6,509	13	3,774	8,166	248	....
Douglas	31,608	21,332	330	2,266	6,667	709	304
Ferry	15,044	11,462	15	3,349	48	170	....
Franklin	2,465	1,556	20	472	417	....	....
Garfield	30,559	997	....	3,639	23,675	1,206	1,042
King	29,527	117	....	24,484	1,924	3,002	....
Kittitas	501,864	305,004	129,881	44,320	17,663	4,996	....
Klickitat	44,113	10,673	235	9,826	15,868	6,562	949
Lincoln	31,736	11,178	451	5,798	6,868	7,234	207
Okanogan	115,426	77,440	5,315	25,100	4,115	3,348	108
Skaminia	1,702	158	....	1,221	38	258	27
Spokane	48,201	4,159	....	40,995	1,284	1,763	....
Stevens	28,840	17,474	1,100	5,677	2,147	2,442	....
Wallawalla	179,873	80,900	11,820	43,374	23,691	14,801	5,287
Whitman	50,151	1,611	47	7,803	34,651	2,240	3,799
Yakima	1,004,242	398,386	65,726	126,147	142,773	6,249	264,961
All other counties.	3,546	....	....	1,826	921	799	....

In the Yakima Valley, the value of irrigated products in 1899 was $1,506,106, or 64.0 per cent of the value of the irrigated products of the state. The value of hay and forage was $703,390, or 47.0 per cent of the total value of products in the valley. A large proportion of this hay and forage was alfalfa. Vegetables and orchard fruits ranked next in importance. Only a small percentage of cereals was irrigated.

O

Twelfth Census of the United States.

CENSUS BULLETIN.

No. 232. WASHINGTON, D. C. July 8, 1902.

AGRICULTURE.

SOUTH CAROLINA.

Hon. WILLIAM R. MERRIAM,
Director of the Census.

SIR: I have the honor to transmit herewith, for publication in bulletin form, the statistics of agriculture for the state of South Carolina, taken in accordance with the provisions of section 7 of the act of March 3, 1899. This section requires that—

The schedules relating to agriculture shall comprehend the following topics: Name of occupant of each farm, color of occupant, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock. All questions as to quantity and value of crops shall relate to the year ending December thirty-first next preceding the enumeration.

A "farm," as defined by the Twelfth Census, includes all the land under one management used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides and all other buildings used by him in connection with his farming operations.

The farms of South Carolina, June 1, 1900, numbered 155,355, and were valued at $126,761,530. Of this amount, $26,955,670, or 21.3 per cent, represents the value of buildings; and $99,805,860, or 78.7 per cent, the value of land and improvements other than buildings. On the same date the value of farm implements and machinery was $6,629,770, and of live stock, $20,199,859. These values, added to that of farms, give $153,591,159, the "total value of farm property."

The products derived from domestic animals, poultry, and bees, including animals sold and animals slaughtered on farms, are referred to in this bulletin as "animal products." The total value of such products, together with the value of all crops, is termed "total value of farm products." This value for 1899 was $68,266,912, of which amount $9,376,499, or 13.7 per cent, represents the value of animal products; and $58,890,413, or 86.3 per cent, the value of crops, including forest products cut or produced on farms. The total value of farm products for 1899 exceeds that for 1889 by $16,928,927, or 33.0 per cent.

The "gross farm income" is obtained by deducting from the total value of farm products the value of the products fed to live stock on the farms of the producers. In 1899 the reported value of products fed was $5,736,550, leaving $62,530,362 as the gross farm income. The ratio which this amount bears to the "total value of farm property" is referred to in this bulletin as the "percentage of gross income upon investment." For South Carolina, in 1899, it was 40.7 per cent.

As no reports of expenditures for taxes, interest, insurance, feed for stock, and similar items have been obtained by any census, no statement of net farm income can be given.

The statistics presented in this bulletin will be treated in greater detail in the report on agriculture in the United States. The present publication is designed to present a summarized advance statement for South Carolina.

Very respectfully,

L. G. Powers.

Chief Statistician for Agriculture.

AGRICULTURE IN SOUTH CAROLINA.

GENERAL STATISTICS.

South Carolina has a total land area of 30,170 square miles, or 19,308,800 acres, of which 13,985,014 acres, or 72.4 per cent, are included in farms.

Along the coast and for 100 miles inland, South Carolina is generally low and level, and covered to a considerable extent by forests. West of this alluvial plain is a range of sand hills, while still farther west the "ridge country" rises abruptly, including all the remainder of the state, from the Savannah River to the Broad River. The average elevation of this part of the state is nearly two thousand feet above sea level.

The soils of the state are generally light and friable. In the lowlands along the coast the soil is sandy and the vegetation is subtropical. The sand hills are the least fertile parts of the state, while in the highlands, where the soil is clayey, there are immense fruit orchards.

NUMBER AND SIZE OF FARMS.

The following table gives, by decades since 1850, the number of farms, the total and average acreage, and the percentage of farm land improved:

Table 1.—FARMS AND FARM ACREAGE: 1850 TO 1900.

YEAR.	Number of farms.	NUMBER OF ACRES IN FARMS.				Per cent of farm land improved.
		Total.	Improved.	Unimproved.	Average.	
1900	155,355	13,985,014	5,775,741	8,209,273	90.0	41.3
1890	115,008	13,184,652	5,255,237	7,929,415	114.6	39.9
1880	93,864	13,457,613	4,132,050	9,325,563	143.4	30.7
1870	51,889	12,105,280	3,010,539	9,094,741	233.3	24.9
1860	33,171	16,195,919	4,572,060	11,623,859	488.3	28.2
1850	29,967	16,217,700	4,072,651	12,145,049	541.2	25.1

The number of farms reported in 1900 was over five times as great as in 1850, and 35.1 per cent greater than in 1890. The total farm area, as shown in the above table, decreased over four million acres in the two decades from 1850 to 1870, and during the following thirty years there was an increase of but 15.5 per cent. Except for the Civil War decade, the area and per cent of improved farm land increased throughout the half century. The rapid increase in the number of farms and the very slight increase in the total acreage involved a decrease in the average size of farms, which, together with the increase in per cent of farm land improved, indicates a progressive division of farm holdings and a more complete utilization of the soil.

FARM PROPERTY AND PRODUCTS.

Table 2 presents a summary of the principal statistics relating to farm property and products for each census year, beginning with 1850.

Table 2.—VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND OF FARM PRODUCTS: 1850 TO 1900.

YEAR.	Total value of farm property.	Land, improvements, and buildings.	Implements and machinery.	Live stock.	Farm products.[1]
1900	$153,591,159	$126,761,530	$6,629,770	$20,199,859	$68,266,912
1890	119,849,272	99,104,600	4,172,262	16,572,410	51,337,985
1880	84,079,702	68,677,482	3,202,710	12,199,510	41,108,112
1870[2]	59,535,219	44,808,763	2,282,946	12,443,510	[3]41,909,402
1860	169,738,630	139,652,508	6,151,657	23,934,465	....
1850	101,628,053	82,431,684	4,136,354	15,060,015	....

[1] For the year preceding that designated.
[2] Values for 1870 were reported in depreciated currency. To reduce to specie basis of other figures they must be diminished one-fifth.
[3] Includes betterments and additions to live stock.

This table shows the remarkable increase in farm values in the decade from 1850 to 1860, the disastrous effect of the Civil War in the following decade, and the subsequent recovery of the state which in 1900 had very nearly regained the valuations of 1860.

The gain in the total value of farm property since 1890 was $33,741,887, or 28.2 per cent. The increase in the value of land, improvements, and buildings was $27,656,930, or 27.9 per cent; in that of live stock it was $3,627,449, or 21.9 per cent; and in that of implements and machinery, $2,457,508, or 58.9 per cent. The value of products was 33.0 per cent greater in 1899 than in 1889. A portion of this increase, and of that shown for implements and machinery, is doubtless the result of a more detailed enumeration in 1900 than in previous census years.

COUNTY STATISTICS.

Table 3 is a statement of general agricultural statistics by counties.

Table 3.—NUMBER AND ACREAGE OF FARMS, AND VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, JUNE 1, 1900, WITH GROSS INCOME (PRODUCTS OF 1899 NOT FED TO LIVE STOCK) AND EXPENDITURES IN 1899 FOR LABOR AND FERTILIZERS, BY COUNTIES.

COUNTIES.	NUMBER OF FARMS.		ACRES IN FARMS.		VALUES OF FARM PROPERTY.				Gross income (products of 1899 not fed to live stock).	EXPENDITURES.	
	Total.	With buildings.	Total.	Improved.	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		Labor.	Fertilizers.
The State	155,355	148,864	13,985,014	5,775,741	$99,805,860	$26,955,670	$6,629,770	$20,199,859	$62,530,362	$6,107,100	$4,494,410
Abbeville	4,574	4,298	348,997	174,520	2,541,950	755,950	169,720	557,554	1,771,758	141,800	104,250
Aiken	3,875	3,703	476,432	198,290	3,018,640	853,870	191,940	581,783	1,983,420	194,370	138,690
Anderson	6,674	6,120	432,710	246,933	6,405,220	1,344,870	323,200	880,255	2,806,851	143,970	250,750
Bamberg	2,024	1,941	174,643	103,345	1,336,050	364,530	116,050	295,533	1,179,782	73,970	74,710
Barnwell	4,605	4,363	417,052	250,086	3,272,740	907,840	220,420	699,174	2,368,108	257,300	177,540
Beaufort	5,476	5,383	263,707	97,451	1,597,850	488,400	163,630	494,550	1,115,616	97,270	75,070
Berkeley	3,790	3,689	455,899	110,774	1,361,020	421,570	125,220	460,494	1,060,380	147,900	54,350
Charleston	3,801	3,455	196,804	80,323	2,201,180	689,490	143,330	345,810	1,375,692	217,500	144,850
Cherokee	2,363	2,304	198,369	86,869	1,635,430	389,160	92,080	301,510	911,471	30,250	50,470
Chester	3,390	3,377	322,970	149,075	2,295,950	680,630	149,200	531,273	1,285,028	128,920	69,240
Chesterfield	2,771	2,699	334,742	97,592	1,140,090	297,590	97,480	307,657	997,708	76,850	68,010
Clarendon	4,006	3,855	280,877	131,492	1,755,530	530,100	143,400	443,493	1,528,250	157,260	108,660
Colleton	4,670	4,535	508,068	145,309	1,889,160	548,470	173,050	623,627	1,560,533	206,980	111,230
Darlington	4,087	3,845	285,783	150,001	2,682,210	827,160	188,340	454,173	2,211,725	227,080	208,520
Dorchester	1,803	1,723	198,776	51,499	808,990	268,280	68,440	219,055	466,653	58,840	27,050
Edgefield	3,566	3,428	320,386	139,895	1,994,560	666,070	149,630	481,330	1,306,246	120,290	92,740
Fairfield	3,560	3,516	413,393	165,486	2,075,670	600,820	139,630	636,058	1,448,884	149,940	72,030
Florence	3,173	3,092	297,859	118,729	1,816,040	548,250	115,070	368,578	1,432,117	204,260	118,720
Georgetown	1,414	1,387	265,449	36,169	937,960	320,720	80,580	177,617	532,625	126,110	8,670
Greenville	6,016	5,735	403,101	195,528	4,873,330	1,223,580	294,410	761,026	1,984,945	95,490	127,740
Greenwood	3,719	3,467	280,000	143,778	2,283,290	667,170	148,010	485,557	1,434,246	121,180	84,150
Hampton	3,257	3,150	385,028	155,600	1,970,480	544,100	147,700	498,917	1,178,125	132,220	61,290
Horry	3,267	3,180	468,174	79,918	1,291,040	415,890	102,460	376,505	1,022,957	57,470	67,220
Kershaw	2,841	2,777	320,187	114,816	1,407,200	383,070	134,210	388,050	1,229,707	144,690	58,060
Lancaster	2,970	2,936	271,316	119,117	1.731,670	418,290	126,630	433,713	1,288,813	173,590	70,380
Laurens	4,680	4,380	403,137	201,065	3,454,160	925,740	215,200	656,478	2,285,392	229,400	159,440
Lexington	3,618	3,389	471,829	144,696	2,841,770	874,650	197,120	559,609	1,364,358	82,530	69,690
Marion	3,724	3,610	416,367	156,893	3,639,820	946,660	200,100	570,252	2,373,030	255,790	212,890
Marlboro	2,645	2,569	240,845	124,571	4,031,300	813,320	168,970	408,877	2,129,990	389,830	300,900
Newberry	3,413	3,245	333,768	157,484	2,642,020	837,840	181,030	510,420	1,448,576	168,040	90,340
Oconee	3,249	3,116	333,038	99,891	2,044,880	471,070	103,950	358,123	908,837	32,850	53,870
Orangeburg	8,408	7,782	670,553	337,229	4,994,810	1,313,350	447,670	1,077,414	3,609,441	401,060	321,210
Pickens	2,954	2,840	238,920	100,387	2,209,720	485,640	106,560	380,544	996,201	34,390	64,400
Richland	2,927	2,828	238,193	98,016	1,913,300	506,550	134,060	392,924	1,099,729	139,040	53,290
Saluda	2,858	2,743	256,709	116,909	2,022,790	553,180	129,190	439,357	1,226,014	85,710	82,100
Spartanburg	6,707	6,453	551,149	224,214	5,491,310	1,198,860	239,210	857,897	2,428,434	84,990	179,280
Sumter	6,597	6,246	405,675	237,088	3,663,330	1,110,460	265,690	714,971	2,852,529	323,290	221,300
Union	2,910	2,867	290,551	109,150	1,761,180	472,870	101,060	410,835	1,119,559	120,170	63,400
Williamsburg	4,585	4,405	437,667	133,838	1,709,570	444,470	139,910	521,374	1,426,225	149,710	95,100
York	4,473	4,419	375,743	191,667	3,061,110	944,820	197,330	636,416	1,779,827	124,800	112,910
Catawba[1]	15	15	148	148	1,540	420	....	1,076	580	....	....

[1] Indian reservation.

On account of numerous territorial changes occurring in the last decade in South Carolina, it is impossible to make many accurate comparisons by counties for the census years, 1890 and 1900. For the last decade increases in the number of farms are shown for all counties whose boundaries were not changed. An increase in the acreage of farm land is reported in three-fourths of the counties, and the increase in the acreage of improved land is still more general. The average size of farms for the state is 90 acres, and varies from 48.2 acres in Beaufort county to 187.7 acres in Georgetown county.

Between 1890 and 1900 the value of farms increased in almost all counties, the average value for the state in 1900 being $816. Increases in the value of implements and machinery and of live stock are reported from nearly all counties.

The average expenditure per farm for labor varied greatly, being highest in the eastern and lowest in the northwestern counties. In Marlboro county the average was over $100 per farm. Berkeley, Greenville, Marion, Marlboro, and Richland counties reported decreased expenditures for fertilizers between 1889 and 1899. All other counties show increases.

FARM TENURE.

Table 4 gives a comparative statement of farm tenure for 1880, 1890, and 1900, showing the number and per cent of farms operated by owners and by tenants. Tenants are divided into two groups: "Cash tenants," who pay a rental in cash or a stated amount of labor or farm produce, and "share tenants," who pay as rental a stated share of the products.

In Table 5 the tenure of farms for 1900 is given by race of farmer, and farms operated by "owners" are subdivided into four groups, designated as farms operated by "owners," "part owners," "owners and tenants," and "managers." These groups comprise, respectively: (1) Farms operated by individuals who own all the land they cultivate; (2) farms operated by individuals who own a part of the land and rent the remainder from others; (3) farms operated under the joint direction and by the united labor of two or more individuals, one owning the farm or a part of it, and the other, or others, owning no part, but receiving for supervision or labor a share of the products; and (4) farms operated by individuals who receive for their supervision and other services a fixed salary from the owners.

TABLE 4.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES: 1880 TO 1900.

YEAR.	Total number of farms.	NUMBER OF FARMS OPERATED BY— Owners.[1]	Cash tenants.	Share tenants.	PER CENT OF FARMS OPERATED BY— Owners.[1]	Cash tenants.	Share tenants.
1900	155,355	60,471	57,046	37,838	39.0	36.7	24.3
1890	115,008	51,428	31,913	31,667	44.7	27.8	27.5
1880	93,864	46,645	21,974	25,245	49.7	23.4	26.9

[1] Including "part owners," "owners and tenants," and "managers."

TABLE 5.—NUMBER AND PER CENT OF FARMS OF SPECIFIED TENURES, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER.

PART 1.—NUMBER OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	155,355	52,623	6,310	484	1,054	57,046	37,838
White	69,954	37,120	2,934	393	874	14,612	14,021
Colored[1]	85,401	15,503	3,376	91	180	42,434	23,817

PART 2.—PER CENT OF FARMS OF SPECIFIED TENURES.

RACE.	Total number of farms.	Owners.	Part owners.	Owners and tenants.	Managers.	Cash tenants.	Share tenants.
The State	100.0	33.9	4.1	0.3	0.7	36.7	24.3
White	100.0	53.1	4.2	0.6	1.2	20.9	20.0
Colored[1]	100.0	18.2	3.9	0.1	0.2	49.7	27.9

[1] Comprising 20 Indians, and 85,381 negroes.

Since 1880 the number of farms has increased 65.5 per cent. The number of farms operated by owners gained 29.6 per cent; by cash tenants, 159.6 per cent; and by share tenants, 49.9 per cent. The greater part of the increase occurred in the last decade, which shows an increase of 35.1 per cent in number of farms, 17.6 per cent in farms operated by owners, 78.7 per cent in cash-tenant farms, and 19.5 per cent in share-tenant farms. The percentages in Table 4 show that the number of tenants has increased more rapidly than that of farms operated by owners.

In 1900, 45.0 per cent of the farms in the state were operated by white farmers and 55.0 per cent, by colored farmers. Of the white farmers, 57.8 per cent own all or a part of the farms they operate, and 42.2 per cent operate farms owned by others. For the colored farmers the corresponding percentages are 22.2 and 77.8.

In 1890, 49.8 per cent of all tenants were share tenants, and in 1900, 39.9 per cent. The relative number of farms rented for cash or for a share of the products is determined largely by the race of the farmers and the kinds of crops grown. In the western counties, where diversified farming is more general and a larger per cent of farmers are white, share tenants outnumber cash tenants, but in the leading cotton-growing counties, where more that one-half of the farmers are colored, cash tenants exceed share tenants. The greater number of colored farmers in the cotton counties are classed as cash tenants, but where local contract systems prevail the distinction between cash and share tenure is hard to draw.

No previous census has reported the number of farms operated by "part owners," "owners and tenants," or "managers," but it is believed that the number conducted by the last-named class is constantly increasing.

FARMS CLASSIFIED BY RACE OF FARMER AND BY TENURE.

TABLE 6.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY RACE OF FARMER AND BY TENURE, WITH PERCENTAGES.

RACE OF FARMER, AND TENURE.	Number of farms.	NUMBER OF ACRES IN FARMS. Average.	Total.	Per cent.	VALUE OF FARM PROPERTY. Total.	Per cent.
The State	155,355	90.0	13,985,014	100.0	$153,591,159	100.0
White	69,954	145.7	10,192,938	72.9	109,589,887	71.4
Colored[1]	85,401	44.4	3,792,076	27.1	44,001,272	28.6
Owners	52,623	144.2	7,585,751	54.2	83,106,067	54.1
Part owners	6,310	88.1	555,625	4.0	5,574,641	3.6
Owners and tenants	484	178.3	86,303	0.6	700,833	0.5
Managers	1,054	631.7	665,760	4.8	5,901,821	3.8
Cash tenants	57,046	56.1	3,202,921	22.9	34,220,038	22.3
Share tenants	37,838	49.9	1,888,654	13.5	24,087,759	15.7

[1] Includes 20 Indians.

TABLE 7.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY RACE OF FARMER AND BY TENURE.

RACE OF FARMER, AND TENURE.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$642	$174	$43	$130	$402	40.7
White	995	304	72	196	541	34.6
Colored[1]	353	67	19	76	289	56.0
Owners	981	323	75	200	495	31.4
Part owners	527	166	48	142	387	43.9
Owners and tenants	924	282	56	186	574	39.6
Managers	3,857	990	246	506	1,559	27.8
Cash tenants	400	84	25	91	328	54.6
Share tenants	463	78	17	79	355	55.7

[1] Includes 20 Indians.

While colored farmers operate more than one-half of all the farms of South Carolina, they control but little over one-fourth of the total acreage, or the value of farm property, and actually own less than one-twelfth of the entire acreage and about one-fourteenth of the total value of farm property.

The values of all forms of farm property are less for colored than for white farmers. The higher per cent of gross income for colored farmers does not indicate superior management, but is due to the smaller average area and consequently more intensive cultivation of their farms, and to the very low average values of their farm property, or capital invested.

Farms operated by managers have the highest average values of all forms of farm property, many of this class being cotton plantations, while some are farms connected with public institutions. The ratio which the gross income bears to the total value of farm property is, however, smaller than for any other group. This is due to the high valuation of the farm property, and the fact that some of them are not cultivated for profit.

FARMS CLASSIFIED BY AREA.

Tables 8 and 9 present the principal statistics for farms classified by area.

TABLE 8.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY AREA, WITH PERCENTAGES.

AREA.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	155,355	90.0	13,985,014	100.0	$153,591,159	100.0
Under 3 acres	1,193	2.0	2,338	(1)	250,841	0.2
3 to 9 acres	13,075	5.8	75,808	0.5	2,639,386	1.7
10 to 19 acres	18,828	13.6	255,815	1.8	5,398,173	3.5
20 to 49 acres	54,384	30.5	1,660,059	11.9	27,978,340	18.2
50 to 99 acres	29,944	67.0	2,005,919	14.3	29,469,508	19.2
100 to 174 acres	20,532	125.4	2,576,058	18.4	31,391,743	20.4
175 to 259 acres	7,866	209.3	1,646,159	11.8	16,235,787	10.6
260 to 499 acres	6,209	345.6	2,145,813	15.4	18,960,100	12.3
500 to 999 acres	2,314	652.0	1,508,769	10.8	10,425,476	6.8
1,000 acres and over	1,010	2,087.4	2,108,276	15.1	10,841,805	7.1

[1] Less than one-tenth of 1 per cent.

TABLE 9.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY AREA.

AREA.	AVERAGE VALUES PER FARM OF—					Per cent of gross income on total investment in farm property.
	Farm property, June 1, 1900.				Gross income (products of 1899 not fed to live stock).	
	Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.		
The State	$642	$174	$43	$130	$402	40.7
Under 3 acres	85	99	7	19	54	25.6
3 to 9 acres	95	69	8	30	86	42.5
10 to 19 acres	155	68	14	50	162	56.7
20 to 49 acres	327	83	21	83	310	60.3
50 to 99 acres	635	169	42	188	466	47.4
100 to 174 acres	1,008	265	66	190	553	36.2
175 to 259 acres	1,355	364	88	257	676	32.8
260 to 499 acres	2,040	525	142	347	897	29.4
500 to 999 acres	3,019	781	192	513	1,154	25.6
1,000 acres and over	7,655	1,684	477	918	2,520	23.5

With a few exceptions, the average values of all forms of farm property increase with the size of the farms. For the group of farms containing less than 3 acres, the average values for land, improvements, and buildings are comparatively high, owing to the fact that many of this group are suburban or summer homes, while a number of them are city dairies and truck farms. The group from 20 to 49 acres includes the largest number of cotton plantations, and the per cent of gross income on total investments is largest for this group.

The average gross incomes per acre for the various groups classified by area are as follows: Farms under 3 acres, $27.43; 3 to 9 acres, $14.78; 10 to 19 acres, $11.96; 20 to 49 acres, $10.15; 50 to 99 acres, $6.96; 100 to 174 acres, $4.41; 175 to 259 acres, $3.23; 260 to 499 acres, $2.59; 500 to 999 acres, $1.77; and 1,000 acres and over, $1.21.

FARMS CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

Tables 10 and 11 present the leading features of the statistics relating to farms classified by principal source of income. If the value of the hay and grain raised on any farm exceeds that of any other crop and constitutes at least 40 per cent of the total value of products not fed to live stock, the farm is classified as a "hay and grain" farm; if vegetables are the leading crop, constituting 40 per cent of the value of products, it is a "vegetable" farm. The farms of the other groups are classified in accordance with the same general principle. "Miscellaneous" farms are those whose operators do not derive 40.0 per cent of their income from any one class of products. Farms with no income in 1899 are classified according to the agricultural operations upon other farms in the same locality.

For the several classes of farms the average values per acre of products not fed to live stock are as follows: For farms whose operators derive their principal income from flowers and plants, $264.29; nursery products, $12.52; vegetables, $10.60; fruit, $6.82; tobacco, $6.27; cotton, $4.94; dairy produce, $4.45; sugar, $3.31; miscellaneous, $3.28; live stock, $3.23; hay and grain, $3.22; and rice, $2.61.

TABLE 10.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME, WITH PERCENTAGES.

PRINCIPAL SOURCE OF INCOME.	Number of farms.	NUMBER OF ACRES IN FARMS.			VALUE OF FARM PROPERTY.	
		Average.	Total.	Per cent.	Total.	Per cent.
The State	155,355	90.0	13,985,014	100.0	$153,591,159	100.0
Hay and grain	9,549	102.9	982,434	7.0	14,465,269	9.4
Vegetables	2,332	63.5	148,062	1.1	2,794,298	1.8
Fruit	189	61.3	11,589	0.1	291,311	0.2
Live stock	3,376	139.8	471,816	3.4	4,766,633	3.1
Dairy produce	442	167.9	74,222	0.5	1,180,499	0.8
Tobacco	1,953	99.9	195,026	1.4	2,312,792	1.5
Cotton	112,822	81.1	9,151,766	65.4	99,843,900	65.0
Rice	1,206	305.2	368,116	2.6	2,775,474	1.8
Sugar	19	97.4	1,850	(1)	16,176	(1)
Flowers and plants	4	3.5	14	(1)	12,515	(1)
Nursery products	3	67.3	202	(1)	5,850	(1)
Miscellaneous	23,460	110.0	2,579,917	18.5	25,126,442	16.4

[1] Less than one-tenth of 1 per cent.

TABLE 11.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY PRINCIPAL SOURCE OF INCOME.

PRINCIPAL SOURCE OF INCOME.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The state	$642	$174	$43	$130	$402	40.7
Hay and grain	1,060	272	76	107	331	21.9
Vegetables	763	266	60	109	673	56.2
Fruit	1,072	340	34	95	418	27.1
Live stock	812	309	68	223	452	32.0
Dairy produce	1,471	617	104	479	747	28.0
Tobacco	736	255	53	140	626	52.9
Cotton	579	143	37	126	401	45.3
Rice	1,592	385	143	181	796	34.6
Sugar	443	190	65	153	322	37.8
Flowers and plants	1,975	1,100	54		925	29.6
Nursery products	1,192	675	77	6	843	43.2
Miscellaneous	664	226	46	135	360	33.6

The wide variations shown in the averages and percentages of gross income are largely due to the fact that in computing gross income no deduction is made for expenditures. For florists' establishments, nurseries, and market gardens the average expenditure for such items as labor and fertilizers represents a far larger percentage of the gross income than in the case of "hay and grain," "live-stock," or "miscellaneous" farms. Were it possible to present the average net incomes, the variations shown would be comparatively slight.

FARMS CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

Tables 12 and 13 present data relating to farms classified by the reported value of products not fed to live stock.

TABLE 12.—NUMBER AND ACREAGE OF FARMS, AND VALUE OF FARM PROPERTY, JUNE 1, 1900, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK, WITH PERCENTAGES.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	Number of farms.	NUMBER OF ACRES IN FARMS. Average.	Total.	Per cent.	VALUE OF FARM PROPERTY. Total.	Per cent.
The State	155,355	90.0	13,985,014	100.0	$153,691,159	100.0
$0	871	69.5	60,541	0.4	453,500	0.3
$1 to $49	10,578	22.9	241,877	1.7	2,231,290	1.5
$50 to $99	15,505	30.4	471,888	3.4	4,441,209	2.9
$100 to $249	48,104	49.8	2,393,801	17.1	24,458,080	15.9
$250 to $499	49,940	80.4	4,012,801	28.7	45,792,400	29.8
$500 to $999	22,230	153.8	3,418,045	24.5	42,435,280	27.6
$1,000 to $2,499	6,769	311.9	2,111,580	15.1	26,234,520	17.1
$2,500 and over	1,358	938.5	1,274,481	9.1	7,544,880	4.9

TABLE 13.—AVERAGE VALUES OF SPECIFIED CLASSES OF FARM PROPERTY, AND AVERAGE GROSS INCOME PER FARM, WITH PER CENT OF GROSS INCOME ON TOTAL INVESTMENT IN FARM PROPERTY, CLASSIFIED BY REPORTED VALUE OF PRODUCTS NOT FED TO LIVE STOCK.

VALUE OF PRODUCTS NOT FED TO LIVE STOCK.	AVERAGE VALUES PER FARM OF— Farm property, June 1, 1900. Land and improvements (except buildings).	Buildings.	Implements and machinery.	Live stock.	Gross income (products of 1899 not fed to live stock).	Per cent of gross income on total investment in farm property.
The State	$642	$174	$43	$130	$402	40.7
$0	387	76	13	45		
$1 to $49	133	43	7	28	29	13.5
$50 to $99	175	61	10	40	78	27.2
$100 to $249	323	90	19	76	203	39.9
$250 to $499	611	167	37	112	392	42.8
$500 to $999	1,226	358	84	241	776	40.7
$1,000 to $2,499	2,612	606	195	464	1,450	37.4
$2,500 and over	3,213	908	311	1,124	3,390	61.0

The absence of income in the first group is due in part to the fact that the enumerators could not always secure complete reports for farms where changes in ownership or tenancy had occurred shortly prior to the date of enumeration. The person in charge of such farms, June 1, 1900, could not always give definite information concerning the products of the preceding year. To this extent the reports fall short of giving a complete exhibit of farm income in 1899. Other farms with small reported incomes are doubtless summer resorts or the suburban homes of business or professional men, who derive their principal incomes from other than agricultural pursuits.

LIVE STOCK.

At the request of the various live-stock associations of the country, a new classification of domestic animals was adopted for the census of 1900. The age grouping for neat cattle was determined by their present and prospective relations to the dairy industry and the supply of meat products. Horses and mules are classified by age, and neat cattle and sheep, by age and sex. The new classification permits a very close comparison with previous census reports.

Table 14 presents a summary of live-stock statistics.

The value of all live stock on farms, June 1, 1900, was $20,199,859. Of this amount, 41.7 per cent represents the value of mules; 24.0 per cent, the value of horses; 12.6 per cent, that of dairy cows; 8.9 per cent, that of other neat cattle; 7.0 per cent, that of swine; 4.4 per cent, that of poultry; 0.5 per cent, that of sheep; and 0.9 per cent, that of all other live stock.

No reports were secured of the value of live stock not on farms, but it is probable that such animals have higher average values than those on farms. Allowing the same averages, the value of domestic animals not on farms was $1,096,655, and the total value of live stock in the state, exclusive of poultry and bees not on farms, was approximately $21,296,514.

TABLE 14.—DOMESTIC ANIMALS, FOWLS, AND BEES ON FARMS, JUNE 1, 1900, WITH TOTAL AND AVERAGE VALUES, AND NUMBER OF DOMESTIC ANIMALS NOT ON FARMS.

LIVE STOCK.	Age in years.	ON FARMS. Number.	ON FARMS. Value.	ON FARMS. Average value.	NOT ON FARMS. Number.
Calves	Under 1	87,734	$361,454	$4.12	2,580
Steers	1 and under 2	14,975	95,827	6.40	466
Steers	2 and under 3	8,157	74,544	9.14	288
Steers	3 and over	19,118	315,707	16.51	613
Bulls	1 and over	10,116	125,621	12.42	153
Heifers	1 and under 2	33,879	291,705	8.61	888
Cows kept for milk	2 and over	126,684	2,541,723	20.06	9,649
Cows and heifers not kept for milk.	2 and over	42,235	528,133	12.50	622
Colts	Under 1	2,701	69,778	25.83	80
Horses	1 and under 2	3,188	161,587	50.69	97
Horses	2 and over	72,530	4,615,538	63.64	9,678
Mule colts	Under 1	520	18,937	36.42	32
Mules	1 and under 2	3,081	187,207	60.76	41
Mules	2 and over	113,768	8,209,379	72.16	2,759
Asses and burros	All ages	247	22,353	90.50	54
Lambs	Under 1	19,102	25,365	1.33	113
Sheep (ewes)	1 and over	40,478	66,202	1.64	217
Sheep (rams and wethers).	1 and over	11,958	20,203	1.69	192
Swine	All ages	618,995	1,411,516	2.28	12,030
Goats	All ages	26,576	24,450	0.92	681
Fowls:[1]					
Chickens[2]		2,664,784			
Turkeys		120,140	889,953		
Geese		83,543			
Ducks		39,852			
Bees (swarms of)		93,958	142,677	1.52	
Value of all live stock			20,199,859		

[1] The number reported is of fowls over three months old. The value is of all, old and young.
[2] Including Guinea fowls.

CHANGES IN LIVE STOCK ON FARMS.

The following table shows the changes since 1850 in the number of the most important domestic animals:

TABLE 15.—NUMBER OF SPECIFIED DOMESTIC ANIMALS ON FARMS: 1850 TO 1900.

YEAR.	Dairy cows.	Other neat cattle.	Horses.	Mules and asses.	Sheep.[1]	Swine.
1900	126,684	216,214	78,419	117,616	52,436	618,995
1890	107,184	161,109	59,888	86,306	79,421	494,696
1880	139,881	223,828	60,660	67,005	118,889	628,198
1870	98,693	150,610	44,105	41,327	124,594	395,999
1860	163,938	342,838	81,125	56,456	233,509	965,779
1850	193,244	584,442	97,171	37,483	285,551	1,065,503

[1] Lambs not included.

In South Carolina, as in most states of this section, the rearing of live stock is but an auxiliary to the other branches of agriculture, and horses and mules exceed all other classes in importance. Since the Civil War the character of general farming industries has so changed in the Atlantic states that the raising of meat-producing stock has been transferred to the West. Each class, except mules and asses, shows fewer numbers in 1900 than in 1850, although for the decade preceding 1900 considerable increases are shown in the numbers of all classes except sheep. The number of sheep has decreased steadily since 1850, the number reported in 1900 being 34.0 per cent less than that in 1890. All other classes show fluctuations in number since 1850. For the last decade the following increases are shown: Dairy cows, 18.2 per cent; other neat cattle, 34.2 per cent; horses, 30.9 per cent; mules and asses, 36.3 per cent; and swine, 25.1 per cent.

In 1900 the enumerators were instructed to report no fowls under three months old, a limitation not made in former census years. This accounts, in part at least, for the following apparent decreases in numbers of all domestic fowls for the decade 1890 to 1900: Geese, 31.3 per cent; chickens, 31.2 per cent; turkeys, 19.4 per cent; ducks, 15.4 per cent. That this decrease is only apparent is indicated by the large increase in the production of eggs for the same decade.

ANIMAL PRODUCTS.

Table 16 presents a summary of animal products for 1899.

TABLE 16.—QUANTITIES AND VALUES OF SPECIFIED ANIMAL PRODUCTS, AND VALUES OF POULTRY RAISED, ANIMALS SOLD, AND ANIMALS SLAUGHTERED ON FARMS IN 1899.

PRODUCTS.	Unit of measure.	Quantity.	Value.
Wool	Pounds	175,290	$31,537
Mohair and goat hair	Pounds	73	26
Milk	Gallons	[1] 44,031,528	
Butter	Pounds	8,150,437	[2] 3,232,725
Cheese	Pounds	1,081	
Eggs	Dozens	9,007,700	925,966
Poultry			1,539,755
Honey	Pounds	872,590	92,857
Wax	Pounds	37,500	
Animals sold			823,554
Animals slaughtered			2,730,079
Total			9,376,499

[1] Includes all milk produced, whether sold, consumed, or made into butter or cheese.
[2] Includes the value of all milk sold or consumed and of butter and cheese made.

The value of animal products for 1899 was $9,376,499, or nearly half as great as the value of all live stock on farms, June 1, 1900, and 13.7 per cent of the value of all farm products for the year 1899. Of this amount, 37.9 per cent represents the value of animals sold and animals slaughtered on farms; 34.5 per cent, the value of dairy produce; 26.3 per cent, the value of poultry and eggs; 1.0 per cent, the value of honey and wax; and 0.3 per cent, the value of wool, mohair, and goat hair.

ANIMALS SOLD AND ANIMALS SLAUGHTERED.

In 1899 the value of animals sold and animals slaughtered on farms was $3,553,633, or 5.2 per cent of all farm products. Animals slaughtered were reported by 94,302 farmers, or 60.7 per cent of all in the state, the average value per farm being $28.95. Sales of live animals were reported by 29,784 farmers, or 19.2 per cent of the whole number, the average receipts per farm being $27.65.

In obtaining these reports the enumerators were instructed to obtain from each farm operator a statement of the amount received from the sale of live animals in 1899, less the amount paid for animals purchased during the same year.

DAIRY PRODUCE.

Of the $3,232,725 given in Table 16 as the value of dairy produce, $2,890,342, or 89.4 per cent, represents the value of such produce consumed on farms, and $342,383, or 10.6 per cent, the amount received from sales. Of the latter amount, $195,939 was received from the sale of 1,103,637 pounds of butter; $141,737, from 1,186,045 gallons of milk; $4,657, from 4,796 gallons of cream; and $50, from 800 pounds of cheese.

The production of milk in the last decade increased 84.7 per cent and that of butter made on farms 42.1 per cent, while a decrease of 56.3 per cent is shown in the amount of cheese made on farms.

POULTRY, EGGS, HONEY AND WAX, AND WOOL.

Of the value of poultry products in 1899, 62.4 per cent represents the value of poultry raised, and 37.6 per cent that of eggs produced. The production of eggs in 1899 was 58.0 per cent greater than in 1889. The census of 1899 compared with that of 1889 shows increases of 1.9 per cent in the production of honey, and 35.2 per cent in that of wax. The production of wool in 1899 was 11.1 per cent greater than in 1889, but this increase is probably only apparent, as the fleeces from a large number of sheep were omitted from the tables in 1890, but included in a general estimate of wool shorn after the census enumeration. Horry and Berkeley counties together reported about one-sixth of the state total.

HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS.

Table 17 presents, for the leading groups of farms, the number of farms reporting horses, mules, and dairy cows, and the average number of these animals per farm. In computing the averages presented, only those farms which report the kind of stock under consideration are included.

In South Carolina, as in other states where cotton is a staple crop, and much of the farm labor is performed by negroes, large numbers of mules are used as work animals. For most classes of farms the average number of mules and horses are about equal, but on farms operated by managers, and on farms of the largest area, more mules than horses are reported. This is due to the fact that these two classes include a relatively large number of cotton plantations.

If the number of horses and mules be combined, the average number of work animals per farm compares favorably with the corresponding figures for the more intensively cultivated farms of New England.

TABLE 17.—HORSES, MULES, AND DAIRY COWS ON SPECIFIED CLASSES OF FARMS, JUNE 1, 1900.

CLASSES.	HORSES.		MULES.		DAIRY COWS.	
	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.	Farms reporting.	Average per farm.
Total	58,541	1.3	75,428	1.6	81,483	1.6
White farmers	35,658	1.4	39,635	1.9	47,356	1.8
Colored farmers	22,883	1.2	35,793	1.2	34,127	1.3
Owners[1]	32,073	1.5	30,215	1.9	38,415	1.9
Managers	645	2.1	722	4.3	678	2.9
Cash tenants	19,106	1.2	25,244	1.3	24,525	1.3
Share tenants	6,717	1.2	19,247	1.2	17,865	1.2
Under 20 acres	7,316	1.1	3,922	1.1	8,140	1.3
20 to 99 acres	29,405	1.2	44,474	1.2	43,824	1.3
100 to 174 acres	10,322	1.4	14,036	1.7	15,349	1.6
175 to 259 acres	4,621	1.5	5,738	2.0	6,303	1.9
260 acres and over	6,877	2.0	7,258	3.1	7,867	2.8
Hay and grain	3,198	1.4	2,815	1.9	3,487	1.6
Vegetable	1,017	1.4	486	1.9	731	1.9
Fruit	71	1.3	60	1.2	97	1.3
Live stock	1,879	1.6	1,173	1.7	2,148	2.3
Dairy	288	1.8	209	1.9	442	8.7
Tobacco	877	1.3	940	1.5	808	1.4
Cotton	40,305	1.3	61,504	1.5	58,691	1.4
Rice	402	2.2	228	4.7	349	2.1
Miscellaneous[2]	10,504	1.3	8,013	1.6	14,730	1.7

[1] Including "part owners" and "owners and tenants."
[2] Including sugar farms, florists' establishments, and nurseries.

CROPS.

The following table gives the statistics of the principal crops of 1899:

TABLE 18.—ACREAGES, QUANTITIES, AND VALUES OF THE PRINCIPAL FARM CROPS IN 1899.

CROPS.	Acres.	Unit of measure.	Quantity.	Value.
Corn	1,772,057	Bushels	17,429,610	$9,149,808
Wheat	174,245	Bushels	1,017,319	958,158
Oats	222,544	Bushels	2,661,670	1,226,575
Barley	281	Bushels	3,106	2,899
Rye	4,256	Bushels	19,372	18,551
Buckwheat	10	Bushels	41	42
Broom corn	21	Pounds	11,280	823
Rice	77,657	Pounds	47,360,128	1,366,528
Clover seed		Bushels	17	72
Grass seed		Bushels	204	171
Hay and forage	106,124	Tons	213,249	2,304,734
Sea-island cotton seed		Tons	[1]3,607	48,200
Upland cotton seed		Tons	[2]410,459	4,925,201
Sea-island cotton	23,902	Bales[3]	9,209	664,559
Upland cotton	2,050,179	Bales[4]	872,213	28,925,593
Tobacco	25,993	Pounds	19,895,970	1,297,293
Peanuts	7,162	Bushels	131,710	106,018
Dry beans	1,657	Bushels	14,925	13,936
Dry pease	143,070	Bushels	1,162,705	859,932
Potatoes	8,068	Bushels	651,916	435,468
Sweet potatoes	48,831	Bushels	3,369,957	1,538,205
Onions	147	Bushels	16,172	11,312
Miscellaneous vegetables	40,624			2,079,862
Sugar cane	7,342	Tons	73,702	
(a) cane sold		Tons	3,585	13,582
(b) cane kept for seed		Tons	29,368	102,788
(c) sugar made		Pounds	49,590	2,256
(d) molasses and sirup made.		Gallons	805,064	310,799
Sorghum cane	7,250	Tons	[5]3,589	10,285
Sorghum sirup		Gallons	478,190	168,038
Small fruits	591			59,486
Grapes	[6]638	Centals	33,238	[7]82,706
Orchard fruits	[6]28,587			[8]272,794
Tropical fruits				1,147
Nuts				3,868
Forest products				1,915,134
Flowers and plants	28			7,920
Seeds	9			505
Nursery products	84			4,416
Miscellaneous	28			749
Total	4,751,385			58,890,413

[1] Exclusive of 1,000 tons, valued at $13,365, sold in seed cotton and included with the cotton.
[2] Exclusive of 8,219 tons, valued at $98,623, sold in seed cotton and included with the cotton.
[3] Average weight, 336 pounds.
[4] Average weight, 480 pounds.
[5] Sold as cane.
[6] Estimated from number of vines and trees.
[7] Including value of raisins, wine, etc.
[8] Including value of cider and vinegar.

Of the total value of crops, cotton, including seed, contributed 58.7 per cent; cereals, including rice, 21.6 per cent; hay and forage, 3.9 per cent; miscellaneous vegetables, 3.5 per cent; forest products, 3.3 per cent; sweet potatoes, 2.6 per cent; tobacco, 2.2 per cent; dry pease, 1.5 per cent; potatoes, 0.7 per cent; and all other products, 2.0 per cent.

The average values per acre of the various crops are as follows: Flowers and plants, $283; onions, $77; potatoes, $54; nursery products, $53; miscellaneous vegetables, $51; tobacco, $50; sweet potatoes, $32; hay and forage, $22; cotton, including seed, $17; peanuts, $15; orchard fruits, $10; cereals, $6; and dry pease, $6. The crops yielding the highest average returns per acre were grown upon very highly improved land. Their production required a relatively great amount of labor, and large expenditures for fertilizers.

COTTON.

The following table is a statement of the changes in cotton production since 1879:

TABLE 19.—ACREAGE AND PRODUCTION OF COTTON: 1879 TO 1899.

YEAR.	ACREAGE.		PRODUCTION.		
	Total.	Per cent of increase.	Commercial bales.	Pounds.	Per cent of increase.
1899	2,074,081	4.4	881,422	421,862,069	18.4
1889	1,987,469	45.7	747,190	356,409,630	50.6
1879	1,364,249	....	522,548	236,714,244	....

In 1849 South Carolina produced 300,901 bales of cotton, and in 1859, 353,412 bales, an increase of 17.5 per cent. The census of 1870 found the cotton crop in this, as in other states, suffering from the effects of the Civil War, the production in 1869 amounting to only 224,500 bales, or 36.5 per cent less than that of 1859. In the following decade the production of cotton more than doubled, while the decade from 1879 to 1889 showed an increase of 43.0 per cent.

In 1899, 134,741 farmers devoted an area of 2,074,081 acres to the cultivation of cotton, an average of 15.4 acres per farm, and 35.9 per cent of the total improved farm land. From this land was produced a total crop of 421,862,069 pounds of cotton, an average of 3,131 pounds per farm, 203 pounds per acre, 13,983 pounds per square mile of land surface, and 315 pounds per capita. Of the total production 99.2 per cent was upland cotton, and the remaining 0.8 per cent was sea-island cotton.

The total value of the crop, including the value of cotton seed, was $34,563,553, an average of $256.52 per farm, $16.66 per acre, and $25.79 per capita. Of the total value, $28,925,593 was the value of the upland cotton, $664,559, that of sea-island cotton, and $4,973,401, that of cotton seed. The total value represents 55.3 per cent of the gross farm income.

The counties reporting the largest area under cotton were Anderson, Orangeburg, Laurens, Abbeville, Sumter, and Spartanburg, ranking in the order named, and reporting 30.0 per cent of the total acreage. These counties, which are located in the central and northwestern parts of the state, were seeded to upland cotton, while sea-island cotton was grown almost entirely in the counties adjacent to the coast.

CEREALS.

Table 20 is a statement of the changes in cereal production since 1849.

TABLE 20.—ACREAGE AND PRODUCTION OF CEREALS: 1849 TO 1899.

PART 1.—ACREAGE.

YEAR.[1]	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	281	1,772.057	222,544	77,657	4,256	174,245
1889	688	1,345,990	308,056	42,238	4,129	115,510
1879	1,162	1,303,404	261,445	78,388	7,152	170,902

PART 2.—BUSHELS PRODUCED.[2]

YEAR.	Barley.	Corn.	Oats.	Rice.	Rye.	Wheat.
1899	3,106	17,429,610	2,661,670	47,360,128	19,372	1,017,319
1889	9,428	13,770,417	3,019,119	30,338,951	17,303	658,351
1879	16,257	11,767,099	2,715,505	52,077,515	27,049	962,358
1869	4,752	7,614,207	613,593	32,304,825	36,165	783,610
1859	11,490	15,065,606	936,974	119,100,528	89,091	1,285,631
1849	4,583	16,271,454	2,322,155	159,930,613	43,790	1,066,277

[1] No statistics of acreage were secured prior to 1879.
[2] Rice reported in pounds.

The total area devoted to cereals in 1879 was 1,822,453 acres; in 1889, 1,816,676 acres; and in 1899, 2,251,050 acres, an increase for the twenty years of 23.5 per cent. The acreage given for 1889 includes 65 acres devoted to buckwheat, and that for 1899 includes 10 acres. The increases in the areas devoted to the various cereals in the decade from 1889 to 1899 were: Rice, 83.9 per cent; wheat, 50.8 per cent; corn, 31.7 per cent; and rye, 3.1 per cent. The decreases were: Barley, 59.2 per cent; and oats, 27.8 per cent.

Exclusive of rice, the total number of bushels of cereals, including buckwheat, reported in 1849 was 19,708,542, and for 1899, 21,131,118, an increase of 7.2 per cent in the half century. The production of rice shows a decrease in the same time of 70.4 per cent.

Of the total area under cereals in 1899, 78.7 per cent was devoted to corn; 9.9 per cent, to oats; 7.7 per cent, to wheat; and 3.7 per cent, to barley, buckwheat, rice, and rye.

Barley, corn, oats, rye, and wheat are reported from nearly all parts of the state. Rice was grown in 35 counties, but 60.0 per cent of the acreage was furnished by the four counties of Georgetown, Colleton, Beaufort, and Berkeley, in the extreme southeastern part of the state.

HAY AND FORAGE.

In 1900, 87,777 farmers, or 56.5 per cent of the total number, reported hay or forage crops. Exclusive of cornstalks and corn strippings, they obtained an average yield of 1.03 tons per acre. The acreage in hay and forage in 1899 was 106,124 acres, or 264.3 per cent greater than ten years before, 46.1 per cent of this acreage producing grains cut green for hay.

In 1899 the acreages and yields of the various kinds of hay and forage were as follows: Wild, salt, and prairie grasses, 954 acres and 985 tons; millet and Hungarian grasses, 474 acres and 806 tons; alfalfa or lucern, 18 acres and 31 tons; clover, 1,435 acres and 1,728 tons; other tame and cultivated grasses, 50,733 acres and 51,608 tons; grains cut green for hay, 48,918 acres and 47,912 tons; crops grown for forage, 3,592 acres and 5,816 tons; cornstalks and corn strippings, 497,527 acres and 104,363 tons.

In Table 18 the production of cornstalks and corn strippings is included under "hay and forage," but the acreage is included under "corn," as the forage secured was only an incidental product of the corn crop.

ORCHARD FRUITS.

The changes in orchard fruits since 1890 may be seen in the following table:

TABLE 21.—ORCHARD TREES AND FRUITS: 1890 AND 1900.

FRUITS.	NUMBER OF TREES.		BUSHELS OF FRUIT.	
	1900	1890	1899	1889
Apples	694,700	321,137	251,728	435,484
Apricots	2,397	2,099	120	2,057
Cherries	95,288	21,329	6,551	10,173
Peaches	1,136,790	711,138	129,472	1,490,633
Pears	72,846	12,720	20,439	9,244
Plums and prunes	99,209	20,383	16,177	8,507

The total number of fruit trees in the state in 1890 was 1,088,806, and in 1900, 2,123,968, an increase of 1,035,162, or 95.1 per cent. The increases are as follows: Pear trees, over five times; cherry, plum and prune trees, over four times; apple trees, 116.3 per cent; and peach trees 59.9 per cent.

Of the total number in 1900, 53.5 per cent were peach trees; 32.7 per cent, apple trees; 3.4 per cent, pear trees; 4.7 per cent, plum and prune trees; and 5.7 per cent, cherry, apricot, and unclassified fruit trees. The last-named class, which is not included in the table, numbered 22,738 and yielded 7,686 bushels of fruit.

The value of orchard fruits given in Table 18 includes the value of 575 barrels of cider, 259 barrels of vinegar, and 21,140 pounds of dried and evaporated fruits. Comparisons of yields or of their values, when made by decades only, have little significance, as the yield of any given year is largely due to the nature of the season.

TROPICAL FRUITS AND NUTS.

In 1899, 2,537 farms produced 74,050 pounds of figs from 7,109 trees. There were reported 9,959 pecan trees, yielding 13,020 pounds of nuts; 566 Persian or English walnut trees, yielding 1,500 pounds; and 3,704 unclassified nut-bearing trees, yielding 3,976 pounds. The total value of the fig crop was $1,147, and that of nuts, $3,868.

SMALL FRUITS.

There were but 591 acres devoted to small fruits in 1899. Strawberries occupied 499 acres, or 84.4 per cent of the total area, and yielded 845,695 quarts. More than half of the acreage in this fruit was reported from Charleston county. The acreages and productions of other berries were as follows: Blackberries and dewberries, 39 acres and 50,960 quarts; raspberries and Logan berries, 4 acres and 4,150 quarts; currants, 2 acres and 2,290 quarts; and other small fruits, 47 acres and 55,790 quarts.

SUGAR CANE.

Table 22 presents a comparative statement of the acreage of cane, and the production of sugar and sirup: 1849 to 1899.

TABLE 22.—ACREAGE OF SUGAR CANE, AND PRODUCTION OF SUGAR AND SIRUP: 1849 TO 1899.

YEAR.[1]	Acreage in cane.	SUGAR.		SIRUP.	
		Production in pounds.	Average yield per acre in pounds.	Production in gallons.	Average yield per acre in gallons.
1899	7,342	49,590	6.8	805,064	109.7
1889	3,305	219,980	66.6	386,615	117.0
1879	1,787	274,800	153.8	138,944	77.8
1869	....	1,266,000	....	....	....
1859	....	237,600	....	....	....
1849	....	805,200	....	....	....

[1] No statistics of acreage were secured prior to 1879.

The present census shows that in 1899 sugar cane was grown by 18,776 farmers on 7,342 acres, an average of 0.4 of an acre for each farm reporting. From this area they sold 3,585 tons of cane for $13,582, and from the remaining product manufactured 49,590 pounds of sugar, valued at $2,256, and 805,064 gallons of molasses and sirup, valued at $310,799. This was an increase in acreage of 122.1 per cent, and in the production of molasses and sirup of 108.2 per cent, but a decrease in the production of sugar of 77.5 per cent.

The total value of sugar-cane products was $429,425, an average of $22.87 for each farm reporting and of $58.49 per acre. The average value of sugar was 4.5 cents per pound and the average value of molasses and sirup was 38.6 cents per gallon.

The crop was grown in 24 counties of the state. The largest production of sugar, 18,990 pounds, was reported from Colleton county; the largest quantity of sirup, 189,642 gallons, was made in Orangeburg county. The latter county also leads in the total value of products, the value reported for 1899 being $91,578. Barnwell county ranks second, with 108,779 gallons of sirup, valued at $45,821.

In addition to the above figures, it is estimated that 29,368 tons of cane, valued at $102,788, were kept for seed.

SORGHUM CANE.

In 1899 sorghum cane was grown by 18,332 farmers on 7,250 acres, from which area they sold 3,589 tons of cane for $10,285, and from the remaining product manufactured 478,190 gallons of sirup, valued at $168,038. This was a decrease in acreage since 1889 of 36.4 per cent. The total value of sorghum-cane products was $178,323, an average of $9.73 for each farm reporting, and of $24.60 per acre.

TOBACCO.

The tobacco crop in South Carolina during the last forty years has fluctuated greatly. In 1849 the state produced 74,285 pounds of tobacco; in 1859, 104,412 pounds; and in 1869, 34,805 pounds. Between 1869 and 1879 there was an increase in the amount produced of 10,873 pounds, or 31.2 per cent; and between 1879 and 1889, a gain of 177,220 pounds, or 388.0 per cent.

The present census shows that tobacco was grown in South Carolina by 6,744 farmers, who obtained from 25,993 acres a yield of 19,895,970 pounds, valued at $1,297,293. This was an increase over the crop area of 1889 of 25,599 acres, or over sixty times, and in production of 19,673,072 pounds, or nearly ninety times. The average yield per acre in the state in 1899 was 765 pounds, against 566 pounds in 1889, and 270 pounds in 1879. The average value was 6.5 cents per pound.

Tobacco is grown in 33 counties in the state. The leading county in acreage and production in 1899 was Marion, with Darlington county second. These two counties furnished 55.1 per cent of the acreage and 56.4 per cent of the crop of the state. Next in order were Florence, Horry, and Clarendon counties. These five leading counties together furnished 85.4 per cent of the acreage, and 86.5 per cent of the production of the state.

PEANUTS.

Peanuts were grown in 1899 by 6,123 farmers, who devoted to the crop 7,162 acres, and secured a product of 131,710 bushels. The average yield per acre was 18.4 bushels, and the average value per acre, approximately, $15. Of the total acreage, 73.2 per cent lies in Bamberg, Horry, Colleton, Hampton, Orangeburg, and Beaufort counties.

Increases of 178.4 per cent in acreage and 208.0 per cent in production are shown for the last decade.

VEGETABLES.

The total value of vegetables grown in 1899, including potatoes, sweet potatoes, and onions, was $4,064,847, of which 51.2 per cent represents the value of miscellaneous vegetables; 37.8 per cent, that of sweet potatoes; 10.7 per cent, that of potatoes; and 0.3 per cent, that of onions.

Sweet potatoes were grown in 1899 by 79,145 farmers, or 50.9 per cent of the total number in the state. The area devoted to this crop in 1889 was 46,086 acres, and in 1899, 48,831 acres, a gain of 6.0 per cent.

In the growing of miscellaneous vegetables, 40,624 acres were used. Of this area the products of 24,005 acres were not reported in detail. Of the remaining 16,619 acres, 10,511 acres were devoted to watermelons; 2,562 acres, to cabbages; 1,037 acres, to muskmelons; 800 acres, to cucumbers; 602 acres, to beans; 403 acres, to asparagus; 317 acres, to tomatoes; and 387 acres, to other vegetables.

FLORICULTURE.

The area devoted to the cultivation of flowers and ornamental plants in 1899 was 28 acres, and the value of products sold therefrom was $7,920. These flowers and plants were grown by 28 farmers and florists, of whom 4 made commercial floriculture their principal business. The capital invested in land, buildings, and implements was $12,515, of which $4,400 represents the value of the buildings. Their sales of flowers and plants amounted to $3,700. They expended for labor $550, and for fertilizers, $180. The average gross income for each farm reporting was $925.

In addition to the 4 principal establishments, 79 farms and market gardens made use of glass in the propagation of flowers, plants, or vegetables. They had an area under glass of 21,833 square feet, making, with the 8,377 square feet belonging to the florists' establishments, a total of 30,210 square feet.

NURSERIES.

The total value of nursery stock sold in 1899 was $4,416, reported by the operators of 34 farms and nurseries, of whom 3 derived their principal income from the nursery business. They had 202 acres of land, and a capital invested in land, buildings, implements, and live stock of $5,850.

Their total income was $2,530, of which $2,430 represents the value of nursery stock, and $100, that of other products. The expenditure for labor was $1,100, and for fertilizers, $110. The average gross income for each farm reporting was $843.

LABOR AND FERTILIZERS.

The total expenditure for labor on farms in 1899, including the value of board furnished, was $6,107,100, an average of $39 per farm. The average expenditure was $367 for nurseries, $138 for florists' establishments, $126 for dairy farms, $96 for tobacco farms, $95 for vegetable farms, $65 for rice farms, $56 for hay and grain farms, $39 for fruit farms, $37 for cotton farms, $36 for live-stock farms, and $26 for sugar farms.

"Managers" expended on an average, $507; "owners," $62; "cash tenants," $23; and "share tenants," $17. White farmers expended $70 per farm and colored farmers, $14.

Fertilizers purchased in 1899 cost $4,494,410, an average of $29 per farm and an increase since 1890 of 16.2 per cent. The average expenditure was $66 for tobacco and for vegetable farms, $45 for florists' establishments, $37 for nurseries, $34 for dairy farms, $33 for hay and grain farms, $29 for cotton farms, $22 for live-stock farms, $21 for fruit farms, $17 for rice farms, and $9 for sugar farms.

IRRIGATION STATISTICS.

The beginning of irrigation in South Carolina was contemporaneous with the introduction of rice growing, the irrigation systems being similar to those now in use. Rice was first planted in 1700, and from that time until 1861 South Carolina ranked first among the states in its production. Changed labor conditions since the war, and the great expense of maintenance, due to the destruction of dikes, and the total loss of crops by floods, which are frequent since the deforestation of the mountain slopes, have operated against the growth of this industry, and rice culture has not made the progress here that it has in a few other states.

Rice is irrigated in South Carolina by manipulating river waters through trunks built in the dikes which protect the low marsh lands from the rivers. The delta lands are selected with reference to the possibility of flooding from the rivers with fresh water at high tide, and of draining them at low tide. The reclamation of these lands necessitates the building, parallel with the river, of costly dikes, capable of resisting the force of the flood tide, and also that of the river in time of freshets. After the dikes are built, the field is divided into sections or squares by similar banks, called "check" banks. These squares contain from 5 to 30 acres each, and in turn are subdivided by ditches into beds, usually about thirty-five feet wide and extending the length of the square. Each of these squares has a wooden trunk with a door at each end, through which the water is admitted to the field. The trunks are from 30 to 40 feet long, from 3 to 12 feet wide, and about sixteen inches deep, and are built under the dikes on a level with the bed of the ditches. In flooding the field the outer door is raised and the inner closed. As the tide rises the water comes in through the trunk, pushes the field door open, and passes through the ditches to the field. When the tide falls in the river, the pressure of the water in the field closes the inner swinging door against the muzzle of the trunk, thus holding the water. In draining the field this method is reversed, the field door being raised at low tide and the outer door dropped. The unlimited supply of fresh water and its perfect control by this system of flooding and draining account for the superior quality of rice for which South Carolina is famous.

The practice of dumping the harbor dredgings into the river above Savannah has injured the system of drainage, causing the abandonment of a number of rice plantations along the Savannah River. On many plantations which formerly were readily drained at low tide, pumping is now resorted to when the rivers are high, as the fields can not properly be drained. The pumps, which are mounted on flats or lighters, are operated by steam and shifted on the river from field to field. The suction pipe is dropped over the dike into any desired field and the water pumped into the river.

Rice is grown inland on low, swampy lands, which are flooded from reservoirs or small streams. The cultivation of upland or "Providence" rice is attempted in many of the interior counties, but owing to the low yield and an occasional total failure the results are not satisfactory. Orangeburg county has the largest crop of upland rice, and in 1899 produced 2,266,162 pounds, an average yield of 309 pounds per acre. The irrigated crop is sure as compared with that of the uplands, the average yield per acre being much higher, and the quality of rice far superior.

Tide-water irrigation is generally practiced in Beaufort, Berkeley, Colleton, Charleston, Georgetown, and Hampton counties. In 1899 the rice acreage of these counties, irrigated and upland, was 70.0 per cent of the total, while the production, 40,651,664 pounds, was 86.0 per cent of the total rice crop of the state. The average yield per acre was 748 pounds. The total product of all other counties was 6,708,464 pounds, an average of 288 pounds per acre.

It is impossible to ascertain the exact cost of reclaiming these delta lands. Rice irrigation was reported on 648 plantations; the acreage was 29,690, and the yield, 33,467,191 pounds. The average first cost per acre for preparing rice lands for irrigation, inclusive of cost of construction of dikes, trunks, check banks, and ditches, is estimated to be $28.68, and the systems in use represent a total investment of over $851,509.